The Relationship Between the Macroeconomic and Demographic Factors and the Demand for and Lapsation of Life Insurance in Malaysia and the United States

by

Chee Chee Lim

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City University (London)
Sir John Cass Business School
Faculty of Actuarial Science and Statistics

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LIST OF ABBREVIATIONS

ACLI	American Council of Life Insurance
ADL	Autoregressive distributed lag
BEA	Bureau of Economic Analysis
BLS	Bureau of Labour Statistics
BNM	Bank Negara Malaysia
CPI	Consumer price index
DF	Dickey-Fuller
DJIA	Dow Jones Industrial Average
DY	Demographic Yearbook
ECM	Error-correction model
EFH	Emergency fund hypothesis
ER	Economic Report
Gets	General-to-specific
GDP	Gross domestic product
GNP	Gross national product
GUM	General unrestricted model
II	Industrial Index
IID	Independent and normally distributed
ILO	International Labour Organisation
IRH	Interest rate hypothesis
KLSE CI	Kuala Lumpur Stock Exchange Composite Index
LIAM	Life Insurance Association of Malaysia
LIMRA	Life Insurance Marketing and Research Association
M2	The broad definition of money
MDCH	Michigan Department of Community Health
MSB	Monthly Statistical Bulletin
NCHS	National Center for Health Statistics
OLS	Ordinary least squares
PIA	Personal Investment Authority
SSB	Social Statistics Bulletin
UK	United Kingdom
US	United States
VS	Vital Statistics
YoS	Yearbook of Statistics

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DECLARATION

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ABSTRACT

Economic environments have an effect on both the growth and lapsation of life insurance business. This thesis is undertaken in order to seek evidence of the significance of and relationship between specific macroeconomic and demographic factors and the demand for and lapsation of life insurance in the context of Malaysia and the United States (US). A dynamic, general-to-specific (Gets) approach is adopted in order to analyse the data. The general model (GUM) is formulated as an ADL(1,1) model to be subject to simplification. PcGets, a computer automated software for econometric model selection, which is capable of implementing the reduction subject to retaining congruence, is used to facilitate the analysis. The major findings show that, for Malaysia, the demographic factor, the change in total fertility rate in the previous period (i.e. positive and significant), is a vitally important factor in connection with life insurance demand (measured by number, by amount and by premium). Income and stock market return are important factors affecting the consumers' ability to purchase life insurance (in terms of amount and premium). The savings deposit rate is found to be related significantly to new life insurance business (by amount and by premium) but savings deposits seem not to be a competing savings instrument to life insurance. The inflation rate appears not to be an important factor affecting new life insurance business (by amount and by premium) but a high insurance cost tends to discourage the purchasing of life insurance (by number, by amount and by premium). Meanwhile, for lapsation of life insurance, both the forfeiture and surrender rates appear to be affected by the emergency fund effect with respect to the performance of the stock market in the previous period. Only fixed deposit rate is found to have the intended (positive) interest rate effect on surrender rate. The policyholders tend to surrender their life policies in favour of other investments that promise a better value for money in order to preserve their purchasing power in an environment of rising inflation rate. When the costs of obtaining insurance protection become more expensive, the forfeiture rate tends to be lower. The demographic factors tend to have a lagged influence on both the forfeiture and surrender rates. On the other hand, for the comparative study of Malaysia and the US, broadly speaking, the inflation rate, crude death rate and total fertility rate are the three factors that appear to be associated significantly with life insurance business in force (measured by number and by amount) in both Malaysia and the US. The surrender rates in Malaysia and the US are affected by a completely different set of factors. The thesis concludes with some suggestions for useful areas for future research.

CHAPTER 1
INTRODUCTION

1.1 Background and Aims

In Malaysia, the insurance industry has grown to become an important sector as a part of the general development in the financial services. The insurance industry plays a vital role in the economic growth of a nation as it may have a significant impact on both the productivity and the volume of savings in the economy. According to the Annual Report of the Director General of Insurance (Bank Negara Malaysia or BNM in short, 1994-2002), the insurance industry has gradually emerged to be an important component of Malaysia's financial institutions in the past decade. The total premium income (comprising premium income from life and non-life insurance businesses) of this industry constituted only 2.9% of the nominal gross national product[1] (GNP) in 1990 but this proportion rose to 5.4% in 2001. The total premium income has been growing from year to year from 1990 to 2001 except for 1998 due to a negative growth in non-life insurance business. During the period 1990-2001, the total premium income has increased more than five fold from RM3,170.1 million in 1990 to RM17,101.2 million in 2001 (i.e. a nominal growth rate of 439% or a real growth rate of 275%). Of the total premium income reported, more than half of the income is contributed by life insurance business (i.e. 51.8% and 68.5% of the total premium income in 1990 and 2001 respectively).

However, the total premium generated by the insurance industry in Malaysia is small as compared with those countries such as the United States (US), Japan and the United Kingdom (UK) [the webpage of the Association of British Insurers (ABI), last updated on 15 November 2002; BNM, 1994-2002; Organisation for Economic Co-operation and Development (OECD), 1999-2002]. The American, Japanese and British insurance markets, being the world largest, second largest and third largest markets respectively (in terms of total premium income), have written as much as US$1,157,516 million, US$342,421 million and US$256,352 million of total premium income respectively in 2000, while the Malaysian insurance market has written only US$4,004 million of total premium income in the same year. As to the penetration of insurance industry in the domestic economy, the ratio of gross premium income to gross domestic product (GDP) of Malaysia remains low (1990: 4.00% and 2000: 7.27%) relative to those of the UK (which ranked second in the world in this respect in 1999 and 2000 – 1990: 10.58% and 2000:

[1] Gross national product (GNP) is now known as gross national income (GNI) in the official statistics.

17.10%). Meanwhile, for the life insurance business specifically, the percentage of its contribution relative to the GDP of Malaysia is only 4.85% in 2000 as compared with those of the UK, Japan and the US of 13.01%, 5.25% and 5.20% respectively in the same year. This indicates that the insurance industry in Malaysia in general, and its life insurance business in specific, could both have bright prospects and a large potential role to play in contributing to the national savings and providing protection to its citizens as the economy develops further.

At a more detailed level, we can expect the economic environment to have an effect on the demand for (and hence the growth of) insurance. History has proven that the performance of the insurance industry is closely linked to the prevailing economic conditions. In Malaysia, the performance of the insurance industry in 1998 was affected by an economic downturn. The total and non-life premium income declined by 2.1% and 9.7% respectively whereas the life premium income experienced a lower positive growth of 4.6% in 1998 (BNM, 1999-2000). In the US, its life insurance business was also affected by the economic environment. When the US economy plunged into recession in 2001, the total individual life insurance premium receipts of the insurance companies decreased by as much as 6.9% (2000: 9.8% and 2002: 11.2%) [American Council of Life Insurance (ACLI), 2003]. Further, the report on the overview of the term assurance market in the UK over a period of 30 years between 1971 and 1999 (Langkjær-Øhlenschlæger and McGaughey, 2001) also has cited that the economic cycles play a role in affecting the demand for pure protection life policies in specific and any other types of life assurance policy in general. The foremost important economic related factor mentioned in the report being the key driver for life insurance demand is the wealth or income level of the population which affect directly the financial ability of the population to pay for insurance cover. Other economic related factors such as employment and unemployment rates also are crucial drivers for life insurance demand. Besides the economic related factors, Langkjær-Øhlenschlæger and McGaughey (2001) also highlight that some demographic factors such as the age composition of the population, death rate, relationships (i.e. marriage, divorce, cohabitation or partnership) and fertility rate may be vitally important in determining the levels of the demand for life insurance.

Given the above, even though life insurance business is versatile in nature and may survive in different economic conditions, the issue of lapsation may hinder its further development. The financial impact of lapsation is significant. It has adverse effects on the following aspects: (a) the social function of insurance for family protection against death or old age, and as a method of savings for the policyholders and their beneficiaries, (b) the development of the agency network, the insurers and the industry, and (c) the economic growth of the nation. The policyholders will suffer a financial loss for lapsing a policy before its contractual maturity. If a policy is forfeited before the entitlement of a cash value, the policyholders will suffer a severe financial loss because this kind of lapsation is not accompanied by any payment of benefit at all. In the case when a policy is surrendered, although the policyholders will be entitled to a surrender value, the savings under their policy is no longer building up. Lapsation of life insurance may affect the earnings of agents because they are no longer entitled to the commission payments when lapses occur to the policies sold by them. Lapsation also has an effect on the profitability and the competitiveness of life insurers. A heavy lapse experience will cause the overhead costs of life insurers to be spread over a much smaller number of policies. Under extreme circumstances, life insurers might suffer a loss for policies issued because the premiums collected would not be able to cover the high initial expenses and commissions incurred if the policies are being terminated at their early policy durations. This may in turn threaten the solvency position of life insurers and may further affect the growth of the agency network and the industry. Further, high lapse rates experienced by the life insurance business could negatively influence the development of the financial market as a whole and lead to a lower level of productivity and savings in the economy of a country.

Lapsation of life insurance is a worldwide issue. As the developed countries such as the UK and US are actively taking measures to tackle this problem in order to enhance the quality of life policies and the persistency of life insurance business, Malaysia is not spared from this problem. In the US, the phenomenon of lapsation has received great attention. Extensive research related to this area has been conducted by Life Insurance Marketing and Research Association (LIMRA) and the American Institute of Actuaries since 1920. In the UK, there is a special report that dedicated to reporting lapsation, i.e. the Survey of the Persistency of Life and Pensions Policies, since 1995. The Financial Services Authority (FSA), currently the single statutory regulator responsible for regulating deposit taking, insurance and investment business effective from 1 December 2001 on the implementation of the Financial Services & Market Act 2000, is responsible for the reports. Prior to this, the Personal Investment Authority (PIA) assumed this reporting responsibility. In Malaysia, the supervisory authorities play a prominent role in researching this issue and reporting these activities in specific reports since 1963. The Treasury and the Ministry of Finance were given the responsibility for reporting on lapsation in the Insurance Annual Report from 1963 to 1977 and from 1978 to 1987 respectively, before the task was taken over by the central bank (i.e. BNM) from 1988 onwards. However, other than the official reports produced by the supervisory authorities, no other reports have been published on the situation in Malaysia.

The economic environment might also have a profound effect on lapsation of life insurance. The study of Richardson and Hartwell (1951) reveals that lapse rates generally are very much governed by the economic conditions in the US. This fact is further supported by the Survey of the Persistency of Life and Pensions Policies in the UK (PIA, 2000 & 2001). In the survey report, six major factors have been identified as having a prominent impact on the persistency of life and pensions policies. One of those cited is the general economic condition. The economic environment has an effect on the overall level of persistency. The state of the economy will affect the economic well-being of households which will in turn influence their ability as well as their willingness to maintain their regular premium policies. Generally improving economic conditions tend to boost the broad measures of persistency. A high growth of GDP, strong employment growth and low unemployment rate tend to support higher levels of persistency. As in Malaysia, when the performance of the insurance industry was affected by an economic downturn in 1998, it is observed that the lapse rates were rising at the same time indicating that the economic conditions in Malaysia do affect lapsation of life insurance.

Noting that life insurance business makes a major contribution to the GDP of Malaysia and the changing economic environment may have a profound effect on its growth and that lapsation has an adverse impact that may hinder the further development of this industry, this thesis is undertaken to examine two important aspects of life insurance business, namely the demand for and lapsation of life insurance, over the period from 1971 to 2001, from a macroeconomic perspective. More formally, this thesis is undertaken to examine the interaction between specific macroeconomic and demographic factors and the demand for and lapsation of life insurance in order to seek evidence of their relationship in the context of Malaysia and the US.

1.2 Structure of the Thesis

This thesis consists of eleven chapters. Chapter one discusses the background and the aims of the studies in this thesis. Chapter two reviews the literature related to the demand for life insurance. Discussions in chapters three and four focus on the lapsation of life insurance. Chapter three reviews the related literature addressing the lapsation of life insurance. Chapter four examines the various types of lapse rate that have been used for reporting in Malaysia since 1963 and explores new methods for computing the forfeiture rate that are in line with the definition of the forfeiture of life insurance in the Insurance Act 1996 of

Malaysia. Chapter five describes the nature and the characteristics of the Malaysian and US data that are used in the studies of this thesis. Chapter six illustrates the specification of the two major models studied in this thesis, i.e. the demand and lapse models. It also provides the operational definitions for the variables and their hypothesised relationships with respect to life insurance demand and lapsation of life insurance. Chapter seven outlines in detail the procedures adopted in order to analyse the data. The following three chapters present and discuss the findings of the analysis. Chapter eight and nine are devoted to the demand and lapse models for Malaysia respectively. Chapter 10 is dedicated to a comparative study of the demand and lapse models between Malaysia and the US. Chapter 11 is the final chapter. It concludes the studies in this thesis with an overview/summary and a highlight of the major findings. It also proposes promising areas for further research in the future.

CHAPTER 2
LITERATURE REVIEW – THE DEMAND FOR LIFE INSURANCE

This chapter reviews the literature related to the demand for life insurance. The next chapter reviews the literature related to lapsation of life insurance.

This chapter has two sections. The first section discusses the different definitions for life insurance demand that have been adopted by researchers in their studies. The second section presents the findings of the empirical studies related to the demand for life insurance conducted by researchers in the past.

2.1 Definitions of Demand

Many studies on the demand for life insurance have been conducted in the past. However, there is no standard definition for life insurance demand. Different researchers have adopted different definitions for this variable in their studies.

Broadly speaking, in defining life insurance demand, some researchers focus on either the savings element (i.e. life insurance savings) (Cargill and Troxel, 1979; Dor and Dodds, 1989) or the protection element (i.e. life insurance protection) (Babbel, 1981; Hua, 2000) of life insurance but some do not differentiate between the two elements (Babbel, 1985; Truett and Truett, 1990; Browne and Kim, 1993; Outreville, 1996; Rubayah and Zaidi, 2000). When the demand is defined as life insurance savings, the net flow of life insurance reserves is used as a measure; when the demand is defined as life insurance protection, the term component of life insurance is used as a measure; when there is no differentiation between the savings and protection elements, the total amount of life insurance is used as a measure. However, there are variations in the definitions in which the demand is expressed (i) either by business in force or by new business or (ii) either in total sales volume or in per capita ownership of life insurance. Besides that, the demand variable has taken on various forms of expression in the analysis: (a) in absolute terms or in logarithmic transform, (b) in real value terms (i.e. in present-valued unit or in constant dollar terms) or in gross value terms and (c) in different units of measurement by premium, by amount or by number. Hence, these have resulted in findings that cannot be compared directly.

The descriptions below highlight some of the different definitions for life insurance demand that have been adopted by researchers in their studies in the past, noting that some of the differences are caused by the data that are available for their analysis.

Cargill and Troxel (1979) study the demand for life insurance by examining the changes in life insurance savings held by life insurers and define it in three different ways.

First, the narrow definition of life insurance savings refers to the changes in life insurance reserves and dividend accumulations. Second, the moderately narrow definition of life insurance savings takes into account policy loans by extracting the changes in policy loans from the earlier definition. Third, the broad definition of life insurance savings further considers pension reserves by adding the changes in pension reserves to the second definition of life insurance savings.

Babbel (1981) examines the consumer demand for term insurance in Brazil. Specifically, the net real amount of life insurance in force per capita (i.e. in present-valued unit) is used as a proxy for life insurance demand in his study. Later, in another study that examines the consumer demand for whole life insurance in the United States (US), Babbel (1985) defines life insurance demand as the real amount of new business written during the year (i.e. in constant dollar terms, in which the personal consumption expenditure deflator is used to render the nominal values into constant dollar terms). The amount of life insurance is analysed in absolute terms and using the logarithmic transform in the latter study.

The demand for life insurance in the study of Dar and Dodds (1989) refers to the household savings through endowment insurance. Similar to the definition of Cargill and Troxel (1979), Dar and Dodds (1989) have adopted the net flow of life insurance reserves as the basis to define life insurance savings. Specifically, life insurance savings in their study is defined as the difference between the end-of-period and beginning-of-period stock of life insurance reserves.

In the comparative study of Truett and Truett (1990), life insurance demand refers to the demand for individual life insurance. Specifically, it is the amount of life insurance in force per capita or per family. A slightly different operational definition has been used for Mexico and the US. The demand for life insurance in Mexico is defined as the total amount of life insurance divided by the number of economically active population. Meanwhile, for the US, it is defined as the average amount of life insurance per family. The amount of life insurance is expressed in the logarithmic transform in their study.

For Browne and Kim (1993), the demand for life insurance in their study refers to life insurance consumption of a country. Life insurance demand is defined as life insurance in force per capita. The demand is measured by premium and by amount, and it is expressed via the logarithmic transform. The demand for life insurance by premium is used for two purposes: (a) to enable direct comparison of findings between the current and previous studies because the demand models in the majority of earlier studies are based on premium as a measurement and (b) to have the greatest number of observations included in the

/sis. Since the premium is deemed not to be a perfect measurement of the demand on wn, the amount of insurance is used in addition to the premium to define life insurance and. According to Browne and Kim (1993), premium is regarded as an inconsistent surement because different countries usually have different pricing systems affected by rs such as the combination of insurance plans being sold, underwriting costs, rnment regulations and the competitiveness of insurance market. Therefore, the unt of insurance (which is the face value or the sum insured of life policies) is superior remium because it measures the extent of protection against premature death more rately.

In the study of Outreville (1996), the demand for life insurance refers to the lopment/growth of life insurance business in a country. The gross life premium per ta reported in the Statistical Survey on Insurance in Developing Countries (1990) is as the proxy. The reported life premium income for a country consists of the premium all forms of life insurance business including annuities. The values of gross life nium per capita are expressed in absolute terms and in the logarithmic transform.

Hau (2000) defines the demand for life insurance in his study as the total term value fe insurance. More precisely, it refers to the total face value of the term component of policies.

The study of Rubayah and Zaidi (2000) uses the number of new policies as a esentation for life insurance demand as it better reflects the actual number of policies ed by the life insurers based on market demand. According to these researchers, both premium and the amount of insurance are considered not appropriate for use as a surement for life insurance demand. This is because different life insurers experience rent levels of underwriting cost and therefore they charge different amount of nium, whilst a policyholder can insure a life for a very huge amount of sum insured. former reason given to the use of premium as a measurement is in line with Browne Kim's (1993) explanation. However, the latter reason with respect to the use of the unt of insurance as a measurement is the opposite to the justification of Browne and (1993) as they regard it to be an advantage.

The various definitions adopted by different researchers in their studies discussed e are summarised in Table 2.1.

From the above, Browne and Kim (1993) and Rubayah and Zaidi (2000) have argued erning whether the premium, the amount of insurance or the number of policies is a r measurement for life insurance demand. We agree with these researchers that the nium is affected directly by the practice of different pricing systems as a result of different experience of underwriting costs. Nevertheless, we also note that using the amount of insurance as an alternative measurement does not eliminate the problem mentioned when the premium is used as a measurement. This is because when insuring for a greater amount of life insurance, it is accompanied by a greater amount of premium payment. Therefore, the premium and the amount of insurance are positively and closely correlated. However, we believe that the number of policies is not a superior measurement to the premium and the amount of insurance as it would not be able to reflect accurately the need for life insurance coverage. For example, an increase in the number of policies issued in a year with a smaller amount of insurance effected per policy does not necessarily imply positive growth for the life insurance industry. On the other hand, a decline in the number of policies issued in a year with a much bigger amount of insurance purchased per policy also does not automatically signal that the life insurance industry is performing badly. Since life insurance can be quantified in three different ways and there is an argument as to which one is the best measurement, all three of them (i.e. by number, by amount and by premium) are used to define the demand for life insurance in this thesis.

2.2 Review of Empirical Studies

There is no unique and integrated theory for life insurance demand. Yaari (1965) is regarded to be the first to develop a theoretical framework to study the problem related to the uncertainty of lifetime and the demand for life insurance in maximising the lifetime utility of an individual. Almost all of the subsequent theoretical works that study the impact of wealth and bequest motives on life insurance demand developed by other researchers such as Fischer (1973), Moffet (1979 a & b), Campbell (1980), Pissarides (1980), Karni and Zilcha (1985 & 1986), Lewis (1989) and Bernheim (1991) have expanded their models based on the study of Yaari (1965) that life insurance demand should be considered within the lifetime allocation process of an individual.

Other than the studies that involve the construction of theoretical models, there are many empirical studies that examine life insurance demand and its relationship with various factors. For the studies on life insurance demand with life insurance considered as savings, both the studies of Cargill and Troxel (1979) and Dor and Dodds (1989) are time-series studies using data at the national level in the US and United Kingdom (UK) respectively.

Cargill and Troxel (1979) investigate the relationship between the net flow of life insurance savings and the factors such as the current stock of life insurance reserves (or savings), wealth, income, inflation and interest rate. The data are obtained from the reports of the American Council of Life Insurance (ACLI). The study covers a 20-year period from

1954 to 1974. The entire period has been subdivided into three different samples: the full-period sample (1954-1974), the early-sub-period sample (1954-1963) and the late-sub-period sample (1964-1974). A total of nine regression models are constructed based on the three different definitions of life insurance savings (in the manner of narrowly, moderately and broadly defined) for each of the three different estimation periods. The research findings indicate that the data for the late-sub-period sample conform more closely to the model than the data for either the full-period or early-sub-period sample. The R^2 values are high for all of the three regression models for the late-sub-period sample but the regression models for the early-sub-period sample perform poorly in explaining the changes in savings flows to life insurers. The major findings of their study are summarised below:

(a) The current stock of life insurance reserves (or savings) is related inversely to the net flow of life insurance savings. Their relationship is significant when the scope of life insurance savings is broadened to include the changes in policy loans and pension reserves. A large stock of life insurance reserves tends to discourage increased savings. When the proportion of current savings held in life insurance is high, we would expect small new flows to this savings.

(b) Disposable personal income has a significant direct relationship with life insurance savings. It can be inferred that since disposable income is highly correlated with personal savings, therefore, it is natural to expect that it would be directly related to life insurance savings.

(c) There are inconclusive findings for the relationship between anticipated inflation and life insurance savings. Only the moderately defined savings model produces a significant result with the expected negative sign. This indicates that only a weak relationship exists between life insurance savings and anticipated inflation. Anticipated inflation has little impact on life insurance savings decisions.

(d) The results are mixed for the relationship between the competing yield proxy (i.e. the proxy for all competing rates of return on alternative savings instruments) and life insurance savings. However, the competing yield proxy tends to be related negatively to life insurance savings. Higher returns on alternative savings products such as savings deposits, savings certificates, government bonds and high-grade corporate bonds tend to lead to smaller new savings in life insurance.

(e) There is no consistent relationship appears between the returns earned by life insurers and life insurance savings. However, the returns earned by life insurers are frequently related positively to life insurance savings. Higher returns earned by life insurers tend to attract and increase life insurance savings.

Dar and Dodds (1989) study household savings through life insurance on endowment policies written by the British life insurers from 1952 to 1985. They adopt the Modigliani (1972) stock-adjustment model as the approach in their study to examine the (partial) adjustment magnitude of the households in reallocating their existing wealth to savings through endowment insurance towards maintaining the optimal asset holding ratio. For this purpose, they employ the emergency fund hypothesis (EFH) and the interest rate hypothesis (IRH) as the underlying hypotheses along with the examination of the effect of inflation to explore the relationship between the net flow of funds into endowment insurance and the interest rate (i.e. the interest rate variable), unemployment (i.e. the emergency fund variable) and the expectation about inflation. The regression models are estimated using non-linear methods, with and without specific restrictions being imposed on the models in order to obtain unique estimates for the variables.

Their findings reveal that the partial adjustment parameter is barely significant. The adjustment magnitude is small (i.e. about 2%) indicating that the adjustment process is slow in eliminating the gap between the actual and optimal asset holdings in any period. The coefficients of the alternative and internal rates of return variables have the expected negative and positive signs respectively and both of them are statistically significant. These findings provide evidence that savings through endowment insurance respond to changes in market interest rates such as the alternative and internal rates of return (and in the manner as predicted by theory). They also prove that endowment policies are a one-for-one substitute for alternative financial assets. If both the alternative and internal rates of return change simultaneously in the same magnitude, there would be no net impact on savings through endowment insurance. However, if the internal rate of return does not increase or increases only slowly when market interest rates increase, a substantial outflow of the savings from endowment insurance to other financial assets would be expected as indicated by the high interest rate elasticity (i.e. −1.4) of life insurance savings through endowment insurance. Contrary to the findings of strong support for the IRH, their study finds no support at all for the EFH because the estimates of the emergency fund variable (i.e. unemployment) are statistically insignificant. Further, their study also shows that inflation does not appear to have any important relationship with savings through endowment insurance.

The findings of Cargill and Troxel (1979) and Dar and Dodds (1989) are not fully consistent. The findings on the interest rate and inflation variables in these two studies are not totally in agreement with each other. The findings of Dar and Dodds (1989) are clear and conclusive but the findings of Cargill and Troxel (1979) are inconsistent. The inconsistent findings in the latter study can be explained because their regression models have three different definitions for life insurance savings covering different sample periods.

For the studies on life insurance demand with life insurance considered as protection, the focus of the studies by Babbel (1981) and Hau (2000) is different. The former is a time series study of life insurance demand in Brazil at the national level whereas the latter is a cross-sectional study that examines life insurance demand by retired singles in the US. Therefore, a direct comparison cannot be made between them.

Babbel (1981) designs a theoretical model founded in the expected utility hypothesis using a discrete-time period analysis to analyse the impact of anticipated inflation and the expected income level upon the demand for term insurance. Specifically, he examines the demand for life insurance protection against premature death in an inflationary environment and in relation to the wealth accumulated by an individual during his lifetime [i.e. the theoretical contribution of Yaari (1965) that the demand for life insurance should be considered within the lifetime allocation process of an individual]. The theoretical relationships derived from the model show that an increase in anticipated inflation leads to a decrease in the demand for life insurance protection and an increase in real future income leads to an increase in the demand for life insurance protection.

Further, statistical tests are conducted to investigate empirically the response of the consumers in Brazil towards anticipated inflation and the expected income level on the demand for indexed term insurance. Indexed life insurance is an insurance in which the nominal values of the premiums, death benefits and cash values are linked to some pre-fixed indices or are adjusted annually for the realised inflation rates in order to compensate for the value erosion caused by inflation. In Brazil, the main implementation of indexing started in 1964. The authorisation for indexing was then extended to the insurance industry at the end of 1966 and indexed-linked life policies were marketed the following year. Therefore, in order to investigate the effect of indexing, the regression analysis focuses on two separate periods: (a) the pre-indexing period (1951-1967) and (b) the post-indexing period (1968-1976). A time-series multivariate linear regression model is used to relate inflationary and income expectations to the demand for life insurance protection. The regression model is estimated using ordinary least squares (OLS).

The empirical findings reveal that anticipated inflation and the expected income level have significant negative and positive relationships respectively with the demand for life insurance protection in Brazil for both the two periods. The findings suggest that the introduction of indexing to the Brazilian insurance industry has not been successful in achieving the aim of offsetting the adverse effects of inflation on life insurance values. In theory, the indexation of life insurance would result in the cost of life insurance protection being invariant with respect to inflation so that life insurance demand is inflation insensitive. However, the findings indicate otherwise that when inflation is anticipated to rise, it leads to a higher level of the perceived cost of life insurance protection even though the policies are index-linked. As such, life insurance demand would be expected to decline in inflationary periods. Meanwhile, the findings on income are in line with the theory that when insurable human wealth increases, insurance coverage is also likely to increase in order to protect against the possibility of a larger loss of income due to premature death.

Hau (2000) uses Tobit regression to examine the relationship between the demographic and wealth variables and the holding of life insurance by retired singles. He adopts the death-contingent claim model in this study to examine the behaviour of the retired singles in allocating their resources into consumable and bequeathable wealth. The sample consists of 275 subjects who are single household heads at age 65 or older (with the assumption that they have retired at this age) in 1988, selected using a range of criteria from 3,143 subject households, appearing in the data set of the US Survey of Consumer Finance 1989. [Refer to Hau (2000) for further details about the sample selection criteria.] Their major findings indicate that demographic and personal characteristics are less important compared with financial and wealth factors in explaining the life insurance holdings (being a financial asset) of retired people.

The propositions that various measures of financial wealth affect life insurance holding are substantiated. In summary, the findings indicate the following tendencies:

(a) Net liquid conventional asset holding tends to be associated negatively with life insurance holding. Retired singles with smaller amounts of conventional assets like savings and checking accounts, government and corporate bonds, other money market instruments, cash values of whole life policies and corporate stocks generally tend to increase their life insurance holdings. Estate liquidation and liquidity are important concerns of retired singles and life insurance holding is regarded as the optimal option as a liquid asset.

(b) Total annuity wealth tends to have a positive effect on life insurance holdings. Retired singles who have higher levels of social security wealth and private pension annuity wealth tend to have higher levels of life insurance holding in order to counteract excessive social security taxes.

(c) Net worth tends to have a direct relationship with life insurance holding. Retired singles, who have more net assets that are free of debt, tend to invest their financial resources in life insurance.

(d) The amount of donation made in the past tends to relate positively to life insurance holdings. Charitable motives may affect life insurance holding. Past charitable donation increases life insurance holding among retired singles.

In contrast, the propositions that various demographic factors affect life insurance holding are not substantiated. It is not clear whether age, education, the presence of children and gender affect life insurance holding. However, the findings on age and the presence of children are consistent with their hypothesised relationship that the former is related indirectly whereas the latter is related directly to life insurance holding. However, gender and education fail to exhibit the expected relationship with life insurance holding.

On the other hand, the studies of Babbel (1985), Truett and Truett (1990), Browne and Kim (1993), Outreville (1996) and Rubayah and Zaidi (2000) do not differentiate between the elements of savings and protection in life insurance. The studies of Browne and Kim (1993) and Outreville (1996) are comprehensive cross-sectional studies that examine life insurance demand across many countries whereas the studies of Babbel (1985) and Rubayah and Zaidi (2000) are time series studies based on a single country. Meanwhile, the study of Truett and Truett (1990) is a comparative study examining life insurance demand in Mexico and the US.

For the comprehensive studies, Browne and Kim (1993) examine the factors that influence the demand for life insurance across 45 countries spread throughout the world which include under-developed and developed nations. The sample consists of three sets of life insurance data reported in the Life Insurance Fact Book and Sigma for the years of 1980 (for the insurance data by amount) and 1987 (for the insurance data by premium and by amount).

They apply the theoretical idea of Lewis (1989) [i.e. an expansion of Yaari's (1965) idea] that the demand for life insurance is regarded to be the individual's or the household's goal in maximising the dependants' (i.e. the spouse and children) expected lifetime utility. Life insurance is purchased to satisfy the needs of the dependants so that they are protected from declining income as a result of the death of the primary income earner in the family. Their major findings reveal the following:

(a) The number of dependants has a direct and significant relationship with the demand for life insurance. Having more children under the age of 15 tends to encourage the purchase of life insurance in order to protect the dependants financially against the premature death of the parents.

(b) Government spending on social security is related positively and significantly to the demand for life insurance. The social security benefit is regarded as a household asset that increases family consumption contingent upon the survival of the income earner. As the payments of social security benefit cease upon the death of the income earner (and is not replaced by any other benefits), it is most likely that the income earner has purchased life insurance as a substitute for social security benefit in order to protect the family against premature loss.

(c) Countries where Islam is a predominant religion tend to have a lower level of the demand for life insurance. The unique culture of Islamic countries may affect the demand for life insurance. Religious persons in the Islamic faith tend to rely more heavily on God for protection rather than life insurance.

(d) National income has a positive and significant relationship with the demand for life insurance. Countries of higher income per capita tend to have higher life insurance demand. Populations with higher income are more able to afford life insurance.

(e) Inflation has a negative and significant relationship with the demand for life insurance. High inflation experienced by a country has an adverse impact on savings through life insurance. This is because inflation erodes the value of life insurance, making it an unattractive financial instrument.

(f) The price of insurance is related negatively to the demand for life insurance. Countries where the cost of buying insurance is more expensive tend to have a lower level of life insurance demand.

(g) Life expectancy at birth and the death rate among 30-34-year-old males (both used as a proxy for the probability of death) are found to be an insignificant factor affecting the demand for life insurance. The possible explanation for the insignificant findings for the two variables is that the population may be not able to estimate their probability of death accurately or the proxy used is not appropriate and not able to capture the intended effect. The researchers noted that the ideal proxy would be the death rate among the heads of household in a country but unfortunately these data are not available.

(h) There are no conclusive findings on whether education (i.e. the proportion of young adult population pursuing third-level education) affects life insurance demand due to inconsistent results.

For the study of Outreville (1996), he examines 48 developing countries to investigate empirically the relationship between the growth of life insurance business and the level of financial development and insurance market structure. The sample is the life insurance data reported for the year 1986 contained in the Statistical Survey on Insurance in Developing Countries (1990).

His findings on income (i.e. positive and significant) and inflation (i.e. negative and significant) provide further evidence in support of the findings of Browne and Kim (1993). On the other hand, the interest rate variable appears not to have an important relationship with the growth of life insurance business as it is found to be insignificant in all of the regression models.

Life expectancy at birth (as a proxy for the actuarially fair price of life insurance) affects significantly the growth of life insurance business. It has a direct relationship with the growth of life insurance business. This finding is not in line with the finding of Browne and Kim (1993). This can be explained by the fact that the life expectancy variable in these two studies is used to represent a different proxy. In the study of Browne and Kim (1993), the life expectancy variable is used to proxy the probability of death. The terminology they use to call this variable is misleading. In their study, the life expectancy variable is referred to as average life expectancy but it is in fact life expectancy at birth based on the definition provided. In the study of Outreville (1996), it is used to proxy the actuarially fair price of life insurance. (It is noted that the fair premium for life insurance is related indirectly to life expectancy at birth, as the higher is life expectancy so the later is the time of a claim being paid and the number of premium paid is likely to be higher.) Even though the probability of death appears not to be related significantly to the demand for life insurance, the price of life insurance has a significant relationship with life insurance demand. The positive relationship between life expectancy at birth and the growth of life insurance business implies that the population with a longer life span tends to buy more life insurance. This is because they would expect to enjoy a lower cost of insurance and a greater incentive for human capital accumulation as the cost is being spread over a longer period and the cash value is being accumulated for a longer duration. In fact, this finding indirectly verifies the finding of Browne and Kim (1993) that the price of insurance is related inversely to the demand for life insurance.

The level of financial development [defined as the percentage calculated as the ratio of quasi-money (M2-M1) to the broad definition of money (M2)] and monopolistic market structure are found to affect significantly the growth of life insurance business. The former has a direct relationship while the latter has an indirect relationship with the growth of life insurance business. A country that has a higher growth in life insurance business tends to be associated with having a more complex structure in its financial sector. Meanwhile, a monopolistic market tends to cause the life insurance industry to be less developed. This suggests that tight conditions imposed on entry should be relaxed to allow more new companies to join the industry so that the industry becomes more competitive. On the other hand, the presence of foreign companies in a market is found to be not significant in affecting the growth of life insurance business in developing countries.

Further, in order to control for the country effects among the developing countries, Outreville (1996) has included eight country-specific variables in the regression model to handle the problem: (a) the agricultural status, (b) the growth rate of population, (c) the health status, (d) the education status of labour force (as a proxy for human capital), (e) the Human Development Index, (f) the predominance of Muslim population, (g) the dependency ratio and (h) the social security contribution. The results show that controlling for the country effects does not have a significant explanatory power over the financial development and insurance market structure variables so that the inclusion of the country-specific variables does not affect the earlier findings qualitatively. The results also show that only a few of the country-specific variables are statistically significant and the variables such as the health status, the education status of labour force, the Human Development Index and social security contribution even have unexpected signs on their parameter estimates.

For the studies on a single country basis, Babbel (1985) examines the price and income sensitivity of consumer demand for whole life insurance in the US. The sample of the study consists of 22 stock insurance companies and five mutual insurance companies covering the period from 1953 to 1979. A total of 32 models with various measures of insurance price index and income figure are formed and subjected to a regression analysis. Overall, there are 16 different estimates of insurance price index and two different measures of income figure used in developing the models. The various insurance price indices are calculated by discounting the expected future cash flows from the policies based on two different discount rates, i.e. the yields of 10-year prime grade municipal and double-A-rated corporate bonds, each for the participating and non-participating forms of whole life insurance, where the projected holding periods are of 10 and 20 years, and for the cases where policy loans are allowed and are not. Meanwhile, the two types of income figure adopted are the single-year income (used as a proxy for human capital) and the three-year moving average income (used as a proxy for permanent income). Each of the 16 insurance price indices is then used, in turn, with either of the two income figures to formulate an estimation equation for testing.

For the insurance price indices, the findings reveal that the results for the various indices in the regression models do not differ significantly, noting that the results for the preferred indices (which are the indices based on the corporate bond yield as a discount rate for policies having a projected holding period of 10 years), allowing for policy loans, tend to exhibit a higher statistical significance. The coefficients on all of the indices show the same sign. This finding is expected and can be explained by the fact that the different indices are highly correlated among themselves. Prices are related negatively and significantly to the demand for whole life insurance for the both types of participating and non-participating policies. The finding also shows that the price elasticity for non-participating policies is more than double the magnitude of that for participating policies. This is because the purchase of participating policies provides a partial hedge for the policyholders against the increase in interest rate as life insurance companies tend to pay out higher dividends in times when they generate higher profits. However, the purchase of non-participating policies only involves a contractually fixed amount of payment. Further, Babbel (1985) also proves that the strong negative elasticity of the demand for whole life insurance with respect to the price of insurance does not indicate that price competition among life insurers is widespread.

On the other hand, for the income variables, the findings also reveal that there is no difference in the results when different income figures are used in the regression models. Their regression statistics in terms of the estimated coefficients, t-statistics and the coefficients of determination are almost the same. Income is related positively and significantly to the demand for whole life insurance.

Rubayah and Zaidi (2000) directly associate the macroeconomic factors with life insurance demand. They examine the influence of seven macroeconomic factors on the demand for life insurance in Malaysia for the period 1971-1997. The variables such as gross domestic product (GDP), personal savings rate, income tax exemption and short-term interest rate are found to have a significant relationship with the demand for life insurance. GDP and income tax exemption are related positively to the demand for life insurance but personal savings rate and short-term interest rate are related negatively to life insurance demand. Economic growth and national income have a favourable effect on the development of life insurance industry. A healthy economic growth and a higher national income tend to boost the growth of life insurance industry. The policy implemented by the government to allow a greater income tax exemption has helped increase the demand for life insurance when people take this opportunity to effect new or additional life policies in order to take advantage of the tax relief. In contrast, high personal savings rates tend to decrease the demand for life insurance. It is inferred that bank savings is an alternative method of savings; thus, when the savings rates are high, people generally would prefer to keep their money in banks to enjoy a higher expected return. Similarly, for the short-term interest rate, when the rates are higher, people tend to invest in short-term financial instruments that promise higher returns than in life insurance products.

On the other hand, income per capita, current interest rate and inflation appear not to have an important relationship with life insurance demand. Even though the estimated coefficients for both the income per capita and current interest rate have the expected positive and negative signs respectively, inflation fails to exhibit the expected negative sign. The insignificant results of income per capita and current interest rate might be due to their being highly correlated with GDP and personal savings rate respectively. Further, the insignificant findings regarding inflation contradict the findings of Browne and Kim (1993) and Outreville (1996). This might be due to the use of different representation for life insurance demand in their study from the past studies. In their study, the demand for life insurance is defined by number of policies rather than by premium or by amount.

The study by Truett and Truett (1990) is a comparative study examining the factors that affect life insurance demand in Mexico and the US. The Mexican data set comprises annual data covering the period from 1964 to 1979 while the US data set is from 1960 to 1982. In their study, it is clear that they employ the theoretical idea of Lewis (1989) that life insurance is purchased for the benefit of the dependants.

Their findings show that education and the income levels of the population in both countries and the age distribution of the population in the US are found to relate positively and significantly to the demand for life insurance. More highly educated individuals and the family members of higher income level in both countries and the population in the age bracket of 25 to 64 years or in the median age of 32 years (i.e. two different age variables are tested) in the US generally tend to consider life insurance to be a desirable instrument to maintain the living standard of the dependents when they loss support from the primary income earner in the family. Their findings also reveal that the estimated income elasticity of the demand for life insurance is much greater in Mexico than in the US. This finding implies that the income elasticity of the demand for life insurance is much higher at lower income levels than at higher income levels. This seems reasonable as the high-income families would likely have already accumulated greater wealth for the surviving family members in the case of a loss of the primary income earner.

2.3 Concluding Comments and Proposed Studies

The discussions above suggest that the many studies conducted in the past have produced results that sometimes are conflicting with one another. The conflicting results have led to a confused picture as to which factors predominantly influence the consumers' purchasing behaviour in specific environment. Therefore, in this thesis, in order to provide a better understanding of the consumers' behaviour in purchasing life insurance, studies are undertaken to examine the demand for life insurance from two different perspectives – i.e. the purchase of new life insurance and life insurance in force – using the three different measurements (i.e. by number, by amount and by premium) that the researchers claim to be a more appropriate proxy for life insurance demand with respect to specific macroeconomic and demographic factors that have been identified to be factors influencing the demand for life insurance. More formally, there are two major studies on the demand for life insurance in this thesis. The first study is on Malaysia. New life insurance business is used as the proxy for life insurance demand in this study and the demand is measured by number, by amount and by premium. The second one is a comparative study between Malaysia and the US so that a comparison of the demand for life insurance between a developing country and a developed country can be made. Life insurance business in force is used to proxy life insurance demand, and the demand is measured by number and by amount in the comparative study due to the lack of availability of other data for the US. More detailed discussions on the data and model specification are presented in the subsequent chapters of this thesis.

APPENDIX CHAPTER 2

Table 2.1
A Summary of the Various Definitions of Life Insurance Demand Adopted in Past Studies

Cargill and Troxel (1979)
• The changes in savings through life insurance held by life insurers o The narrow definition refers to the changes in life insurance reserves and dividend accumulations. o The moderately narrow definition takes into account policy loans by extracting the changes in policy loans from the narrow definition. o The broad definition further considers pension reserves by adding the changes in pension reserves to the moderately narrow definition.
Babbel (1981)
• The consumer demand for term insurance o It is defined as the net real amount of insurance in force per capita (i.e. in present-valued unit).
Babbel (1985)
• The consumer demand for whole life insurance o It is defined as the real amount of new business written during the year (i.e. in constant dollar terms) expressed in absolute terms and in the logarithmic transform.
Dar and Dodds (1989)
• The household savings through endowment insurance o It is defined as the difference between the end-of-period and beginning-of-period stock of reserves on endowment insurance (i.e. the net flow of life insurance reserves).
Truett and Truett (1990)
• The demand for individual life insurance o For Mexico, it is defined as the total amount of insurance in force divided by the economically active population. o For the US, it is defined as the average amount of insurance in force per family.
Browne and Kim (1993)
• The insurance consumption of a country o It is defined as life insurance in force per capita (by premium and by amount) expressed in the logarithmic transform.
Outreville (1996)
• The development/growth of life insurance business in a country o It is defined as the gross life premium per capita expressed in absolute terms and in the logarithmic transform.
Hau (2000)
• The total term value of life insurance o It is defined as the total face value of the term component of life policies.
Rubayah and Zaidi (2000)
• Life insurance demand of a country o It is defined as the number of new life policies.

CHAPTER 3
LITERATURE REVIEW – LAPSATION OF LIFE INSURANCE

This chapter has two sections. First, it discusses the different types of lapse rate that have been adopted by researchers in their studies. Then, this is followed by a review of the literature related to lapsation of life insurance.

3.1 Definitions of Lapsation

A number of studies on lapsation of life insurance have been conducted. Since there are no standard definitions for lapse rate, a wide array of definitions has been adopted by researchers in the past. The use of different definitions for lapse rate in past studies has meant that these studies are not directly comparable. One of the reasons noted for the differences in definition is that the studies relate to different contexts and environments. Different countries have different regulations, rules and laws governing their insurance industry and their insurance markets have developed to a different degree. As a consequence, different countries may have a different way of defining the lapse rate.

As can be seen in the literature, the definitions for lapsation of life insurance differ from one study to another and there are no clear definitions differentiating the lapse rates between the forfeiture rate and the surrender rate. In Malaysia, there are clear definitions stated in the Insurance Act 1996 (Legal Research Board, 1997) in order to differentiate the forfeiture rate from the surrender rate. According to Section 155 of the Act, the discontinuation of a whole life or an endowment policy that has been in force for three years or more (so that the policyholder is entitled to receive a cash value) is regarded as a surrender of a life policy. Meanwhile, according to Section 156 of the same Act, the discontinuation of whole life and endowment policies during the first three years from the inception of the policies, which are not being accorded any cash value, is regarded as the forfeiture of life policies.

Below is a brief description of the different types of lapse rate and their definitions that have been adopted by researchers in the literature.

In the study conducted by Richardson and Hartwell (1951), there are a few versions of lapse rate used depending on the objectives of their studies on the lapsation of life insurance experienced by The Mutual Life of New York. Among them, the lapse rates used refer to the first year and the second year lapse rates. The first year lapse rate is the proportion of the policies (by number) that have paid no part of the premium in the second year. Meanwhile, the second year lapse rate is the proportion of the policies (by number) on which no part of the premium in the third year is paid.

In another context, for lapse rates by calendar year of exposure, the rates refer to the termination rates in the first two policy years and after the second policy year. The termination rate in the first two policy years is expressed as the ratio of the policies (by number and by amount – as reported in the annual statement on life and endowment policies) that lapsed in a year to 75% of the business issued in the preceding year plus 25% of the business written two years before lapses occurred, that is:

$$\text{Termination Rate in the First Two Policy Years} = \frac{\text{Business Lapsed}_t}{0.75 * \text{New Business}_{t-1} + 0.25 * \text{New Business}_{t-2}}$$

The researchers themselves admit that this is not an accurate measure of terminations because the denominator in the formula only reflects a rough and ready approximation to the exposure. It would undoubtedly be inaccurate in years when the volume of new business is changing rapidly. However, it may be good enough to be used for the purpose of showing the general trend in lapse rates if the volume of new business is reasonably steady.

On the other hand, for the terminations after the second policy year, they refer to lapses for policies three or more years in force. Lapses in this case consist of a sum of transfers, surrenders and decreases (less increases) but exclude term policies that have no cash values. The termination rate after the second policy year is expressed as the ratio of the policies (by number and by amount) that lapsed in a year to the mean value of the business in force at the beginning and at the end of the years plus one-half of the lapses in the current year. The formula is as shown below:

$$\text{Termination Rate after the Second Policy Year} = \frac{\text{Business Lapsed}_t}{0.5 * (\text{Business in Force at BOY} + \text{Business in Force at EOY}) + 0.5 * \text{Business Lapsed}_t}$$

where

Business in Force at BOY = business in force at the beginning of the year
Business in Force at EOY = business in force at the end of the year

Further, Richardson and Hartwell (1951) use the termination rates after the second policy year to examine the patterns of lapses between policies with and without a policy loan. Specifically, the lapse rate on policies with a policy loan is the ratio of the policies (by number) on which loans were repaid by surrender of the policies during the year to the mean number of policy loans in force, plus one-half of the number of policy loans repaid by surrender. Meanwhile, the lapse rate on policies without a policy loan is the difference between the lapse rate after the second policy year and the lapse rate on policies with a policy loan. The computations of the two lapse rates are as shown below:

$$\text{Lapse Rate on Policies with a Policy Loan} = \frac{\text{Number of Policy Loans Repaid by Surrender}_t}{\text{Mean Number of Policy Loans in Force} + 0.5 * \text{Number of Policy Loans Repaid by Surrender}_t}$$

$$\text{Lapse Rate on Policies without a Policy Loan} = \text{Lapse Rate after the Second Policy Year} - \text{Lapse Rate on Policies with a Policy Loan}$$

Besides the lapse rates by calendar year of exposure, Richardson and Hartwell (1951) also use the lapse rate by policy year in their study.

Other researchers have studied the lapsation of life insurance of New York Life. Thus, Thompson (1960) examines the first year withdrawal rate as the lapse rate in his study. On the other hand, Barry (1960) examines the surrender rate as the lapse rate in his study. The surrender rate is defined as the ratio of the surrender values paid during a year relative to the aggregate cash values exposed at the beginning of the year.

Buck (1960) focuses on two kinds of lapse rate, i.e. the first year lapse rate and the default rate, of Lincoln National. The first year lapse rate in his study refers to the proportion of the policies (by number and by premium) that have paid some premiums but none at all in the second year. This definition is similar to the one adopted by Richardson and Hartwell (1951) for their first year lapse rate. Meanwhile, the default rate is defined as the proportion of first year defaults (by number) to business issued. The first year defaults include not-takens, cancellations and first year lapses. The business issued comprises business paid for, not-takens and cancellations. Judging from the definitions of the two lapse rates, the terminations in terms of defaults are higher than first year lapses because defaults also take into account cancellations and not-takens. Not-takens can be regarded as the worst form of termination for life insurer because no premiums have been collected at all for policies issued whereas for cancellations and first year lapses, at least some premiums have been collected for the policies issued.

The lapse rate in the study of Renshaw and Haberman (1986) of seven Scottish life offices takes on the traditional definition. Lapse policies refer to the volume of business going off the books due to the voluntary termination of policies by policyholders, but prematurely, either with or without surrender values (but excluding the conversion of a policy to a paid-up amount, the reduction of premium and/or sum insured or the surrender of bonus). The researchers explore in detail three different measures for the risk of lapsing at the initial stage, namely the annual lapse rate, the lapse frequency and the log odds of lapsing. However, the first two types of the lapse rates are not adopted in their study because they fail to produce satisfactory residual plots when fitted for a variety of model structures. Specifically, the log odds of lapsing in the study of Renshaw and Haberman (1986) is defined as the logarithmic transform of the ratio of the number of lapses to the difference between total exposures and the number of lapses.

In the study of Dar and Dodds (1989) that examines savings through endowment policies in the United Kingdom (UK), they also investigate policy surrenders that may cause a reversal in the net flow of life insurance savings. Specifically, the lapsed policies are the policies that are surrendered for their cash values. The data for surrenders are obtained from the Industrial Life Offices Association. However, the researchers do not explicitly provide a clear definition for the surrender rate used in their study.

The lapse rate in the study of Outreville (1990) follows the traditional definition. It is the ratio of the life insurance business (by amount) being removed owing to premature terminations, with or without payment of surrender values, to the business in force. Two termination rates are used in his study: (a) the termination rates for early lapsation on ordinary life insurance (therefore excluding group life, industrial life, credit life, annuities and health insurance) – i.e. the termination rates for lapses within 13 months of issue or conversion as reported in the United States and Canadian 13-Month Ordinary Lapse Survey published by Life Insurance Marketing and Research Association (LIMRA) and (b) the annual average lapse rates on whole life insurance – i.e. the rates for the United States (US) are readily available in the reports published by American Council of Life Insurance (ACLI) and the rates for Canada are computed using the data in the Annual Report of the Superintendent of Insurance in Canada.

In the studies conducted by two groups of researchers from Singapore, Lian at al (1993) and Loi at al (1996) use the same data set in their studies. The lapsed policies in their studies consist of policies which have forfeited, surrendered, converted to reduced paid-up and converted to extended term (but excluding policies terminated because of death, maturity, expiry or conversion to permanent plans, policies which are fully paid-up and single premium policies). The researchers use a survival model approach in their analysis, with policy duration as the time variable. This is defined as the number of completed years from the inception of a life policy before it lapses.

Russell (1997) examines two kinds of lapse rate, i.e. the surrender rates at the state level and at the company level. The surrender rate used at the state level is defined as the surrender benefits to life insurance in force. The data are acquired from the reports of ACLI and LIMRA. For the lapse rate used at the company level, it is defined as the surrender benefits to the adjusted assets of life insurer. The data are obtained from the annual reports of National Association of Insurance Commissioners.

The lapse rate in the study of Dankyi (2001) on the with-profit endowment policies in the UK does not follow the traditional measure. He adopts a different definition for the lapse rate in his study as compared with that adopted by Outreville (1990). He has modified the traditional lapse rate to take into account the number of policies exposed to the risk of lapsing in the year leading up to the r^{th} policy anniversary, where the exposure to the risk of lapsing refers to the number of policies in force that can be terminated within a period of 12 months. The adjusted lapse rate is measured by premium because, from his viewpoint, number of policies is deemed to be an unreliable measure of lapse rate.

For Kuo, Tsai and Chen (2003), the lapse rate in their study is the voluntary termination rate. The rate is the ratio of the number of lapsed (forfeited) or surrendered policies to the mean number of policies in force. The lapsed policies comprise the permanent insurance (i.e. universal life, variable life, variable-universal life and traditional whole life), term insurance and endowment insurance. The data are acquired from the annual reports of ACLI.

The various definitions adopted by researchers in their studies discussed above are summarised in Table 3.1.

Further to the discussion in this section, the next chapter is devoted wholly to discussing the computations of the lapse rate. The next chapter examines the various types of lapse rate that have been used for reporting in the Insurance Annual Report of Malaysia since 1963. In addition, new methods to compute the forfeiture rate that are in line with the definition for the forfeiture of life insurance in the Insurance Act 1996 of Malaysia are explored.

3.2 Review of Empirical Studies

The phenomenon of lapsation in life insurance business has received great attention. The study of lapsation of life insurance started with the development of persistency tables. The lapse ratio has been used as a key measurement in determining the persistency of life policies. A number of researchers have explored various forms of persistency table by incorporating new features, by considering different variations of the feature, or by making modifications to the existing tables to suit a particular need. The existence of persistency tables is beneficial to the relevant authorities in tackling the problem related to the persistency of various life insurance products available in the market from different perspectives.

We note that US researchers have been actively developing persistency tables. Two well-known pioneers related to the development of persistency tables in the early twentieth century are Papps and Linton. According to Moorhead (1960a), Papps (1919) proposed a desired value of the percentage surviving at the tenth policy year and then worked out the mathematical formulas to derive the values for earlier duration. Meanwhile, Linton (1924) developed the widely known "A" table that has the voluntary withdrawal rates with selected mortality rates at entry age 40 and "B" table (as a type of sensitivity analysis) which has the voluntary withdrawal rates equal to double those of "A" table in each year in order to illustrate the importance of persistency.

Another significant development is the persistency tables developed by Moorhead (1960 a & b). His tables are superior to the tables of Linton (1924) as two refinements have been introduced into the tables of Linton (1924), i.e. allowing for voluntary withdrawal during each policy year arising from fractional premium business and incorporating different mortality rates at various issue ages. Since then, others have explored other forms of persistency table that cater for a particular need.

In the development of persistency tables, Buck (1960) has strongly proposed the use of graduated lapse rate tables. According to him, the graduated lapse rates are in fact the expected lapse rates that can be used as a rough measure of the quality of business written by the insurance company. Their use can improve the validity of comparisons of the lapse rates within a company from one period to another and between companies. Further, the graduated lapse rates also can be utilised to calculate the ratios of actual to expected lapses to examine the effect of a particular factor affecting lapse rates. He has employed this method to demonstrate that the premium has a more dominant effect than the amount of insurance on the first year lapse rates.

In this respect, another milestone has been achieved by Brzezinski (1975). He has developed a new set of eight select and four ultimate expected lapse tables to replace the lapse tables of Linton (1924) and Moorhead (1960 a & b). His new tables incorporate two major features, namely the attained ages of the insured and the types of insurance being purchased, in order to address the inadequacies of the tables of Linton (1924) and

Moorhead (1960 a & b). In general, the tables of Brzezinzki (1975) are useful for the investigation of the effects on lapsation of various policy characteristics. His tables have been widely used in the long-term lapse study by LIMRA in examining the lapse trends among insurance companies and by the companies in making lapse comparisons of various kinds.

Other than the classic technical papers by Papps (1919), Linton (1924), Moorhead (1960 a & b), Buck (1960) and Brzezinki (1975) related to the formulation of persistency tables, there has been a long-term interest in the subject of lapsation of life insurance, especially in answering the basic question of what causes lapses. Extensive studies that investigate the causes of lapsation of life insurance are centred on examining the effects on lapses due to various factors attributed to the policyholder, the policy, and the agent (Richardson and Hartwell, 1951; Renshaw and Haberman, 1986; Lian et al, 1993; Loi et al, 1996). The common policyholder related factors being examined include the following: age, income level, gender, occupation and the status of being existing or new client to the insurance company. For the policy related factors, a majority of the studies have investigated factors such as the amount of policy, annual premium per policy, the frequency of premium payment, the duration of policy, the type of insurance plan and participating or non-participating policy. Meanwhile, the commonly examined agent related factor is the length of service of the agent.

The findings of these studies are in agreement. In general, the findings indicate the following tendencies:

(a) The lapse rates tend to decrease with increasing age (Richardson and Hartwell, 1951; Renshaw and Haberman, 1986; Lian et al, 1993; Loi et al, 1996) and income level (Richardson and Hartwell, 1951) of the policyholders.
(b) The lapse rates tend to be lower for female policyholders than for male policyholders (Richardson and Hartwell, 1951; Lian et al, 1993; Loi et al, 1996).
(c) The lapse rates are found to be the lowest among students and the highest among farm labourers and sales clerks. The patterns of lapses among the various occupational groups conform to the generally accepted view that the lapse rates trend upwards as the occupational status declines (Richardson and Hartwell, 1951).
(d) Richardson and Hartwell (1951) find that the amount of insurance has little influence on lapse rates but the findings of Lian et al (1993) and Loi et al (1996) find that the smaller size policies have a better persistency.
(e) The lapse rates tend to decrease with increasing annual premium (Richardson and Hartwell, 1951; Brzezinski, 1975).

(f) The findings of Richardson and Hartwell (1951), Lian et al (1993) and Loi et al (1996) show that the lapse rates tend to be the lowest for premiums paid annually and the highest for premiums paid monthly. The lapse rates tend to deteriorate when the frequency of premium payment increases. This result is expected because there is a much higher probability of stopping paying premium when the premiums are paid monthly, quarterly or semi-annually than when the premiums are paid annually. For example, the policyholders paying monthly premium have 12 times as many opportunities to lapse their policies as compared with those paying annual premium.

(g) The lapse rates tend to be lower for policies of longer duration than for those of shorter duration (Richardson and Hartwell, 1951; Renshaw and Haberman, 1986).

(h) The lapse rates tend to be high for term insurance business, which is characterised by having no savings component and hence low reserves; however, there are no consistent patterns in lapse rates among other types of insurance for life plans, endowments and endowment annuities (Lian et al, 1993; Loi et al, 1996).

(i) The lapse rates of the business of mature agents tend to be lower than those of new agents (Richardson and Hartwell, 1951). The lapse rates of the business of agents tend to decrease with increasing length of service of the agents.

From the review of literature related to lapsation of life insurance, it is apparent that at the earlier stage, for studies conducted before the 1980s, these studies are descriptive in nature. The results are mainly presented in tabulated forms and in-depth statistical analysis and modelling have not been employed to examine the factors affecting lapsation of life insurance. At the later stage, the studies conducted after the 1980s have started to measure the recognised interaction of the factors affecting lapsation of life insurance by using specific statistical tools such as the generalised linear models and maximum likelihood estimation methods (Renshaw and Haberman, 1986), Spearman rank order correlation (Chung and Skipper, 1987; Dankyi, 2001), multiple regression analysis – time series (Outreville, 1990), cross-sectional (Lian et al, 1993) and cross-sectional time series (Russell, 1997), survival analysis (Loi et al, 1996), simulation (Katrakis, 2000), Friedman's non-parametric test of homogeneity (Dankyi, 2001) and co-integration technique and impulse response analysis (Kuo, Tsai and Chen, 2003).

The earlier studies conducted by Richardson and Hartwell (1951), Buck (1960) and Thomas (1960) are purely descriptive in nature.

Richardson and Hartwell (1951) present the extensive results of a few studies on the lapsation of life insurance policies made by The Mutual Life of New York. The results reveal that there had been little improvement in the lapse rates since 1920. The lapse rates generally seem to be affected by the economic conditions. The major findings on economic conditions affecting lapsation of life insurance are summarised below:

(a) For the lapse rate by calendar year of exposure, the lapse rates after the second policy year tend to be much more greatly affected by economic conditions than the lapse rates for the first two years.

(b) Economic depression has an adverse impact on lapse rates for policies at all durations. It is noted obviously that the economic depression experienced in 1932-1933 had an adverse effect on lapsation for policies issued earlier and also for those that had been in force for a very long duration, i.e. as long as 10 years. This finding provides support for the emergency fund hypothesis (EFH). (More discussion on EFH later in this section.)

(c) For the lapse rate after the second policy year, policies with a policy loan tend to have a greater variation in lapse rates than those without a policy loan under different economic conditions. This tendency prevails because, in many cases, application for a policy loan is an early indication of the policyholders' desire to surrender their policies.

Richardson and Hartwell (1951) also examine whether the surrendered policies have fulfilled their original purpose or have met some other legitimate economic need. The findings contradict the belief concerning the negative consequences that policyholders who lapse their life policies would suffer from a detrimental financial effect. However, the findings show that the majority of the surrendered policies, in fact, have performed a real service to the policyholders. Surrenders tend to occur because the insurance has served its primary purpose and the cash values accumulated under the policies are needed urgently to meet the needs of the policyholders that have arisen during that time. This finding again provides further evidence to support the EFH.

Buck (1960) examines Lincoln National's lapse experience on standard direct ordinary policies using the first year lapse rates and default rates (refer to page 24 for definition). He examines the attributes of the first year lapse rates and default rates using three different measures, by number, by amount and by premium. He finds that the first year lapse rates by number are the highest, followed by the rates by amount, while the rates by premium are the lowest. The first year lapse rates by number are the highest because large policies are weighted more heavily by amount and by premium than by number. However, within narrow premium ranges, the lapse rates are nearly the same by number and by premium. Likewise, within narrow amount ranges, the lapse rates are almost identical by number and by amount. On the other hand, all of the three different measures of the default rates are nearly similar by number, by amount and by premium.

In addition, Buck's (1960) findings also reveal that the default rates tend to offset the first year lapse rates to a certain degree. The higher renewal lapse rates experienced by small policies tend to be offset by the lower default rates. This offsetting trend is especially apparent for policies with higher annual premiums. However, the extent of the offsetting trend depends partly on the rules and practices of the respective insurance companies. If it were true that trends on defaults offset trends on first year lapses, then the efforts taken by the life insurance industry to improve the persistency of its business by encouraging agents to sell policies with larger premiums than those with smaller ones may be misdirected and this would further lead the industry to neglect a particular segment in the market.

Thomas (1960) has carried out a comparative study to investigate the relative persistency of ordinary life and graded premium ordinary life policies of Connecticut Mutual. His findings show that different types of insurance have different levels of lapse rate. The termination rates on graded premium ordinary life policies tend to be higher than those on the ordinary life policies for the first few years after issue. However, the differences decrease rapidly and disappear by the end of the grading period. This lapse pattern can be explained by the fact that the graded premium ordinary life policy is a type of whole life insurance that is designed for people who want more life coverage than they can currently afford. The policyholder pays a lower initial premium that increases gradually over a period of time (e.g. the premium increases every year for the first three or five years) before the premium becomes constant/level for the remaining duration of the policy. As the premium payment is increasing over the grading period, the policyholder might have difficulty in servicing the policy which is beyond their ability to afford it. Thus, there is a higher tendency that the policy would become lapsed during the grading period.

A few empirical studies in the 1990s have used the EFH and the interest rate hypothesis (IRH) as the underlying hypotheses in explaining lapsation of life insurance. For examples, in the studies of Dar and Dodds (1989), Outreville (1990), Russell (1997) and Kuo, Tsai and Chen (2003), they have explicitly employed these two hypotheses in examining the lapse rate dynamics in relation to some macroeconomic factors.

The EFH proposed by Linton (1932) conjectures that people would draw on the last resort source of funds to obtain cash in an emergency time (i.e. when facing personal financial distress) in order to help them get through the financial hardships. A testable implication of this hypothesis is that the lapse rate would increase during economic downturns. Based upon this hypothesis, the propensity to lapse (i.e. forfeiture and surrender) a life insurance policy is assumed to be a function of economic/financial pressures and the life policies owned by the policyholders are regarded to be the last resort source of funds available to them. The policyholders react to changes in their financial circumstances following changes in the macroeconomic situations by changing their stake in life insurance savings/protection. Some policyholders are unable to maintain their policies during bad economic times. They tend to utilise the cash meant for premium payments and/or the surrender values of their life policies as an emergency fund to tide them over times of financial difficulties when the economic situation is adverse such as when the stock market is depressed, during times of unexpected changes in their personal income and during period of recession-induced unemployment.

On the other hand, the IRH contends that an increase in interest rates across the term structure would cause people to engage in interest rate arbitrage. As an increase in interest rates would result in a decline in the value of fixed income assets, people tend to liquidate those assets that have a lower fixed interest rate in order to transfer the funds into alternative investment products that offer a higher market interest rate. A testable implication of this hypothesis is that the lapse rate would rise when the market interest rate increases. Based upon this hypothesis, the market interest rate is seemed to be an opportunity cost of owning life insurance. The policyholders are expected to withdraw funds from their life policies during periods of high interest rates in order to engage in interest rate arbitrage, when they perceive that the rates credited to the cash values under their life policies are not as attractive as the returns offered by alternative investment instruments. Meanwhile, as the market interest rates rise, the equilibrium premiums/prices for life policies fall. There is a greater likelihood that the policyholders can acquire a new life policy with the same coverage at a lower premium. Therefore, these would cause an increase in lapsation of life insurance during period of high or increasing interest rates when the policyholders find a better value on alternative investments in the market, either to exploit the higher yields or to take advantage of the lower prices offered by alternative investments.

Dar and Dodds (1989) examine savings through endowment insurance in the UK. They empirically determine whether or not the EFH and IRH have an independent impact on surrenders because a surrender is one of the possibilities that will cause a decrease in the net flow of life insurance savings. Their findings provide support for the EFH. The unemployment variables have a positive sign on their estimated parameters and are significant. However, their findings do not provide any support for the IRH. The interest rate variables such as the alternative real rate of return and the real internal rate of return have the wrong sign on their estimated parameters and are not significantly different from zero. The findings suggest that UK endowment surrenders appear to be affected by the emergency fund effect but not the changes in the interest rates in the general market.

It is interesting to note that the findings related to the EFH and IRH on surrenders are just the opposite of those on savings through life insurance (see Chapter two). By taking into consideration both the findings on surrenders and savings through life insurance, the overall results indicate that while savings through endowment policies are affected by interest rates, the adjustment takes place through channels other than policy surrenders. This implies that interest rates typically determine the way the policyholders allocate their new wealth between assets but do not affect their existing wealth in the form of endowment policies through surrenders. On the other hand, the emergency fund effect affects savings through endowment policies via policy surrenders.

In addition to testing EFH and IRH, Dar and Dodds (1989) also examine whether or not inflation and the stock of life insurance funds have an impact on policy surrenders of endowment policies. Their findings reveal that inflation appears not to have any impact on surrenders but the stock variable that captures the scale effect on surrenders is found to have a significant impact on surrenders.

In the study of Outreville (1990) that investigates the early lapsation on ordinary and whole life insurance in the US and Canada, two different data sets have been used for the analysis: (a) a data set of 28 semi-annual observations of lapse rate each for the American and Canadian ordinary life policies for years 1966-1979 reported in the United States and Canadian 13-Month Ordinary Lapse Survey published by LIMRA and (b) a data set of 25 annual average lapse rates each for the American and Canadian whole life policies over the period 1955-1979.

The results of this study provide considerable evidence in favour of the EFH. Specifically, the findings of the study reveal that factors such as transitory income (i.e. the difference between current income and expected normal income), the rate of change in disposable personal income and unemployment tend to affect significantly early lapsation of life insurance. Income level is found to affect inversely whereas unemployment affects positively the early lapsation of life insurance. In addition, broadly speaking, the EFH is found to be consistent in both the US and Canada.

On the other hand, Outreville's (1990) findings on the relationship between interest rates and early lapsation of life insurance are mixed and inconclusive. The findings do not provide strong evidence in support of IRH. His findings do not discover a significant relationship between interest rates and ordinary life policies that have lapsed within 13 months of the policy issue date. Various types of interest rate such as the real rate of return on alternative long-term assets, the short-term interest rate on three-month treasury bills, the long-term interest rate on industrial bonds and the interest rate on government bonds are tested and fail to show any significant effect on lapses even though their estimated parameters tend to have the expected positive sign. For lapses on whole life policies, significant results are obtained in the US with different types of interest rate but the interest rate variables are never significant in Canada.

The above situation can be explained by the fact that when policies are lapsed at an early duration (especially during the first year or two), it is most likely that the lapsed policies have not acquired any cash surrender values yet. Since there is no fund which the policyholders can transfer out from the lapsed policies to be invested in alternative investments, early lapsation of life insurance is not necessarily the consequence of unexpected changes in interest rates. However, early lapsation might be due to policyholders who have bought their life policies under the sales pressure from agents and who at a later stage decide to cancel the policies in the absence of the pressure. Another possibility that can help to explain the situation is that an early lapsation may simply indicate that the policyholders, having had the time to consider the relative merits of their life coverage, decide not to renew their policies in favour of other policies or investments.

In addition to testing EFH and IRH, Outreville (1990) also examines whether or not anticipated inflation and the price of insurance have a significant relationship with early lapsation of life insurance. His findings show that anticipated inflation is not significant in the regression models and it even has the wrong sign. This finding provides further support for the finding of Dar and Dodds (1989) that inflation appears not to have any impact on lapsation of life insurance (i.e. even for the case of policy surrender). The price of insurance variable has the expected negative sign and is significant in the regression models for whole life policies (that use annual observations). In the absence of an appropriate proxy for the price variable on a semi-annual basis, Outreville (1990) has included a linear trend in the regression models for ordinary life policies in order to capture the price effect and this trend variable is found to have a significant negative relationship with early lapsation of life insurance. This finding suggests that when it is more costly to obtain insurance protection, early cancellation of life policies would tend to be lower.

Further, as the growth of new business and the demand for term insurance can distort lapse rates, two variables are used by Outreville (1990) in order to control for the biases that might arise. The two control variables are a one-period lag (t−1) for the ratio of new ordinary life business to ordinary life business in force (i.e. new/existing business) and for the ratio of term insurance business to total ordinary life business. The former control variable is used in the regression models for ordinary life policies. Even though this control variable is found to have a positive and significant relationship with early lapsation of life insurance (indicating replacement motivated surrender in which a high volume of replacement business induces lapsation of existing life policies), it does not have significant explanatory power over EFH and IRH as it does not affect the overall results for the models qualitatively. Both of the control variables are used in the regression models for whole life policies. The findings show that these two variables have a positive and significant relationship with early lapsation of life insurance. Controlling for these two variables does not affect the results for the emergency fund variables but the interest rate and price variables in both countries become insignificant and are dropped from the models. This implies that the emergency fund effect is as strong as and independent of the replacement effects (i.e. the policyholders surrender their existing life policies for new ones or for term insurance) but the interest rate and price effects are weak and less dominant as compared with the replacement effects and eventually the interest rate and price variables are forced out of the models.

Another related study has been conducted by Russell (1997) in order to examine the phenomenon of surrender activity among policyholders in the US. Two different cross-sectional time series data sets are used in his study to test the EFH, IRH and life insurance market dynamics: (a) the state-specific data set covers the period 1968-1993 for all of the 50 states and the District of Columbia and (b) the company-specific data set covers the period 1985-1995 for 395 life insurance companies that issued cash value life policies and existed for the entire period of the study. Three different estimation methods are used in his study, namely the ordinary least squares (OLS), least squares dummy variables and random-effects models.

For the state-specific data, the results under the three estimation methods are found to be similar. The estimated signs on the regression parameters are generally in line with expectation and consistent for the variables of interest rate, inflation and unemployment. Real interest rates (i.e. the yields on long-term, intermediate-term and short-term Treasuries), inflation and unemployment are related positively and significantly to surrender activity. However, the estimated sign on the regression parameters for real income per capita unexpectedly is positive and significant. Russell (1997) explains that the lack of variation in the income variable over time might have accounted for the unexpected sign for this variable. The findings on the various interest rate variables provide strong evidence in support of IRH. On the other hand, the study of Russell (1997) only finds weak evidence in support of EFH as the findings on the unemployment and income variables have conflicting results, i.e. the findings on unemployment lend support to the EFH but the findings on income do not. The findings on inflation have the expected positive sign on its estimated coefficients. When inflation is high, the value of fixed income assets such as life insurance deteriorates causing policyholders to lapse their policies in favour of other investments that promise better value for money in order to preserve their purchasing power.

The findings on life insurance market dynamic variables are mixed. The variables such as the new/existing business, premium (or commission) rebating (i.e. a situation where life insurance agents rebate/refund a portion of their commissions to the policyholders) and the proportion of population over the age of 65 are found to have the expected positive and significant relationship with surrender activity. These findings suggest that a high volume of replacement business, allowing for premium (or commission) rebating and older population tend to be associated with high surrender activity. Russell (1997) also uses a year dummy variable to capture the effect of the introduction of universal life insurance since 1979 on surrender activity, but its findings do not conform to expectation. The year dummy variable unexpectedly is negative and significant. Russell (1997) explains that these unexpected findings might indicate the following possibilities: (a) the introduction of universal life insurance is not an important factor affecting surrender activity – i.e. the existence of universal life insurance does not cause replacement related surrenders, (b) the effect of the introduction of universal life insurance on surrender activity might have been captured by another variable in the model (such as the variable of new/existing business) or (c) the year dummy variable might not be serving as a proxy to examine the intended effect but rather an unspecified phenomena.

For the company-specific data, the findings show that macroeconomic variables still maintain their expected signs in the company level regression models under different estimation methods but lose most of their significance, with the exception for the income variable. Even though real income per capita has an unexpected positive sign, it is the only macroeconomic variable that stays significant consistently across all of the regression models under different estimation methods. Russell (1997) explains that the failure of the company-specific data set (derived from 395 companies over a period of 11 years) to provide as many significant coefficients as the state-specific data set (derived from 51 states over a period of 26 years) might be due to the fact that the data from the individual companies, having a larger number of different subjects and a shorter sample period, are expected to possess substantially more noise and variation than the data from the states that have a smaller number of different subjects and a longer sample period.

For the life insurance market dynamic variables, the findings indicate that company leverage [being a one-period lag (t−1) for the ratio of total liabilities to the insurer's surplus] and policy loan (being the proportion of policy loans relative to total assets in the previous period) have a significant positive impact on surrender activity after one period. The policyholders would tend to react by surrendering their policies the year after the financial conditions of life insurers have deteriorated (based on the measures that normally are released to the public on a yearly basis). An increase in policy loans is followed by an increase in surrender activity the year after as the policyholders seek to eliminate policy loan repayments (i.e. a surrender results in an automatic policy loan payoff) and to preserve liquidity (i.e. this provides some further evidence to support the EFH). On the other hand, the findings on the organisational forms of company are mixed. Therefore, a conclusion as to whether the stock or mutual company tends to experience a lower surrender activity cannot be drawn. Meanwhile, the findings on the new/existing business, policy size and home sales variables are also mixed but these variables are not significant in any of the regression models, indicating that the volume of replacement business, the wealth of the insurers' clientele and the home sales business are not important factors in determining surrender activity.

In summary, the findings of Russell (1997) reveal that the surrender activity as a whole tends to be related positively and significantly to real interest rates, inflation, and unemployment. However, the surrender activity unexpectedly is found to be related directly to real income per capita at both the state and company levels. Russell's (1997) findings on the relationship between lapses and unemployment provide further evidence for the findings of Dar and Dodds (1989) and Outreville (1990) in support of EFH but this is not the case for the findings on the income variable. On the other hand, for the findings on interest rate, unlike the findings of Dar and Dodds (1989) and Outreville (1990) that provide no support or weak support for the IRH, the findings of Russell (1997) provide strong evidence in support of IRH. For the life insurance market dynamic variable, the findings of Russell (1997) that new/existing business tends to be related to a high level of lapses at the state level are in line with the findings of Outreville (1990) but this is not the case at the company level. This situation can be explained by the fact that a more highly aggregated data set (i.e. the state-wide data) is better able to reflect the relationship between two variables and to provide a precise assessment of the policyholders' reaction towards replacement effect on surrender activity than a less aggregated data set (i.e. the company-wide data) that contains many variations/differences across companies that the models fail to address. However, caution should be noted in comparing the findings of Russell (1997) and Outreville (1990) as the dependent variables in these two studies are slightly different. The dependent variables in the study of Russell (1997) are the lapse rates for policies that have at least some surrender values but the dependent variables in the study of Outreville (1990) are the lapse rates for policies that lapsed at early duration that have little or no surrender values.

More recently, Kuo, Tsai and Chen (2003) have re-examined the EFH and IRH with respect to the lapse rate. Their empirical model has two advantages over the models developed in previous studies by Dar and Dodds (1989), Outreville (1990) and Russell (1997). Firstly, they use the co-integrated vector autoregression model developed by Engle and Granger (1987) to construct their empirical model. Co-integration modelling is able to separate the potential long-term relationship among lapse rate, interest rate and unemployment rate from their short-term adjustment mechanisms. The co-integration technique is very different from the OLS method used by Outreville (1990) that focuses mainly on the short-term dynamics and ignores the potential long-term relations. The co-integration technique is superior to the OLS method as it can explore further the influence of the interest rate and unemployment rate on the lapse rate through a long-term channel that normally cannot be identified using the OLS method. Further, they also employ the impulse response analysis to examine the estimated error-correction model (ECM) in order to assess the relative economic importance of interest rate and unemployment rate in causing variations in lapse rate. Secondly, compared with the study of Outreville (1990), the study of Kuo, Tsai and Chen (2003) has data covering a longer sample period. They use 48 observations dating from 1951 to 1998 whereas Outreville (1990) uses less than 28 observations with a sampling period that is less than 25 years. Having a larger sample size is better as it enhances the power of the estimation and the robustness of the analysis.

The findings of Kuo, Tsai and Chen (2003) reveal that the unemployment rate affects the lapse rate both in the short- and long-term while the interest rate has a less obvious impact in the short-term but a more significant impact in the long-term. The findings seem to suggest that EFH has a more important influence on the lapse rate than IRH. However, according to the impulse response analysis, the findings show that the interest rate overwhelms the unemployment rate in its overall impact on the dynamics of lapse rate. The lapse rate responds significantly to shocks from the interest rate but insignificantly to shocks from the unemployment rate. The latter findings indicate that IRH is favoured relative to EFH as the interest rate appears to be more economically significant than the unemployment rate in explaining the lapse rate dynamics.

Other studies in the literature that are related to lapse rate have been conducted by Chung and Skipper (1987), Katrakis (2000) and Dankyi (2001).

The lapse study of Chung and Skipper (1987) relates interest rate with policy surrender value. Specifically, they investigate the effects of interest rates on surrender values of universal life policies sold by 60 life insurers that appeared in the 1985 edition of Best's Flitcraft Compend. The interest rate being examined refers to the interest rate advertised by the insurer that is being credited to the policy. Their findings reveal that higher interest rates do not necessarily generate higher surrender values for policies with a shorter duration when the period in force is less than 10 years, partially due to the stronger effects of factors such as the expense loadings, surrender charges and mortality charges. However, the reverse is true for policies with a longer duration such as those have been in force for 10, 15 and 20 years. Thus, the interest rate is not a reliable indicator for the policy surrender values. The researchers advise the prospective buyers to make their decision by weighing more heavily the absolute level of the projected surrender value accumulated under a policy than the advertised level of the interest rate being credited to a policy. The findings of Chung and Skipper (1987) highlight the fact that the interest rate should not be considered as the sole criterion in determining the policy surrender values but the policyholders should also take into consideration the transaction costs that might be incurred when they surrender their policies.

Katrakis (2000) uses the concept of dependent lapsing to investigate the division of the policyholder's total (or accumulated) premium payments among the various participants. The term "dependent lapsing" means the dependency of the lapse rates on economic conditions. It refers to the situations in which lapse rates would surge to an abnormally greater extent (i.e. an increment that is greater than 50%) when the economy is in recession and when the stock market is experiencing unfavourable conditions as compared with the usual levels of the lapse rate experienced under a stable economic backdrop. Meanwhile, the cost of dependent lapsing refers to the difference of the participant's share [being the benefit (net of all types of deduction) paid to the participant relative to the accumulated total premium paid by the policyholder] between adverse and non-adverse economic conditions. The study focuses on two types of savings policy that are commonly available in the UK, namely the Unit-linked Endowment Contracts and Unit-linked Personal Pension Plans. In particular, Katrakis's (2000) investigation relates lapse rates to the general economic situations and the performance of the stock market because the premiums of the unit-linked policies typically are being invested in the stock market. The various participants involved refer to the policyholder, the insurer and the agent. The

Wilkie asset model is used to derive stochastically the shares (that is the division of the policyholder's total premium payments) of the various participants for policy terminations at different policy durations, modes of exit (either lapse, death or maturity) and modes of accumulation (either at the unit fund growth rate, at a rate appropriate for the respective participants receiving the share, or at the ratio of the nominal share of the policyholder's total premium payment to the total nominal sum of premiums), whilst the Monte-Carlo simulation is used to estimate the distributions of the various participants' shares under different investment scenarios.

The major findings of the study reveal that there is a statistical difference between the policyholder's share during adverse and non-adverse economic conditions during the first three to five policy years depending on the modes of accumulation. The costs of dependent lapsing for the Unit-linked Endowment Contracts to the various participants when the policies are terminated at their early durations under a depressed stock market are significant in most cases. The costs of dependent lapsing borne by the policyholders are in the range of 3%–5% depending on the modes of accumulation. The costs of dependent lapsing for the Unit-linked Personal Pension Plans to the policyholders are also significant. The cost is positive and decreases over time in most occasions. Dependent lapsing has an adverse effect on the policyholders and it causes them to receive a lower future expected pension when their pension plans are being retired during times of economic recession. The finding on the declining trend of the cost is expected because the size of the pension entitlement normally increases with increasing length of pensionable service.

The study of Dankyi (2001) examines the effects of life insurance payouts, in terms of maturity benefits and surrender values, on lapse rates of the with-profit endowment policies in the UK for the period 1986-1994. The first major findings of his study reveal that surrendering policyholders generally are not relatively better off than policyholders who hold on to the policies until maturity as the insurance companies which pay higher surrender values to surrendering policyholders also pay higher maturity benefits to continuing policyholders. Second, the policies that have lower maturity benefits or surrender values (relative to the average market values) tend to have higher lapse rates because the policyholders generally prefer policies with better value and normally would surrender their policies when they perceive poor value for money. These findings indirectly lend support to the IRH and the proposition that lapses tend to increase in an economic environment that is experiencing high inflation. Third, the insurance companies that offer higher maturity benefits or surrender values do not necessarily have higher yields on their assets as the ability of a company to pay out more benefits to the policyholders does not depend merely on its return from investment but also on other factors. This finding provides considerable evidence to confirm the findings of Dar and Dodds (1989) that the real internal rate of return does not play an important role in affecting surrenders.

3.3 Concluding Comments and Proposed Studies

Based on the discussions above, similar to the results of the studies that address life insurance demand, the results of the many lapse studies are inconsistent and sometimes are conflicting with one another. For example, the findings on EFH and IRH are inconclusive. For the EFH, only the findings on unemployment are consistent in the studies of Dar and Dodds (1989), Outreville (1990) and Russell (1997) that unemployment causes the emergency effect on lapsation of life insurance. However, the findings on income are inconsistent and contradictory in the studies of Outreville (1990) (i.e. negative and significant, thus in support of EFH) and Russell (1997) (i.e. positive and significant, thus do not provide support for the EFH). On the other hand, for the IRH, the findings on the various types of interest rate are inconsistent. Dar and Dodds's (1989) findings do not lend support to the IRH but Russell's (1997) findings are in favour of the IRH, whilst Outreville's (1990) findings are mixed. This has led to a confused picture as to which factors predominantly affecting lapsation of life insurance. Therefore, in this thesis, in order to provide a better understanding of lapsation of life insurance, studies are undertaken to examine lapses from two different aspects, i.e. the forfeiture and surrender of life insurance, in relation to specific macroeconomic and demographic factors. In particular, there are two major studies on lapsation of life insurance in this thesis. The first study is on Malaysia in which three types of forfeiture rate and a surrender rate are examined. The second one is a comparative study between Malaysia and the US which only examines the surrender of life insurance. More detailed discussions on the data and the specification of the lapse models are presented in the subsequent chapters of this thesis (see Chapters five and six).

APPENDIX CHAPTER 3

Table 3.1

A Summary of the Various Definitions of Lapse Rate Adopted in Past Studies

Richardson and Hartwell (1951) • First year lapse rate It is defined as the proportion of the policies (by number) that have paid no part of the premium in the second year. • Second year lapse rate It is defined as the proportion of the policies (by number) on which no part of the premium in the third year is paid. • Termination rate in the first two policy years It is defined as the ratio of the policies (by number and by amount) that lapsed in a year to 75% of the business issued in the preceding year plus 25% of the business written two years before lapses occurred. • Termination rate after the second policy year, that is the lapse rate for policies three or more years in force It is defined as the ratio of the policies (by number and by amount) that lapsed in a year to the mean value of the business in force at the beginning and at the end of the years plus one-half of the lapses in the current year. • Lapse rate for policies have been in force for three or more years that with a policy loan It is defined as the ratio of the policies (by number) on which loans were repaid by surrender of policies during the year to the mean number of policy loans in force, plus one-half of the number of policy loans repaid by surrender. • Lapse rate for policies have been in force for three or more years that without a policy loan It is defined as the difference between the lapse rate after the second policy year and the lapse rate on policies with a policy loan. • Lapse rate by policy year It is the lapse rate of individual policy year (i.e. the lapse rate in the first, second or third policy year) for policies issued in a given year.
Thompson (1960) • First year withdrawal rate
Barry (1960) • Surrender rate It is defined as the ratio of the surrender values paid during a year relative to the aggregate cash values exposed at the beginning of the year.
Buck (1960) • First year lapse rate It is defined as the proportion of the policies (by number and by premium) that have paid some premiums but none at all in the second year. • Default rate It is defined as the proportion of first year defaults (by number) to business issued.
Renshaw and Haberman (1986) • Log odds of lapsing It is defined as the logarithmic transform of the ratio of the number of lapses to the difference between total exposures and the number of lapses.
Dar and Dodds (1989) • Surrender rate
Outreville (1990) • Early lapsation It is defined as the ratio of the life insurance business (by amount) being removed owing to premature terminations, with or without payment of surrender values, to the business in force.
Lian at al (1993) and Loi at al (1996) • Duration of policy It is defined as the number of completed years from the inception of a life policy before it became lapsed.
Russell (1997) • Surrender rate at the state level It is defined as the surrender benefits to life insurance in force. • Surrender rates at the company level It is defined as the surrender benefits to the adjusted assets of life insurer.
Dankyi (2001) • Adjusted lapse rate The rate is a modification of the traditional lapse rate that takes into account the number of policies (by premium) exposed to the risk of lapsing in the year leading up to the r^{th} policy anniversary.
Kuo, Tsai and Chen (2001) • Lapse rate It is defined as the ratio of the number of lapsed (forfeited) or surrendered policies to the mean number of policies in force.

CHAPTER 4
COMPUTATION OF LAPSE RATE

In general, lapsation of life insurance refers to the discontinuation of life policies due to non-payment of premiums by the policyholders. A lapse ratio measures the percentage of life policies that was in force at the beginning of a year, but is no longer in force at the end of the year. It indicates the rate at which policies are going off the books, thus representing the loss of earnings to the life insurers or the insurance industry and some cash loss to the remaining policyholders (Treasury, 1964). In other words, the lapse ratio is a key measurement in determining the persistency of life policies. The longer a policy is in force, the better is its continued persistency.

In Malaysia, there are clear definitions stated in the Insurance Act 1996 (Legal Research Board, 1997) differentiating the forfeiture rate from the surrender rate. The forfeiture of a policy is more severe than the surrender of a policy in terms of financial adversity. This is because, when policies are forfeited, they are terminated prior to the acquisition of cash values. The absence of a cash value is because the total costs incurred (such as the commissions and other expenses) during the initial policy years are often greater than the premiums being collected by the life insurers.

Considering that lapsation has a significant adverse effect on financial strength, the supervisory authority in Malaysia has paid great concern to this issue and reported on this phenomenon in its annual reports. The authority has urged individual life insurers to take concerted efforts to improve their respective lapse experience in order to maintain a healthy life insurance industry as a whole.

4.1 Lapse Rates Reported in the Insurance Annual Report of Malaysia

In Malaysia, the Insurance Commissioner began to report on lapsation of life policies in the insurance annual report from 1963 when the Insurance Act of Malaysia was enforced in the same year. This task was then taken over by the Director General of Insurance from 1970 onwards.

The computation of lapse ratios and the reporting of terminations on life policies adopted in the insurance annual report have experienced changes several times in years 1966, 1978, 1984, 1990, 1995 and 1999.

In the Insurance Annual Report 1964, the forfeiture rate is defined as the percentage of the forfeitures for the year (by amount and by premium) to the new policies issued for the year, that is:

$$\text{Forfeiture Rate} = \frac{\text{Business Forfeited}_t}{\text{New Business}_t}$$

This formula was adopted for only two years to report the forfeiture rates in 1963 and 1964.

In the Insurance Annual Report 1966, the forfeiture rate is redefined and forfeitures are measured against the mean of new business for two years. It is based on the assumption that most forfeiture occurs during the first and second premium paying years and therefore it is appropriate to gauge the forfeiture against the mean of new business for two years (Treasury, 1964 & 1966). Specifically, the forfeiture rate refers to the ratio of the sums insured forfeited in a year to the mean value of the new sums insured in respect of whole life and endowment policies written in that year and the preceding year, that is:

$$\text{Forfeiture Rate} = \frac{\text{Sums Insured Forfeited}_t}{\tfrac{1}{2}*(\text{New Sums Insured}_t + \text{New Sums Insured}_{t-1})} \quad \text{(Eq4.1)}$$

The reported forfeiture rate is the forfeiture rate of the industry for combined life insurance business (i.e. ordinary life and home service businesses). The revised formula has been adopted for reporting forfeiture rate for years 1964 to 1993 in the insurance annual report. However, the computation on this basis is not possible for 1963 as the 1962 statistics are not available.

It is admitted by the relevant authority that the revised formula is not a very accurate indicator for the forfeiture experience of the life insurance industry. This is because this basis of computing forfeiture has resulted in an understatement of the rate in years of rapid new business growth due to the inclusion of term insurance and single premium insurance (which are not subject to forfeitures) in the new business. Further, it has resulted in an overstatement of the rate in years of abnormal slowdown in the new business.

Further scrutiny of the formula reveals that the denominator should be supported by three years of new life insurance business so that the formula is in line with the definition stated in Section 156 of the Insurance Act 1996 of Malaysia. This is because policies are regarded as forfeited if they are being lapsed during the first three years of their inception.

In the Insurance Annual Report 1978, the surrender rate is reported for the very first time in addition to the forfeiture rate. The statistics for the rate are made available for years dated back to 1970. The surrender rate is defined as the percentage of the total sums insured terminated through surrenders during the year to the total sums insured in force at the beginning of the year, that is:

$$\text{Surrender Rate} = \frac{\text{Sums Insured Surrendered in a Year}}{\text{Sums Insured in Force at the Beginning of the Year}} \quad \text{(Eq4.2)}$$

In the Insurance Annual Report 1984, an improvement has been made to report different kinds of lapses and terminations. An additional table showing the terminations of sums insured (in absolute value and as a percentage of the total sums insured terminated) by various causes, namely death, maturity, surrender, forfeiture and others, is included. The statistics of these terminations are made available dated back to 1974.

In the Insurance Annual Report 1990, in order to rectify the situation of the forfeiture rate being understated or overstated in times of rapid new business growth or abnormal slowdown in the new business, a new method to compute the forfeiture rate by policy year was introduced. Under this new basis, the forfeiture experience of the insurance industry is monitored based on policy year. Data on forfeiture for each of the first three policy years are reported. The forfeiture rate for the individual policy year refers to the ratio of the business written in a year which has been forfeited in its first, second or third policy year to the new policies issued in the respective policy year. Meanwhile, the forfeiture rate with respect to policies issued in a given year is defined as the aggregate of the forfeiture rates for the first three policy years. The formulae are as shown below:

$$\begin{array}{c}\text{Forfeiture Rate}\\ \text{of Individual}\\ \text{Policy Year}\end{array} = \frac{\begin{array}{c}\text{Business Written in a Year that has been Forfeited in the First,}\\ \text{Second or Third Policy Year}\end{array}}{\text{New Business Written in the Respective Policy Year}}$$

$$\begin{array}{l}\text{Forfeiture Rate with}\\ \text{respect to Policies}\\ \text{Issued in a Given Year}\end{array} = \begin{array}{l}\text{Forfeiture Rate in}\\ \text{the 1}^{\text{st}}\text{ Policy Year}\end{array} + \begin{array}{l}\text{Forfeiture Rate in}\\ \text{the 2}^{\text{nd}}\text{ Policy Year}\end{array} + \begin{array}{l}\text{Forfeiture Rate in}\\ \text{the 3}^{\text{rd}}\text{ Policy Year}\end{array}$$

The annual report provided statistics on the forfeiture rates occurring within the first three policy years for business underwritten dated back to 1986.

In the Insurance Annual Report 1995, the method used to compute the forfeiture rate since 1966 has been revised. A new weighted forfeiture rate has been introduced to replace the forfeiture rate measured against the mean of new business. The statistics on this forfeiture rate are made available dated back to 1990. The weighted forfeiture rate is defined as the percentage of the annual premiums forfeited to new annual premiums in respect of policies written in the last three years with the weights of 20%, 56% and 24% for the new business premiums for the latest year, the immediately preceding year and the second immediately preceding year respectively, that is:

$$\text{Weighted Forfeiture Rate} = \frac{\text{Annual Premiums Forfeited}_t}{0.20{*}\text{New Annual Premiums}_t + 0.56{*}\text{New Annual Premiums}_{t-1} + 0.24{*}\text{New Annual Premiums}_{t-2}}$$

The weights were determined based on the analysis of actual forfeiture of new policies during the three successive accounting periods. However, the details as to how the weights are derived are not explained in the annual report.

In the Insurance Annual Report 1999, an additional table which is similar to the one introduced in the Insurance Annual Report 1984 is presented to show an analysis of terminations by premiums for the various causes, namely death, maturity, surrender, forfeiture and others (in absolute value, as a percentage of the total premiums terminated and in percent of change relative to the previous termination). The tabulated data cover the period back to 1994.

Table 4.1 summarises the developments of the various methods used to report lapses and terminations in the Insurance Annual Report since 1963.

4.2 Improved Methods to Compute Forfeiture Rate

From the various methods available in the annual report that can be used to compute the forfeiture rate, one of them is chosen for this study based on the availability of data contained in the annual report. The forfeiture rate chosen is the forfeiture rate defined as the ratio of the sums insured forfeited in a year to the mean value of new sums insured on combined life insurance business written in that year and the preceding year (i.e. Eq4.1). They are industry-wide forfeiture rate for combined life insurance business (i.e. ordinary life and home service businesses). MFR1 is used to denote this method of computing the forfeiture rate. The formula is reproduced below:

$$\text{MFR1} = \frac{\text{Sums Insured Forfeited}_t}{\tfrac{1}{2}{*}(\text{New Sums Insured}_t + \text{New Sums Insured}_{t-1})} \qquad \text{(Eq4.1)}$$

These forfeiture rates are readily available in the annual report for years 1964 to 1993 except for 1967-1969, and the forfeiture rates for years 1994 through to 2001 can be easily computed using the data of sums insured forfeited and new sums insured reported in the annual reports.

The above formula does not capture fully the definition for the forfeiture of life insurance stated in the Insurance Act of Malaysia because its denominator is supported only by the mean value of new business for two years. Hence, three other alternative methods are suggested to improve the existing formula. As we shall see, two forfeiture rates that are dependent on calendar year are used in this study but the forfeiture rate that is dependent on duration is not adopted because it fails to produce sensible estimates for the model proposed.

4.2.1 Dependent on Calendar Year

The first improved method to compute the forfeiture rate is denoted MFR2. It is the ratio of the sums insured forfeited in a year to the exposure of new sums insured written in the three preceding years in the following manner: one-half of the new sums insured written in that year, total new sums insured written in the preceding year, total new sums insured written two years before lapses occurred and one-half of the new sums insured written three years before lapses occurred. The revised formula makes more practical sense as the denominator captures three years of new life insurance business. The improved formula is shown below:

$$\text{MFR2} = \frac{\text{Sums Insured Forfeited}_t}{0.5^*\text{New Sums Insured}_t + \text{New Sums Insured}_{t-1} + \text{New Sums Insured}_{t-2} + 0.5^*\text{New Sums Insured}_{t-3}} \qquad \text{(Eq4.3)}$$

The forfeiture rates calculated using this formula are much lower compared with those obtained using the formula MFR1. The forfeiture rates computed using MFR2 are only about 0.4 times of those computed using MFR1. The newly defined formula (i.e. MFR2) is a superior formula to MFR1 as it is in line with the definition for the forfeiture of life insurance stated in the Insurance Act of Malaysia. Hence, the forfeiture rates computed using MFR2 should better reflect the lapsation of life insurance experienced in Malaysia.

4.2.2 Dependent on Duration

In addition to the formula mentioned above, two other approaches recommended by Dr Tony Puzey to compute the forfeiture rate have been investigated. The first method assumes that the forfeiture rate depends on duration. In this method, the data available are subdivided by duration within three years and each cohort of the policies is assumed to have the same "run-off" pattern by policy duration. Based on the assumptions mentioned, for a given cohort:

Let $Y_E(t)$ = the expected sums insured forfeited in year t
$Y_A(t)$ = the actual sums insured forfeited in year t
NSI_t = the new business of life insurance by sums insured written in year t
k_0 = the proportion of the original new entrants exiting in the calendar year of entry (CY_0)
k_1 = the proportion of the original new entrants in CY_0 exiting in the following calendar year (CY_1)
k_2 = the proportion of the original new entrants in CY_0 exiting in the second following calendar year (CY_2)
k_3 = the proportion of the original new entrants in CY_0 exiting in the third following calendar year (CY_3)

where CY_0 is the calendar year of entry, and CY_1, CY_2 and CY_3 represent the immediately following calendar years so that $CY_3 = CY_2+1 = CY_1+2 = CY_0+3$.

Therefore, the expected sums insured forfeited in year t can be computed as shown below:

$$\boxed{Y_E(t) = NSI_t{*}(k_0) + NSI_{t-1}{*}(k_1) + NSI_{t-2}{*}(k_2) + NSI_{t-3}{*}(k_3)}$$

Meanwhile, the actual sums insured forfeited in year t [$Y_A(t)$] is obtained from the insurance annual report.

For example, the expected sums insured forfeited in 1999 can be computed as shown below:

$$\boxed{Y_E(99) = NSI_{99}{*}(k_0) + NSI_{98}{*}(k_1) + NSI_{97}{*}(k_2) + NSI_{96}{*}(k_3)}$$

Meanwhile, the actual sums insured forfeited in 1999 [$Y_A(99)$] is RM13,634.3 million, obtained from the insurance annual report.

A total of 31 equations relating the expected sums insured forfeited (Y_E) and the actual sums insured forfeited (Y_A) can be formulated based on the data available for years 1970 through to 2000. The four k-factors are then estimated using the ordinary least squares (OLS) regression analysis to obtain the best estimates for k_0, k_1, k_2 and k_3.

Having estimated the k-factors, then the forfeiture rates can be computed using the formulae shown below by assuming further that the mortality rate is of trivial importance in this respect:

$$
\begin{aligned}
{}_{\frac{1}{2}}q_0^{\,w} &= k_0 \\
q_{\frac{1}{2}}^{\,w} &= k_1 / (1-k_0) \\
q_{1\frac{1}{2}}^{\,w} &= k_2 / (1-k_0-k_1) \\
{}_{\frac{1}{2}}q_{1\frac{1}{2}}^{\,w} &= k_3 / (1-k_0-k_1-k_2)
\end{aligned}
$$

The regression analysis does not produce sensible results as the estimated coefficients of k_0 and k_3 are negative in values. Therefore, a further analysis was conducted by excluding both of the variables that have negative coefficients from the equation but the results obtained, again, were unsatisfactory.

A key assumption made here is that the k_i factors do not change over time. However, the poor results suggest that this assumption could be relaxed and the k_i factors can be considered to have time dependence. Thus, the modifications to the k-factors according to calendar year have been made in order to cater for the temporal changes in the forfeiture rates. The expected sums insured forfeited (Y_E) and the actual sums insured forfeited (Y_A) were divided into four separate batches rolling over the period 1970 through to 2000. The division was made based on the lapse patterns of the forfeiture rates computed using MFR2 in sub-section 4.2.1. The first batch of nine covered the period 1970-1978, having the forfeiture rates around 10.0% to 15.4%. The second batch has six observations covering the period 1979-1984 with the forfeiture rates between 7.6% and 9.2%. The third batch covered a period of three years from 1985 to 1987 with the forfeiture rates in the range of 11.4% and 16.2%. The fourth batch consisted of 13 observations for the period 1988-2000 with the forfeiture rates varied around 3.4% to 7.2%.

These four batches were subject to the same process mentioned earlier in order to obtain the best estimates for k_0, k_1, k_2 and k_3. However, the regression results, again, did not produce sensible results. The estimated coefficients of k_1 and k_3 in batch-1, the estimated coefficients of k_0 and k_2 in batch-2 and the estimated coefficients of k_0 and k_3 in batch-4 are negative in values. A further analysis by excluding the variables with negative coefficients from the equations also did not produce satisfactory results. For batch-3, we would expect a problem because there are four parameters with only three data points.

This methodology has failed to produce sensible estimates for the four k-factors (i.e. k_0, k_1, k_2 and k_3) and has been abandoned. (Full details are available from the author but are not presented here to save space.)

4.2.3 Dependent on Calendar Year – Revisited

Under the second method recommended by Dr Puzey, assumptions are made that the forfeiture rate is independent of duration since the policies were issued but is dependent on calendar year and that all of the policies are issued midway through the year.

Based on the assumptions made above, the sums insured forfeited in year t [Y(t)] is defined as:

$$Y(t) = NSI_t*[1-P_t] + NSI_{t-1}*[P_{t-1}]*[1-(P_t)^2] + NSI_{t-2}*[P_{t-2}]*[P_{t-1}]^2*[1-(P_t)^2] + NSI_{t-3}*[P_{t-3}]*[P_{t-2}]^2*[P_{t-1}]^2*[1-P_t]$$

where

$Y(t)$ = the sums insured forfeited in year t
P_t = the probability of surviving half a year in year t
NSI_t = the new business of life insurance by sums insured written in year t

For example, the sums insured forfeited in 1970 can be computed as shown below:

$$Y(70) = NSI_{70}*[1-P_{70}] + NSI_{69}*[P_{69}]*[1-(P_{70})^2] + NSI_{68}*[P_{68}]*[P_{69}]^2*[1-(P_{70})^2] + NSI_{67}*[P_{67}]*[P_{68}]^2*[P_{69}]^2*[1-P_{70}]$$

A total of 31 equations can be formed based on the data available for years 1970 through to 2000. Then the next task is to compute the probabilities of surviving half a year (P_t). To start off computing the probability of surviving half a year in 1970 (P_{70}), an assumption is made by setting $P_{70}=P_{69}=P_{68}=P_{67}$ so that there is only one unknown in the above equation. Once P_{70} is obtained, the probability of surviving half a year in 1971 (P_{71}) can be calculated by assuming $P_{70}=P_{69}=P_{68}$. Then the probability of surviving half a year in 1972 (P_{72}) can be calculated by using P_{71} and by assuming $P_{70}=P_{69}$. For the probability of surviving half a year in 1973 (P_{73}), it can be calculated by using P_{72}, P_{71}, and P_{70}. The similar process is repeated for the rest of the probabilities of surviving half a year right up to 2000. This can be done by making repeated use of the goal seek facility in the Excel spreadsheet software.

Having all the probabilities of surviving half a year calculated, then the forfeiture rates can be obtained. The annual forfeiture rate in year t can be computed as shown below:

$$\boxed{q_t^w = 1-(P_t)^2}$$

Therefore, the annual forfeiture rate in year 1970 is $q_{70}^w=1-(P_{70})^2$ and so on.

This method of computing the forfeiture rate is denoted MFR3. The formula of MFR3 produces the forfeiture rates that are much smaller than those computed using MFR1. Similar to the forfeiture rates computed using MFR2, the forfeiture rates computed using MFR3 are on average 0.4 times smaller than those computed using MFR1. A comparison of the forfeiture rates computed using MFR3 with those computed using MFR2 shows that they are quite similar in values but the forfeiture rates computed using MFR3 are always slightly greater than the forfeiture rates computed using MFR2 by an absolute amount that varies between 0.2% and 2.0%.

4.3 Comparing the Forfeiture Rates Computed Using Different Methods

The three forfeiture rates computed using MFR1, MFR2 and MFR3 for years 1970 through to 2000 are displayed in Figure 4.1 for comparison. In general, the forfeiture rates computed using MFR1 are the highest. Meanwhile, the forfeiture rates computed using MFR2 and MFR3 are much lower as compared with those computed using MFR1.

Further, a close inspection at Figure 4.1 reveals that the three forfeiture rates depict a similar pattern throughout 1970-2000. The forfeiture rates improve steadily until 1973, but there is a sharp rise in 1974. During 1975-1981, the forfeiture rates fluctuate from year to year but in general they follow a declining trend. After 1981, the forfeiture rates rise gradually until 1985. Then this is followed by a sharp rise in 1986. After that the rates drop dramatically through 1986 to 1989. The forfeiture rates are quite stable and fluctuate marginally during 1989 to 1997. However, the rates rise slightly in 1998. After that the rates fall in the following two years.

In this thesis, four types of lapse rate are examined in the two major studies on lapsation of life insurance. The lapse studies of Malaysia investigate three types of forfeiture rate using different computation methods, namely MFR1, MFR2 and MFR3, and the surrender rate (refer to Eq4.2). As such, two sets of comparison can be made on the findings of the lapse models using the forfeiture rate and the surrender rate, and on the findings of the lapse models of the forfeiture rate using three different computation methods. On the other hand, the comparative study between Malaysia and the US only examines the surrender rate (refer to Eq4.2) so that a comparison can be made on the findings between the two countries.

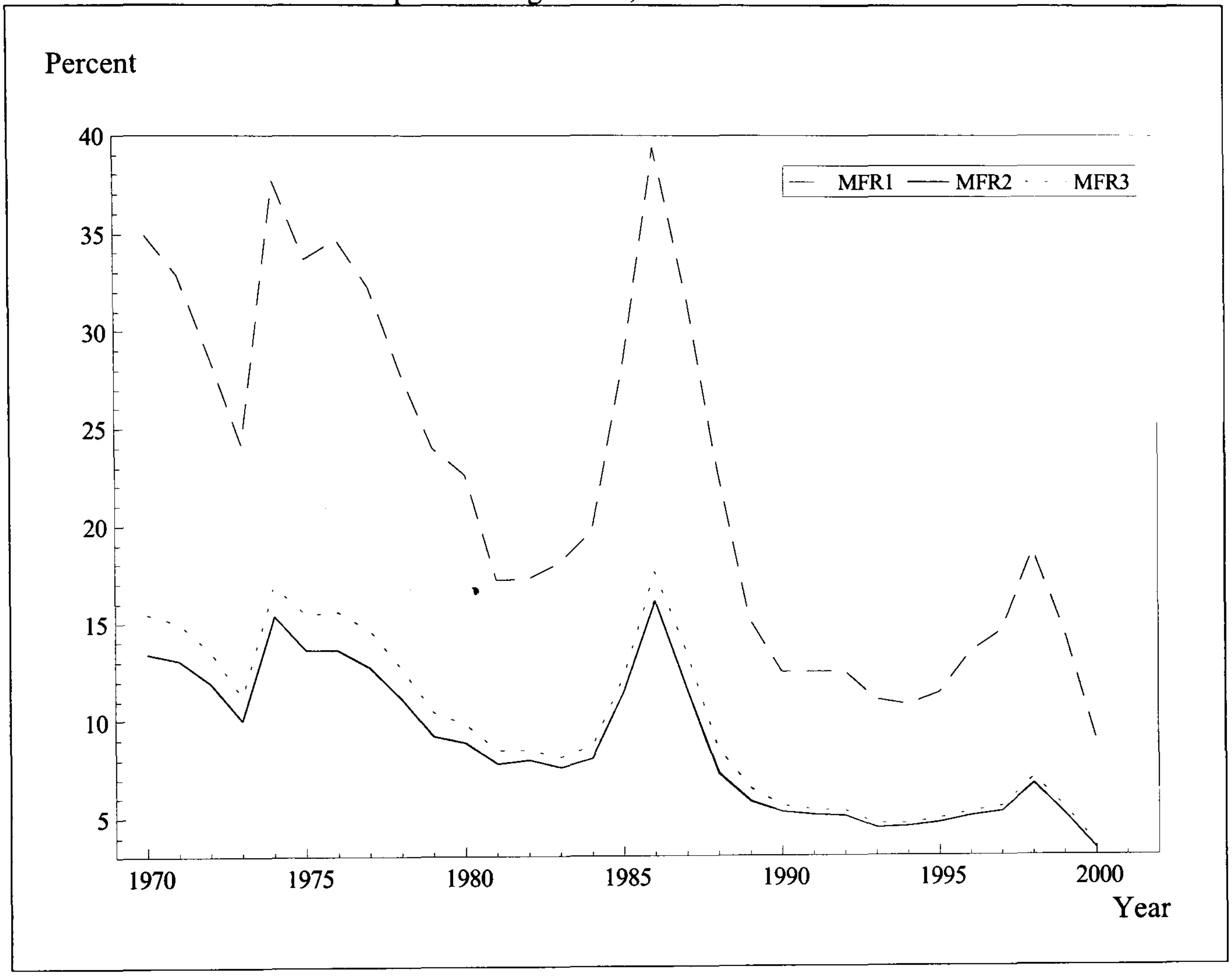
APPENDIX CHAPTER 4

Table 4.1
The Developments of the Various Methods Used to Report the Lapses and Terminations in the Insurance Annual Report since 1963

1963
• The forfeiture rate is defined as the ratio of the forfeitures for the year (by amount and by premium) to the new policies issued for the year. • Statistics available for 1963 and 1964.
1966
• The forfeiture rate is redefined as the percentage of the sums insured forfeited in a year to the mean value of the new sums insured in respect of whole life and endowment policies written in that year and the preceding year. • Statistics available for 1964-1993.
1978
• The surrender rate is first introduced and is defined as the percentage of the total sums insured terminated through surrenders during the year to the total sums insured in force at the beginning of the year. • Statistics available since 1970.
1984
• A table showing terminations by sums insured (in absolute value and as a percentage of the total sums insured terminated) for the various causes, namely, death, maturity, surrender, forfeiture and others, is included. • Statistics available since 1974. • Later, terminations in percent of change relative to the previous termination are also made available. • Statistics available since 1994.
1990
• The forfeiture rate by policy year with respect to policies issued in a given year is introduced and is defined as the aggregate of the forfeiture rates for the first three policy years. • Statistics available since 1986.
1995
• The weighted forfeiture rate is introduced to replace the forfeiture rate in use since 1966. It is defined as the percentage of the premiums forfeited to new business premiums in respect of policies written in the last three years with the weights of 20%, 56% and 24% for the new business premiums for the latest year, the immediately preceding year and the second immediately preceding year respectively. • Statistics available since 1990.
1999
• Another table is added to show the terminations by premiums (in absolute value, in percent of change relative to the previous termination and as a percentage of the total premiums terminated) for the various causes, namely, death, maturity, surrender, forfeiture and others. • Statistics available since 1994.

Source: Annual Report of the Insurance Commissioner, 1963-1969 and Annual Report of the Director General of Insurance, 1970-2000.

Figure 4.1
The Forfeiture Rates Computed Using MFR1, MFR2 and MFR3 for the Period 1970–2000



CHAPTER 5
DATA

All of the data needed for this thesis are secondary in nature. There are two major data sets in this thesis: the Malaysian data set and the data set of the United States (US). Both the Malaysian and US data sets contain annual aggregate data. Broadly speaking, the data in this thesis can be classified into three different categories, namely insurance, macroeconomic and demographic data.

5.1 Malaysian Data Set

5.1.1 Sample Size

In general, the annual aggregate data cover the period from 1969 to 2001. However, the data for certain variables have a slightly shorter period such as from 1972 to 2000.

5.1.2 Insurance Data

For the insurance data related to the demand for and lapsation of life insurance, they are obtained from the following two insurance annual reports: (a) the Annual Report of the Insurance Commissioner, 1963-1969 and (b) the Annual Report of the Director General of Insurance, 1970-2001.

The insurance data collected for this study are subject to the availability of data in the insurance annual report. The data are industry-wide data for combined life insurance business (i.e. ordinary life and home service businesses). The data collected are as follows: (a) new life insurance business by number, by amount and by premium – i.e. the number of new policies (data available for 1970-2001), new sums insured (data available for 1963-2001) and new annual premium (data available for 1963-2001), (b) life insurance business in force as on 31 December by number, by amount and by premium – i.e. the number of policies in force as on 31 December (data available for 1970-2001), sums insured in force as on 31 December (data available for 1962-2001) and annual premium in force as on 31 December (data available for 1962-2001), (c) life insurance business that lapsed by amount – i.e. sums insured forfeited (data available for 1974-2000) and sums insured surrendered (data available for 1974-2001) and (d) the lapse rates – i.e. the forfeiture rate (data available for 1964-1993) and the surrender rate (data available for 1970-2001).

5.1.3 Macroeconomic Data

For macroeconomic data, the data are obtained from various sources.

Gross Domestic Product (GDP). The data on GDP at market price (for data 1969-2001) are obtained from the Economic Report (ER) 1975/76–2001/02. The data reported in ER since 1978/79 are based on the new system of national accounts (for data 1972-2001) but the data reported in ER prior to 1978/79 are based on the old system of national accounts (for data 1969-1971). The data for 2001 is an estimate by the Ministry of Finance.

The GDP at market price is used instead of the GDP at constant price due to the lack of availability for the constant price data. Even though the GDP at constant price is presumed to be a better income proxy because it is free of the effects of inflation but the annual data available for the GDP at constant price are very limited. The annual data for the GDP at constant prices 1978 and 1987 are only available for 1980-1998 and 1988-2001 respectively.

Stock Market Index. Two types of stock market index are collected for this study. They are the Industrial Index (II) and the Kuala Lumpur Stock Exchange Composite Index (KLSE CI).

The KLSE CI (i.e. equivalent to the FTSE index in the United Kingdom) is generally accepted as the local stock market barometer. It was introduced in 1986 after it was found that there was a need for a stock market index that would serve as an accurate indicator of the performance of the Malaysian stock market and the economy. The index is computed based on a sample of stocks derived using a weighted average method. The component companies selected to compose the index are blue-chip companies from the various sectors in the main board. In 1995, the number of component companies was increased to 100 and has been limited to this number although the actual component companies may change from time to time.

As KLSE CI was introduced in 1986 and the data have been made available by the Kuala Lumpur Stock Exchange dated back to 1977 only, the II is used in place in the absence of KLSE CI in order to formulate a complete data set (for data 1969-2001). The II is one of the three stock market indices that has been followed widely by the investors before the introduction of KLSE CI and this index is supplied by the local stock exchange. The other two popular indices are the New Straits Times (NST) Industrial Index and the OCBC Composite Index. These indices are provided by NST and OCBC respectively. The II includes only the industrial sectors in its computation. Therefore, the tin/mining, rubber/plantation, property and finance sectors of the economy are not represented. The index is a weighted average with the weights being the number of ordinary shares issued. It is admitted that II is not an accurate barometer to reflect the overall performance of the stock market since the index represents only one sector of the economy. Nevertheless, the II has been a reasonable yardstick for the performance of the Malaysian stock market in general before the introduction of KLSE CI.

The data on II are obtained from the Stock Exchange of Malaysia and Singapore Gazette January 1969 – January 1971 (for data 1969-1970) and the Kuala Lumpur Stock Exchange Gazette March 1974 – January 1979 (for data 1971-1977). Meanwhile, the data on KLSE CI are obtained from the Kuala Lumpur Stock Exchange Index (1986) (for data 1977-1985) and the Investors Digest January 1987 – January 2002 (for data 1986-2001).

All of the data on II are the indices recorded on the last trading day in the year except for the data for 1969, 1971 and 1972. Efforts have been taken to ensure the consistency of the data. In the case when the index on the last trading day in the year is not available, a substitution is made using the index on the last Friday of December. If both the indices on the last trading day in the year and on the last Friday of December are not available, a computation is made to obtain a reasonable proxy for the missing data. Based on the above explanation, the data for 1969 is computed by averaging the indices at the end of November 1969 (using the index on the last trading day of the month) and at the end of January 1970 (using the index on the last Friday of the month), while the data for 1971 and 1972 are the indices on the last Friday of December. Likewise, all of the data on KLSE CI are the indices recorded on the last trading day in the year.

Monetary Aggregates. The main source for the data on monetary aggregates, M1 and M2, is the Monthly Statistical Bulletin (MSB) January 2002 – May 2002 published by the central bank of Malaysia (i.e. Bank Negara Malaysia or BNM in short) (for data 1969-2001).

According to the Glossary in MSB June 2001, M1 refers to narrow money supply. It comprises the currency in circulation and demand deposits. The currency in circulation refers to the notes and coins issued by BNM less the amount held by the commercial banks. Demand deposits refer specifically to the demand deposits held by the non-bank private sector in the commercial banks. Meanwhile, M2 refers to the private sector liquidity. It comprises M1 plus narrow quasi-money of the private sector (M2–M1). The narrow quasi-money of private sector (M2–M1) is defined to comprise the savings and fixed deposits of the private sector placed with BNM and the commercial banks (excluding Islamic Bank), the holdings of deposit certificates such as the negotiable certificates of deposit and the central bank certificates, and the foreign currency deposits. The definitions for the above can be summarised as follows:

M1	=	Currency in Circulation + Demand Deposits
M2	=	M1 + Narrow Quasi-Money of Private Sector
	=	M1 + Savings Deposits + Fixed Deposits + NIDs + Repos + Foreign Currency Deposits

Commonly Defined Unemployment Rate. The data on unemployment rate are obtained from ER 1981/82–2001/02. Only data starting from 1976 are available in ER for this rate. Therefore, the data for 1976-2001 are collected. The unemployment rate is the proportion of the number of unemployed persons to all working age groups of both sexes for all ethnic groups. The working population are those persons aged 15-64 years. The unemployed comprise both actively and inactively unemployed persons. The definition for the unemployment of Malaysia is different from the international standard definition recommended by the International Labour Organisation (ILO) (http://laborsta.ilo.org). The main difference being the treatment of those who are inactively unemployed[1]. Because of the use of a slightly different definition for the unemployment of Malaysia from that of the US (in which it is a standard ILO definition – refer to sub-section 5.2.3), it may introduce some biases or distortions to the results of the comparative study between the two countries.

Registered Unemployment Rate. Because only a short series of data on the commonly defined unemployment rate being available (i.e. the data are only available for 1976-2001), an alternative data set is explored. The data on unemployed registrants and labour force are collected for the purpose of computing the registered unemployment rate. The rate can be computed by dividing the number of unemployed registrants by the mean labour force, as shown below:

$$\text{Registered Unemployment Rate} = \frac{\text{The Number of Unemployed Registrants}}{\text{Mean Labour Force}}$$

The data on the number of unemployed registrants are obtained from ER 1976/77–2001/02. The data are available for 1969-2001. The unemployed registrants refer to the applicants for work on the job registers of the Employment Service of Malaysia at the

[1] The inactively unemployed include all persons aged 15 to 64 who fall into the following categories: (a) those not looking for work because they believed no work was available, or if available, they were not qualified, (b) those who would have looked for work if they had not been temporarily ill or in confinement, or had it not been due to bad weather, (c) those waiting for answers to their job applications and those who have looked for work prior to the reference week and (d) those without a job and currently available for work who had made arrangements to start a new job.

end of the year. These registrants consist of jobseekers who are wholly unemployed as well as those who are employed but seeking a change of job, those who are self-employed or family workers.

The data on labour force are also obtained from ER 1979/80–2001/02. Only annual data from 1970 onwards are available in ER. Therefore, the data are collected for the period 1970-2001. The labour force refers to the total number of population in the working age of 15 to 64 years.

Savings and Fixed Deposits Rates. Both the data on savings and fixed deposits rates (for data 1969-2001) are obtained from MSB April 1997 – May 2002. Various formats have been adopted for reporting interest rates in MSB. Prior to 23 October, 1978, MSB reported the interest rates when there were changes in the interest rates being made and announced by the central bank from time to time to become effective at a specific date. This is because, prior to 23 October 1978, the interest rates of the financial institutions in Malaysia were regulated by the central bank and both the interest rates on savings and fixed deposits of the commercial banks were fixed by the central bank. Since 23 October 1978, when the financial institutions were free to quote their interest rates, the commercial banks became free to quote their interest rates payable on savings and fixed deposits. Since then, MSB has reported the interest rates in three different ways in terms of the lowest, the highest, and the most frequently (i.e. mode) quoted rates. The data on these types of interest rate are available throughout 1979-1997. Later, starting from January 1998, there has been a change in the way the data on interest rates were reported. The interest rates reported are the rates that reflect the average maturity of the deposits. These kinds of data are available for 1980-2001. Further, from January 2002 onwards, the reporting on the fixed deposit rates of commercial banks has been revised. This new data set is available dated back to August 2000. The new fixed deposit rates refer to the quoted rates for that particular maturity alone.

Due to the existence of various formats in reporting the interest rates for savings and fixed deposits, the data have to be combined in order to form a complete data set for further analysis in such a way that (a) for the data prior to 1979, a computation is made to obtain a representative rate which reflects the duration the various interest rates have been effective throughout the year – e.g. if two different interest rates are in effect in a year: 4% from 1 January to 30 April and 5% from 1 May to 31 December, a representative rate is calculated proportionately to the period these two rates have been in effect, that is (4%*120/365)+(5%*245/365)=4.67%, (b) for the data 1979, the most frequently (i.e. mode) quoted rate is taken and (c) for the data 1980-2001, the rates which reflect the average maturity of the deposits are taken.

Average Discount Rate on Treasury Bills. The data on the average discount rates on the three-month and 12-month treasury bills (for data 1969-2001) are also obtained from MSB January 1974 – May 2002. Different formats have been used in reporting the discount rates on treasury bills in MSB. For the data prior to August 1973, MSB reported the rates when there were changes in the rate that became effective at a specific date. Later, the data on the average discount rates on monthly (from August 1973) and yearly (from 1980) basis are also made available in MSB.

In forming a complete data set for analysis, a computation is made for the data prior to 1974 in order to obtain a representative rate that reflects the duration for which the various discount rates have been in effect throughout the year. In the same manner, this method is applied to compute a representative rate for the savings and fixed deposits rates for the data prior to 1979.

Inflation Rate. The data on the inflation rate (for data 1969-2001) are obtained directly from the Table of Consumer Price Index in MSB November 1984 – May 2002. The inflation rate is the percentage change in the consumer price indices (CPIs). The annual inflation rates reported in MSB are computed in (an unusual way) using the average CPIs in which the indices are a simple average of 12 monthly CPIs from January to December but not the end-of-year CPIs (i.e. the CPIs at the end of December) that are normally used in the computation of annual inflation rates.

At the beginning of this study, it was decided to use the readily available average inflation rates because a full data set (for data 1969-2001) on the preferred inflation rates could not be computed using the end-of-year CPIs since there are too many missing data of the CPIs at the end of December (i.e. there are six missing data for 1971, 1972, 1973, 1991, 1994 and 2000). Later, an effort has been made to approach the central bank and the Department of Statistics to explore the possibilities in obtaining the missing (unpublished) end-of-year CPIs. In response to this request for data, the central bank has been very kind to provide the missing data even though this happened at a much later stage of this study.

5.1.4 Demographic Data

Other than the macroeconomic factors mentioned above, a number of demographic factors such as the crude live-birth rate, crude death rate, total fertility rate, and life expectancy are included in this study. The data collection for the demographic data was problematic as the data are incomplete from one source and have to be combined with the data from other sources where some adjustments have to be made in order to maintain the consistency of the data set.

Crude Live-Birth Rate. For the data on crude live-birth rate, various sources such as the Demographic Yearbook (DY), Vital Statistics (VS) and Yearbook of Statistics (YoS) have been examined in order to explore the possibilities of getting a set of consistent data. After careful consideration, the data in DY are adopted. The related data on crude live-birth rate are available for 1961-1998 from DY 1975-1999. While the crude live-birth rates for 1991-1998 are readily available in DY 1995-1999, the rates prior to 1991 (for data 1961-1990) are computed using the supplementary data such as the number of live births and mid-year population contained in DY (i.e. in DY 1975-1994 and DY 1970-1999 respectively). As the crude live-birth rate is defined as the annual number of live births per 1,000 mid-year population, the rate can be computed based on the formula below:

$$\text{Crude Live-birth Rate} = \frac{\text{Annual Number of Live Births}}{\text{Mid-Year Population}} \text{ X } 1000$$

The data for 1999-2001 are obtained from YoS 2001. The data reported in YoS are adjusted upward (see below for an explanation) in order to combine with the data obtained from DY to make a complete data set for further analysis. The author has used YoS 2001 (published in the same year) for data because (at the time when the author collected the data during June-September, 2001) the latest versions of DY 1999 and VS 2000 published in 2001 merely have both the data on the number of live births and crude live-birth rate reported up to 1998 and 2000 respectively. Further, there is a need to adjust the crude live-birth rates reported in YoS because the rates reported in YoS tend to appear slightly lower than those reported in DY. A decision has been made to use the ratio of 25.0 to 23.7 to adjust the crude live-birth rates for 1999-2001 reported in YoS 2001 based on the rates for 1998 reported in DY 1999 and YoS 2001 which are 25.0 and 23.7 per 1,000 mid-year population respectively.

Crude Death Rate. The crude death rate is defined as the annual number of deaths per 1,000 mid-year population. Similar to the manner in obtaining the data on crude live-birth rate, the yearbooks of DY, VS and YoS have been explored in order to identify a set of consistent data for crude death rates. A decision has been made to utilise the data reported in VS where the most data points are available. The data on crude death rate are available for 1957-2000 in VS 1974-2000. Since the latest publication of VS (for year 2000 published in 2001 – as at the time when the author collected the data) provides the data on the crude death rate up to the year 2000 only, an assumption is made to derive the rate for 2001. The crude death rate for 2001 is assumed to remain the same as for 2000 based on the trends of the rates for 1999-2000 reported in VS 2000 and the rates for 1999-2001 reported in YoS 2001. As the rates reported in YoS remain the same at 4.4 per 1,000 mid-year population for three years in a row (i.e. 1999-2001) and the rates reported in VS also stay at the same level of 4.6 per 1,000 mid-year population for the two consecutive years (i.e. 1999-2000), hence, the crude death rate for 2001 to be appeared in VS is assumed to remain constant as the previous year at 4.6 per 1,000 mid-year population.

Total Fertility Rate. Considerable efforts have been made in trying to gather the data on total fertility rate. Various sources have been looked into in order to gather a complete data set for this variable. The Malaysian reports such as the VS and Social Statistics Bulletin (SSB) have limited reporting on this rate. The data are not made available in the reports continuously every year, so there are a lot of missing data. Moreover, the data in the 1960s and 1970s are extremely limited. Due to this limitation, the rates reported in DY are adopted for this study because this source has the most data available except for having data missing for 1985, 1994, and 1999-2001.

The data on the total fertility rate for 1970-84, 1987-88, 1990-93, and 1995-98 are obtained directly from DY 1975-1999. The data for 1969, 1986 and 1989 are calculated using the supplementary data on the live-birth rates specific for age of mother reported in DY 1975 and 1992. The live-birth rate specific for age of mother refers to the annual number of live births for each age group of mother per 1,000 female population in the same age group. The age groups of mother are classified in a range of five years covering the female population aged 15-49 years (i.e. 15-19, 20-24, 25-29, 30-34, 35-39, 40-44, and 45-49). As the total fertility rate is defined as the sum of age-specific fertility rates per woman over the reproductive age range (i.e. aged 15 to 49 years), the total fertility rate can be computed using the supplementary data as follows:

Total Fertility Rate	=	The Sum for All Age Groups of Live-Birth Rates Specific for Age of Mother * 5 / 1000

For the missing data for 1985, 1994, and 1999-2001, the gaps are filled by obtaining the data from either VS 1985 and 2000 (for data 1985, 1994 and 1999-2000) or SSB 2001 (for data 2001), depending on the availability of the data in the reports.

Life Expectancy. The data collection of these variables encountered the same problems faced in connection with the total fertility rate. At the initial stage, the DY of United Nations is explored to obtain the life expectancy for males and females at the ages of zero (i.e. at birth), five, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, and 80. Only the data for 1965-1998 are available but there are a lot of missing data within the period mentioned. Even the two best data series (in terms of having the most data points available), namely the life expectancy at birth and at age 65, have as many as seven data missing within the period 1965-1998 (i.e. the data for 1967, 1968, 1973, 1980-82 and 1993 are not available).

Later, the Malaysian reports such as the VS, YoS and ER have been investigated for these data. In general, the reports, except for ER, do not provide these data in every annual published volume. Furthermore, the data in the 1960s and 1970s are extremely limited. After careful consideration, the data on the life expectancy reported in ER are adopted. The data reported are the life expectancy at birth for males and females. Since the first and the latest volume of ER were published in 1972 and 2001 respectively, only the data for 1970 and 1972-2000 are available in ER 1978/79–2001/02. The data for 1969 and 1971 are obtained from DY 1973-1974. The data for 2001 are provisional and are obtained from YoS 2001.

Mid-Year National Population. The data on mid-year population are collected to enable the computations of the missing data on crude live-birth rate. The data on mid-year population for the period 1969-1999 are obtained from DY 1978-1999. As the latest edition of DY (for year 1999 published in 2001 – as at the time when the author collected the data) merely has the estimates reported up to the year 1999, the data for the period 2000-2001 are obtained from YoS 2001. The data on mid-year population are the official estimates of the population on 1 July, or an average of the end-of-year estimates.

A summary table listing the types of the data collected and the availability of the data together with their sources for the Malaysian data is displayed in Table 5.1.

5.2 US Data Set

5.2.1 Sample Size

In general, the annual aggregate data collected cover the period from 1969 to 2001. However, some data have a slightly shorter series such as from 1970 to 2000 except for the data on new life insurance business (by number) that have substantially shorter series from 1980 to 2001.

5.2.2 Insurance Data

The main source for the insurance data related to life insurance demand and lapse rates is the Life Insurers Fact Book published by the American Council of Life Insurance (ACLI).

The data on life insurance business in force are available by number and by amount for each of the three types of life policy: the individual, group and credit policies. Continuous data are available from 1970 to 2001. The data are obtained from the Life Insurers Fact Book 2001 (for data 1970 and 1975-2001) and 2002 (for data 1971-1974).

The data on new life insurance business by number are available for two types of life policy: the individual and group policies. Their data series are short. Continuous data are only available for 1980-2001. All of them are obtained from the Life Insurers Fact Book 2002.

The data on aggregate surrender values for life policies comprising the individual and group policies are reported in the Life Insurers Fact Book. Continuous data are available from 1965 to 2001. The data are taken from the Life Insurers Fact Book 2002.

5.2.3 Macroeconomic Data

The data related to macroeconomic factors are obtained from various resources. The online databases have been explored to obtain the data needed for this study. They comprise the websites of the following organisations: (a) the Bureau of Economic Analysis (BEA) of the US Department of Commerce, (b) the Bureau of Labour Statistics (BLS) of the US Department of Labour, (c) EconStats and (d) the Federal Reserve (i.e. the central bank of the US). Further, the database of Datastream also has been explored to obtain the US related stock market indices.

GDP. The data on GDP at market value are obtained from the website of BEA at http://www.bea.doc.gov/bea/dn/nipaweb/TableViewFixed.asp#Mid (last revised on 25 April 2003). The data from 1929 to 2002 are available.

Income Per Capita. The data on income per capita are also obtained from the website of BEA at http://www.bea.doc.gov/bea/regional/reis/drill.cfm (last revised on May 2003). It is the amount of income defined as the GDP at market price divided by the number of mid-year population. Annual data from 1969 to 2000 are available.

Stock Market Index. The data on Dow Jones Industrial Average (DJIA) index are collected for this study. The DJIA index is the most commonly used indicator of the US stock market performance. The DJIA index is computed based on the prices of 30 major US companies. The DJIA indices are extracted from the database of Datastream. They are the indices recorded on the last trading day in the year. The data on DJIA index are available from 1951 to 2002.

Monetary Aggregates. The data on monetary aggregates of M1 and M2 are obtained from the official website of the central bank (i.e. Federal Reserve). The data on M1 and M2 are obtained from http://research.stlouisfed.org/fred/data/monetary/m1ns and http://research.stlouisfed.org/fred/data/monetary/m2ns respectively. Both the data on M1 and M2 are available for 1959-2002.

According to http://www.federalreserve.gov/releases/h6/about.htm (last updated on 29 July 2002), M1 is the most narrowly defined measure of money stock and M2 is a more inclusive measure of money stock than M1 where M1 is included in M2. M1 consists of the most liquid forms of money: currency and checkable deposits. The non-M1 components of M2 are mainly household holdings of savings deposits, time deposits and retail money market mutual funds.

Unemployment Rate. The data on unemployment rate reported in the website of BLS at http://data.bls.gov/servlet/SurveyOutputServlet are obtained for analysis. Annual data since 1948 are available. The rate is calculated as the ratio of the number of unemployed to the labour force. The unemployment definition of the US is similar to the recommended standard definition of the ILO (but variations are allowed with regard to the age limit and reference period that arise from country-specific differences) (http://laborsta.ilo.org). The unemployed persons are those who had no employment during the reference week, were available for work (except for temporarily illness) and had made specific efforts to find employment some time during the previous reference week. Labour force comprised all persons in the working ages of 16 years and over (either employed or unemployed) in the civilian non-institutional population.

Yield on Treasury. The data collected are the US Treasury one-year yield. The data are obtained from the website of EconStats at http://www.econstats.com/r_aa2.htm (last updated on 21 April 2003). The data are available for 1962-2003.

The website mentioned above also has the US Treasury with maturity of different lengths but some of them have a very short data series: three-month (data available for 1982-2003), six-month (data available for 1982-2003), two-year (data available for 1976-2003), three-year (data available for 1962-2003), five-year (data available for 1962-2003), seven-year (data available for 1969-2003), 10-year (data available for 1962-2003), 20-year (data available for 1962-1986 and 1993-2003) and 30-year (data available for 1977-2003).

CPI. In the US, the CPIs are available for two population groups, namely for all of the urban consumers and for the urban wage earners and clerical workers, in which the latter population group is a subset of the former population group. The index for the former group is called the CPI for All Urban Consumers (denoted CPI-U) and it covers approximately 87% of the total population. The index for the latter group is called the CPI for Urban Wage Earners and Clerical Workers (denoted CPI-W) and it covers about 32% of the total population. Since CPI-U has a wider coverage of the population than CPI-W, the CPIs collected for the US study are the end-of-year CPI-U with the base period 1982-84. It is the US City Average All Items index that accounts for the changes in prices of all goods and services purchased for consumption by urban households (http://www.bls.gov/cpi/cpiovrvw.htm). The data from 1914 to 2002 are available in the database of BLS at http://data.bls.gov/servlet/SurveyOutputServlet.

5.2.4 Demographic Data

The demographic data related to the crude live-birth rate and life expectancy at birth for males and for females are obtained from the online databases of the National Center for Health Statistics (NCHS) of the Centers for Disease Control and Prevention that published the National Vital Statistics Report. The national data on crude death rate and age-adjusted death rate are extracted from the online database of the Michigan Department of Community Health (MDCH) and Life Insurers Fact Book respectively. The national data on total fertility rate are taken from the database from the official website of the State of Utah.

Crude Live-Birth Rate. The data on crude live-birth rate are obtained from the website of NCHS. The data for 1960-2000 are retrieved from http://www.cdc.gov/nchs/fastats/pdf/nvsr50_05t1.pdf and the data for 2001 is retrieved from http://www.cdc.gov/nchs/data/nvsr/nvsr50/nvsr50_10.pdf.

Crude Death Rate. The national data are extracted from the mortality statistical tables from the website of MDCH at http://www.mdch.state.mi.us/pha/osr/deaths/USMIcrudedxrt.asp. Only data from 1970 to 2002 are available. The data for 2001 and 2002 are provisional.

Age-Adjusted Death Rate. The data on age-adjusted death rate are readily available and reported in the Life Insurers Fact Book. It is the annual number of deaths per 1,000 population that has been technically adjusted for the changing proportion of people at each age in the US population (by assuming a constant over time age structure). The age-adjusted death rate is a better proxy for the overall death rate in a population than the crude death rate as the former will not be confounded by a changing age structure. The data on the age-adjusted death rate (that based on the 1990 population estimates) are available from 1960 to 1998 and they are reported in the Life Insurers Fact Book 2001. There is no reporting on age-adjusted death rates in the Life Insurers Fact Book 2002. In the Life Insurers Fact Book 2003, although the age-adjusted death rates are reported, the rates have been revised and are different from those published previously. The revised age-adjusted death rates are based on the population estimates from the 2000 census. Continuous data for the revised age-adjusted death rates are available from 1985 to 2001. As the former has a longer data series than the latter, the former is used for analysis.

Total Fertility Rate. The national data on total fertility rate are obtained from the official website of the State of Utah. The data from 1917 are readily available at http://www.qget.state.ut.us/programs/td1.asp?database=TFR&TableType=T1.

Life Expectancy at Birth. Both the data on the life expectancy at birth for males and for females of all races (for the white, black and others) are obtained from the website of NCHS. The data from 1900 to 2001 are available. The data for 1900-1999 are taken from http://www.cdc.gov/nchs/fastats/pdf/nvsr50_06tb12.pdf. The data for 2000-2001 are taken http://www.cdc.gov/nchs/data/nvsr/nvsr51/nvsr51_05.pdf.

A similar summary table like the one for the Malaysian data is formulated for the US data showing the types of the data, their availability and the sources from which the data are collected is displayed in Table 5.2.

APPENDIX CHAPTER 5

Table 5.1
The Malaysian Data Set: Type, Availability and Source

Type	Availability	Source
The number of new policies	1970-2001	Annual Report of the Director of Insurance, 1980-2001
New sum insured	1969-2001	Annual Report of the Director of Insurance, 1975-2001
New annual premium	1969-2001	Annual Report of the Director of Insurance, 1975-2001
The number of policies in force	1970-2001	Annual Report of the Director of Insurance, 1980-2001
Sum insured in force	1969-2001	Annual Report of the Director of Insurance, 1975-2001
Annual premium in force	1969-2001	Annual Report of the Director of Insurance, 1975-2001
Sum insured forfeited	1974-2000	Annual Report of the Director of Insurance, 1984-2001
Sum insured surrendered	1974-2001	Annual Report of the Director of Insurance, 1984-2001
Forfeiture rate	1970-1973	Annual Report of the Director of Insurance, 1980-1983
Surrender rate	1970-1973	Annual Report of the Director of Insurance, 1980-1983
GDP at current market prices	1969-2001	Economic Report, 1975/76 – 2001/02
Industrial Index	1969-1970	Stock Exchange of Malaysia and Singapore Gazette, Jan 1969 – Jan 1971
	1971-1977	Kuala Lumpur Stock Exchange Gazette, Mar 1974 – Jan 1979
KLSE CI	1977-1985	Kuala Lumpur Stock Exchange Index, 1986
	1986-2001	Investors Digest, Jan 1987 – Jan 2002
M1	1969-2001	Monthly Statistical Bulletin, Jan 2002 – May 2002
M2	1969-2001	Monthly Statistical Bulletin, Jan 2002 – May 2002
Commonly defined unemployment rate	1976-2001	Economic Report, 1981/82 – 2001/02
Unemployed registrant	1969-2001	Economic Report, 1976/77 – 2001/02
Labour force	1970-2001	Economic Report, 1979/80 – 2001/02
Savings deposit rate	1969-2001	Monthly Statistical Bulletin, Apr 1997 – May 2002
Fixed deposit rate	1969-2001	Monthly Statistical Bulletin, Apr 1997 – May 2002
Average discount rate on three-month treasury bills	1969-2001	Monthly Statistical Bulletin, Jan 1974 – May 2002
Average discount rate on 12-month treasury bills	1969-2001	Monthly Statistical Bulletin, Jan 1974 – May 2002
Average inflation rate	1969-2001	Monthly Statistical Bulletin, Nov 1984 – May 2002
Crude live-birth rate	1969-1998	Demographic Yearbook, 1986-1999
	1999-2001	Yearbook of Statistics, 2001
Crude death rate	1969-2000	Vital Statistics, 1971-2000
	2001	The rate is derived based on assumption.
Total fertility rate	1969-1984, 1986-1993 & 1995-1998	Demographic Yearbook, 1975-1999
	1985, 1994 & 1999-2000	Vital Statistics, 1985 & 2000
	2001	Social Statistics Bulletin, 2001
Life expectancy at birth for males	1969 & 1971	Demographic Yearbook, 1973-1974
	1970 & 1972-2000	Economic Report, 1978/79 – 2001/02
	2001	Yearbook of Statistics, 2001
Life expectancy at birth for females	1969 & 1971	Demographic Yearbook, 1973-1974
	1970 & 1972-2000	Economic Report, 1978/79 – 2001/02
	2001	Yearbook of Statistics, 2001
Mid-year national population	1969-1999	Demographic Yearbook, 1978-1999
	2000-2001	Yearbook of Statistics, 2001

Table 5.2
The US Data Set: Type, Availability and Source

Type	Availability	Source
The number of new policies for individual life policies	1980-2001	Life Insurers Fact Book 2002
The number of new policies for group life policies	1980-2001	Life Insurers Fact Book 2002
The number of policies in force for individual life policies	1970, 1975-2001 1971-1974	Life Insurers Fact Book 2001 Life Insurers Fact Book 2002
The number of policies in force for group life policies	1970, 1975-2001 1971-1974	Life Insurers Fact Book 2001 Life Insurers Fact Book 2002
The number of policies in force for credit life policies	1970, 1975-2001 1971-1974	Life Insurers Fact Book 2001 Life Insurers Fact Book 2002
Sum insured in force for individual life policies	1970, 1975-2001 1971-1974	Life Insurers Fact Book 2001 Life Insurers Fact Book 2002
Sum insured in force for group life policies	1970, 1975-2001 1971-1974	Life Insurers Fact Book 2001 Life Insurers Fact Book 2002
Sum insured in force for credit life policies	1970, 1975-2001 1971-1974	Life Insurers Fact Book 2001 Life Insurers Fact Book 2002
Sum insured surrendered for individual and group life policies	1969-2001	Life Insurers Fact Book 2002
GDP at current market prices	1969-2001	http://www.bea.doc.gov/bea/dn/nipaweb/TableViewFixed.asp#Mid
Income per capita	1969-2000	http://www.bea.doc.gov/bea/regional/reis/drill.cfm
DJIA index	1969-2001	Datastream
M1	1969-2001	http://research.stlouisfed.org/fred/data/monetary/m1ns
M2	1969-2001	http://research.stlouisfed.org/fred/data/monetary/m2ns
Unemployment rate	1969-2001	http://data.bls.gov/servlet/SurveyOutputServlet
US Treasury one-year yield	1969-2001	http://www. econstats.com/r_aa2.htm
The end-of-year consumer price index for all urban consumers	1969-2001	http://data.bls.gov/servlet/SurveyOutputServlet
Crude live-birth rate	1969-2000 2001	http://www.cdc.gov/nchs/fastats/pdf/nvsr50_05t1.pdf http://www.cdc.gov/nchs/data/nvsr/nvsr50/nvsr50_10.pdf
Crude death rate	1970-2002	http://www.mdch.state.mi.us/pha/osr/deaths/USMIcrudedxrt.asp
Age-adjusted death rate (that based on 1990 population estimates)	1969-1998	Life Insurers Fact Book 2001
Age-adjusted death rate (that based on 2000 population estimates)	1985-2001	Life Insurers Fact Book 2003
Total fertility rate	1969-2002	http://www.qget.state.ut.us/programs/td1.asp?database=TFR&TableType=T1
Life expectancy at birth for males	1969-1999 2000-2001	http://www.cdc.gov/nchs/fastats/pdf/nvsr50_06tb12.pdf http://www.cdc.gov/nchs/data/nvsr/nvsr51/nvsr51_05.pdf
Life expectancy at birth for females	1969-1999 2000-2001	http://www.cdc.gov/nchs/fastats/pdf/nvsr50_06tb12.pdf http://www.cdc.gov/nchs/data/nvsr/nvsr51/nvsr51_05.pdf

CHAPTER 6
MODEL SPECIFICATION AND MEASUREMENT OF VARIABLES

In this thesis, the studies use two different data sets [i.e. one for Malaysia and another one for the United States (US)] to test the emergency fund hypothesis (EFH), interest rate hypothesis (IRH) and other relevant hypotheses on the demand for and lapsation of life insurance.

The publicly available insurance data are limited to annual observations. Therefore, the analysis may not provide a precise assessment of the policyholders' reaction towards very short-term changes in any of the explanatory variables. Ideally, non-annualised data such as monthly and quarterly data would be preferable as they could provide a much better measure of the policyholders' response towards current changes in the explanatory variables such as interest rates or other relevant factors. However, there is an advantage in using annual aggregate data because highly aggregated data can eliminate the monthly or seasonal anomalies that can affect the estimation.

6.1 Model Specification

6.1.1 The Demand for Life Insurance

Based on the demand studies in the literature (refer to section 2.2), this study is undertaken to examine the life insurance demand function which is derived from the maximisation of the utility function for the beneficiaries [i.e. based on the theoretical idea behind the studies of Lewis (1989), Truett and Truett (1990) and Browne and Kim (1993)] and that depends on the income stream, a vector of interest rates, inflation and the price of insurance. This study also examines the consumer's subjective discount function for the utility function with respect to consumption and wealth that are affected by the development of the financial market [i.e. based on the idea behind the study of Outreville (1996)] and the performance of the stock market (i.e. a new variable that has not been examined in the past). In addition to the above, some variables related to the demographic characteristics of the population [such as those that have been examined in the studies of Browne and Kim (1993) and Outreville (1996)] are also included in this study. Therefore, in this study, the demand for life insurance (denoted DEMAND) is modelled as a function of the following: (a) the factors that affect the consumers' ability to buy and the size of the potential market (denoted ABS), (b) the factors that affect the consumers' decisions on savings and the accumulation of financial assets (denoted DS), (c) the factors that affect the consumers' purchasing power in acquiring financial assets (denoted PPP) and (d) the demographic characteristics of the population (denoted DCP). The proposed model is shown below:

DEMAND = f (ABS, DS, PPP, DCP)

By using appropriate proxies for ABS, DS, PPP and DCP, the demand for life insurance can be analysed in terms of its relationship with the economic and demographic factors from a macro perspective. For ABS, income levels, stock market performance and the level of financial development are used as proxies. For DS, various types of interest rate offered by alternative investment products are used as proxies. For PPP, inflation and the price of insurance are used as proxies. For DCP, other than the life expectancy of the population that has been examined in past studies (Browne and Kim, 1993; Outreville, 1996), it is proposed that other demographic variables such as the crude live-birth rate, crude death rate and total fertility rate are also used as proxies. In summary, the proxies for ABS, DS, PPP and DCP are as shown below:

Category	Proxy
ABS	Income, stock market performance and the level of financial development
DS	Various types of interest rate offered by alternative investment products
PPP	Inflation and the price of insurance
DCP	Crude live-birth rate, crude death rate, total fertility rate and life expectancy

6.1.2 Lapsation of Life Insurance

Based on the lapse studies in the literature testing for the hypotheses of EFH and IRH (refer to section 3.2), this study is undertaken to test these two hypotheses in relation to the lapse experience of Malaysia and the US. Further, this study also aims to examine the relationship between inflation and lapsation of life insurance that has been investigated by Dar and Dodds (1989), Outreville (1990) and Russell (1997). In addition to inflation, the price of insurance that has been examined by Outreville (1990) is also included in this study. The two variables on inflation and price are used to test the relationship between the policyholders' behaviour towards the preservation of purchasing power and lapsation of life insurance. Further, we have also included some demographic variables at the macro level that have not been investigated by researchers in the past. Therefore, in this study, lapsation of life insurance (denoted LAPSE) is modelled as a function of the need for cash due to the liquidity constraints of policyholders – i.e. the emergency fund hypothesis (denoted EFH), the interest rate arbitrage – i.e. the interest rate hypothesis (denoted IRH), the preservation of purchasing power (denoted PPP) and the demographic characteristics of the population (denoted DCP). The model is as projected below:

LAPSE = f (EFH, IRH, PPP, DCP)

The relationship between lapsation of life insurance and the economic and demographic factors can be analysed by using appropriate proxies for EFH, IRH, PPP and DCP. The proxies for EFH, IRH and PPP are selected based on those that have been used in the studies of Dar and Dodds (1989), Outreville (1990), Russell (1997) and Kuo, Tsai and Chen (2003). For EFH, the income and unemployment variables are used as proxies. In addition, in order to test the concept of dependent lapsing – i.e. the dependency of lapse rates on economic conditions (Katrakis, 2000), an indicator to measure the stock market performance is also proposed to be included. For IRH, various types of interest rate offered by alternative investment products are used as proxies. For PPP, inflation and the price of insurance are used as proxies. For DCP, it is proposed that variables such as the crude live-birth rate, crude death rate, total fertility rate and life expectancy are used as proxies. In summary, the proxies for EFH, IRH, PPP and DCP are as shown below:

Category	Proxy
EFH	Income, stock market performance and unemployment
IRH	Various types of interest rate offered by alternative investment products
PPP	Inflation and the price of insurance
DCP	Crude live-birth rate, crude death rate, total fertility rate and life expectancy

6.2 Measurement of Variables

Based on the literature review (refer to sections 2.2 and 3.2), the following operational definitions are used for the purpose of the studies in this thesis.

6.2.1 Insurance Data

The Demand for Life Insurance. For the Malaysian study, life insurance demand refers to the new life insurance business written in a year. The demand for life insurance is defined by number (denoted mnd), by amount (denoted mad) and by premium (denoted mpd). The definitions of life insurance demand as new life insurance business by number and by amount are similar to those used in the studies of Rubayah and Zaidi

(2000) and Babbel (1985) respectively (refer to Table 2.1). These definitions are adopted so that the findings on the demand model by number of this study can be compared with those of the study of Rubayah and Zaidi (2000) (which is also Malaysian oriented) and the findings on the demand model by amount of this study can be compared with those of the study of Babbel (1985). However, no researchers in the past have defined life insurance demand as new life insurance business using premium as a measurement. All of the data are industry-wide data for combined life insurance business (i.e. ordinary life and home service businesses). The data at market prices are converted into constant 1987 prices using consumer price indices (CPIs) and are expressed in the logarithmic transform. There are two sets of regression models in the Malaysian study. The first set includes regression models using the average annual CPIs only as deflators (although we note that this is not completely an appropriate way of deflating the stock variables) and the second set includes regression models using a combination of average and end-of-year CPIs as deflators. The analysis of the second set is made possible when the missing (unpublished) end-of-year CPIs are provided by the central bank of Malaysia in a later stage of the project so that the stock and flow variables can be deflated as appropriate and also it has enabled the computation of the end-of-year inflation rates.

For the comparative study between Malaysia and the US, life insurance demand refers to life insurance business in force by number and by amount. The earlier definition of life insurance demand using new business is not adopted here for two reasons. First, it is to enable more observations to be included in the analysis because the data series for new life insurance business of the US is short (i.e. the data are only available for 1980-2001) but the data series for life insurance business in force of the US is longer (i.e. the data are available for 1970-2001). Second, the use of an alternative representation for life insurance demand would allow the examination of the demand for life insurance from a different perspective. More formally, for Malaysia, life insurance demand refers to life insurance business in force for combined life insurance business defined by number per thousand population (denoted mnifptp) and by amount per capita (denoted maifpc). For the US, life insurance demand refers to life insurance business in force for all life policies (that consist of individual, group and credit life policies) defined by number per thousand population (denoted usnifptp) and by amount per capita (denoted usaifpc). The data at market prices are converted into constant 1987 prices using the CPIs (as appropriate) and are expressed in the logarithmic transform.

Lapsation of Life Insurance. For the Malaysian study, two kinds of lapse rate are examined: the forfeiture and surrender rates.

The forfeiture rate refers to the percentage of policies terminated prior to the acquisition of cash values. Three types of forfeiture rate derived from different methods of computation are used in this study. The first type of forfeiture rate is computed using the formula (Eq4.1) adopted by the central bank as reported in the insurance annual report (denoted by MFR1). MFR1 is the ratio of the sums insured forfeited in a year to the mean value of new sums insured written in that year and the preceding year. The second type of forfeiture rate is obtained using the formula (Eq4.3) as discussed in section 4.2.1 (denoted by MFR2), which involves an improved measure of exposure. The third type of forfeiture rate is calculated using the method discussed in section 4.2.3 (denoted by MFR3).

In contrast, the surrender rate refers to the percentage of lapsed policies that have a cash value accumulated under the policies. The formula adopted by the central bank as reported in the insurance annual report is used to compute the surrender rate (denoted MSR). MSR is the percentage of the total sums insured terminated through surrenders during the year to the total sums insured in force at the beginning of the year (refer to Eq4.2).

All of the insurance data are industry-wide data for combined life insurance business. The insurance data at market prices are converted into constant 1987 prices using the CPIs before they are used in the computation of the various kinds of lapse rate. There are two sets of regression models in the Malaysian study, similar to that discussed earlier for the study on life insurance demand: (a) regression models using the average annual CPIs only as deflators and (b) regression models using a combination of average and end-of-year CPIs as deflators.

For the US data, the lapse rate that is equivalent to the surrender rate of Malaysia is being examined. The surrender rate for the US (denoted USSR) is calculated in the same manner in which the surrender rate for Malaysia is calculated using the formula in Eq4.2. As the surrender values reported in the Life Insurers Fact Book are the aggregate values for the individual and group life policies, life insurance business in force for the individual and group life policies is used as the denominator when computing the surrender rate. The data at market prices are converted into constant 1987 prices using the CPIs (as appropriate) before they are used in the computation of surrender rate.

6.2.2 Macroeconomic Data

The author has tried to adopt similar proxies for the macroeconomic variables for the studies in this thesis to those that have been used by researchers in the past. But, on certain occasions, it is not possible to do so due to a lack of data of the similar type. In such circumstances, the best alternative data available are used in their place. Therefore, the adoption of the proxies for the macroeconomic variables in both the demand and lapse models is dictated by the availability and also the accessibility of the data for the individual variables.

Income. Income is hypothesised to relate positively to life insurance demand but negatively to lapses.

For the demand for life insurance, the findings of Cargill and Troxel (1979), Babbel (1981 & 1985), Truett and Truett (1990), Browne and Kim (1993), Outreville (1996) and Rubayah and Zaidi[1] (2000) confirm that income has a significant positive relationship with life insurance demand. Life insurance becomes more affordable when income increases.

All of the studies have adopted disposable income as their income variable. Disposable income is used to proxy insurable human wealth or permanent income. However, the operational definitions for disposable income in these studies are different from one another.

The income variable in the study of Cargill and Troxel (1979) refers to the normalised disposable personal income. It is defined as the disposable personal income divided by total household net worth. In Babbel (1981), the income variable is an index derived based upon real disposable personal income and is a three-year moving average. The real disposable personal income is obtained by deflating the nominal income by mid-year CPI before it is divided by the population estimate. Then, a series of indices are formed based on the income values in both the pre- and post-indexing periods. A value of unity is assigned to the first income values in both the pre- and post-indexing periods. The rest of the indices are derived accordingly for the other income values in the pre- and post-indexing periods in exact proportion to the first income values in their respective periods. In another study, Babbel (1985) uses two different measures for disposable personal income in his study. The single-year income is used as a proxy for human capital and the three-year moving average income is used as a proxy for permanent income. The income variables are expressed in real terms. The nominal values are deflated by the yearly average indices of personal consumption expenditure deflator to render them into constant dollar terms. For the comparative study of Truett and Truett (1990), gross national product (GNP) and gross domestic product (GDP) are used as the basis for disposable personal income with respect to Mexico and the US. The income values at the current period (t) and the forecast for three periods in the future (t+3) are used for analysis. The income variables are expressed in real terms per capita. The income variable in Browne and Kim (1993) refers to national income. It is defined as the GNP minus depreciation (i.e. capital consumption) and indirect business taxes. According to Browne and Kim (1993), national income is a more accurate measurement of disposable income for a country than GNP or GDP because national

[1] Only gross domestic product is applicable but the other income variable (i.e. income per capita) is aborted when subject to stepwise regression analysis – refer to the definitions of variables in the following paragraph.

income is the income earned by the various production factors. Outreville (1996) adopts GDP per capita as disposable personal income. The income variable is expressed in linear and in the logarithmic forms in his analysis. Rubayah and Zaidi (2000) examine two types of income variable in their study, namely the GDP and income per capita. Income per capita is defined as the GDP divided by the number of population.

For lapsation of life insurance, the findings of Outreville (1990) and Russell (1997) show that income significantly affects lapse rate. The findings of Outreville (1990) provide considerable evidence to support the EFH. Early lapsation is inversely related to income. As income increases, life insurance becomes more affordable and the policyholders are more likely not going to withdraw their policies. However, the findings of Russell (1997) fail to provide any evidence to support the EFH as the income variable unexpectedly has a positive relationship with surrender activity.

The income variable in the study of Outreville (1990) refers to real transitory income per capita. Transitory income is used as a measure in order to indicate a slow down in economic growth. Specifically, the nominal transitory income refers to the difference between the current income at period t and the expected normal income at period t, where the expected normal income is defined as the distributed lag of the past observation of disposable personal income. The transitory income is expressed in real terms per capita – i.e. the nominal values of transitory income are deflated using the price deflator of GNP and are divided by the working age population to obtain the real per capita expression. Further, in order to reaffirm the finding of EFH on early lapsation, the rate of change in disposable personal income is used as an alternative parameter. On the other hand, in the study of Russell (1997), the income variable refers to real income per capita.

For the studies in this thesis, GDP is used as the basis for the income variables. The choice is made based on the proxies adopted in the studies of Truett and Truett (1990), Outreville (1996) and Rubayah and Zaidi (2000). For the Malaysian data, the income variables are the GDP (denoted mgdp) and income per capita (denoted mipc). Income per capita is defined as the GDP divided by mid-year population. The two income variables are at constant 1987 prices. The CPIs are used to deflate the data at market prices into constant 1987 prices. For the US data, the GDP (denoted usgdp) and income per capita (denoted usipc) are also used as the proxies for the income variables. Their market prices are converted into constant 1987 prices using the Consumer Price Index for All Urban Consumers (CPI-U).

Stock Market Return. Stock market return is hypothesised to relate positively to life insurance demand but negatively to lapses.

The stock market return variable is included in this study based on the concept of dependent lapsing used by Katrakis (2000) in his study to investigate the cost of dependent lapsing for the policyholders. The concept of dependent lapsing is consistent with the EFH. This concept proposes that lapse rates tend to be higher when the economy is in recession and when the stock market is under depressed conditions than when the economy is stable.

This variable is new and has not been examined in the past. For Malaysia, a combination of the percentage changes in the Industrial Index (II) and Kuala Lumpur Stock Exchange Composite Index (KLSE CI) are used to gauge the performance of the stock market (denoted MSMR). The two indices are regarded as suitable proxies because KLSE CI has been used as the local stock market barometer since its introduction in 1986 (but the data have been made available by KLSE dated back to 1977) and II is the local stock market index that has been followed widely by the investors before the introduction of KLSE CI. Therefore, the proportionate changes in IIs are used to reflect the performance of the stock market for the period prior to 1978, while the proportionate changes in KLSE CIs are used since 1978. For the US, the Dow Jones Industrial Average (DJIA) index is the most commonly used indicator of the stock market performance. Therefore, these indices are used as the basis in computing stock market return, which is defined as the proportionate changes in the DJIA indices (denoted USSMR).

Financial Development. Financial development is hypothesised to relate positively to life insurance demand.

For the demand for life insurance, whether financial development has a significant relationship with the demand for life insurance in the literature depends upon the indicators used to measure it. In the study of Outreville (1996), three different proxies are used as a measurement for financial development. The first one is the percentage calculated as the ratio of quasi-money (M2–M1) to broad money (M2). It is an indicator for the complexity of financial structure. The second one is the ratio of M2 to the nominal GDP. It is an indicator for financial deepening. The last one is the broad definition of money (M2). He claims that M2 is regarded as an adequate measure for financial development for the 48 developing countries in his study because banking is the predominant sector in the financial market of developing countries. It is an average value over four years for the period 1983-1986. The findings of Outreville (1996) indicate that when financial development is defined based on the first definition, it appears to be related positively and significantly to the growth of life insurance business. However, when financial development is defined based on the latter two definitions, even though its estimated coefficients have the expected positive sign but they are not statistically significant.

For the studies in this thesis, the first and the last proxies for financial development used by Outreville (1996) are adopted. The former proxy is regarded as a more sophisticated measure for financial development whereas the latter proxy is a simple measure for financial development. They are the ratio of quasi-money to broad money expressed in percentage term (denoted MFD and USFD respectively for the Malaysian and US data) and the broad definition of money (denoted mm2 and usm2 respectively for the Malaysian and US data).

Unemployment. Unemployment is hypothesised to relate positively to lapses.

For lapsation of life insurance, Dar and Dodds (1989) and Outreville (1990) find a significant positive relationship between unemployment and lapses. The findings provide strong evidence in support of EFH. However, even though Russell (1997) finds evidence in support of EFH for surrender activity at the state level but this variable tends to be not significant at the company level. These findings suggest that during a period of unemployment, policy surrender and early lapsation tend to be higher. High unemployment rates tend to trigger a high level of lapsation. Not having a job and, thus, having no income (apart from social security benefits) would tend to prompt early termination of life policies due to being financially unable to continue paying premiums.

Two unemployment-related measures are used in the study of Dar and Dodds (1989). The first measure is the annual growth rate in the level of unemployment. The second measure is defined as the level of actual unemployment relative to trend unemployment (i.e. actual-to-trend unemployment). Their results show that the regression models with the first unemployment measure (i.e. the growth rate in unemployment) as the emergency fund variable appear to be somewhat more efficiently estimated. The unemployment rate used in the studies of Outreville (1990), Russell (1997) and Kuo, Tsai and Chen (2003) is not explicitly defined, so it is assumed that the rate is the most commonly quoted measure for unemployment rate.

For the Malaysian data, the data series of the commonly defined unemployment rate (denoted MUR) as reported in the Economic Report is very short. The data are only available for 1976-2001. As a result, the commonly defined unemployment rate is not used in the main analysis but in the "sensitivity analysis" in order to test whether it has more explanatory power than the registered unemployment rate as the unemployment rate variable. In the main analysis, the registered unemployment rate (denoted MRUR) is used instead for analysis. For the US data, the commonly defined unemployment rate (denoted USUR) is used for analysis.

Interest Rate. The interest rates of alternative investments are hypothesised to relate negatively to life insurance demand but positively to lapses.

For the demand for life insurance, there is disagreement in the literature on how alternative interest rates are related to life insurance demand. The findings on the relationship between competing interest rates and the demand for life insurance are inconclusive. Their relationship depends partly on how the interest rates are defined.

In Cargill and Troxel (1979), the findings on the competing yield are inconsistent. However, the competing yield tends to be related negatively to the demand for life insurance savings. A higher interest rate on alternative savings products tends to cause insurance products to become less attractive as a savings instrument. The yield on newly issued AAA utility bonds is used to represent all types of the competing rates of return on alternative savings products. Cargill and Troxel (1979) include the current and twelve-quarter distributed lags of competing yields in their study in order to investigate the immediate responses of the changes in interest rate on the demand for life insurance savings and to reflect the delayed reactions of savers towards new information regarding interest rates on savings (because the changes in interest rates are assumed to produce a lagged response). In contrast, Dar and Dodds (1989) find that the alternative rate of return has a significant negative relationship with the demand for life insurance savings. They use the real rate of return on the 2.5% end-of-year flat yield of War loan (a perpetuity) as a single alternative rate of return in their study to capture the effect of the whole spectrum of alternative rates of return. On the other hand, the findings of Outreville (1996) show that interest rates such as the real interest rate and lending rate are not a determining factor affecting the demand for life insurance. The real interest rate is obtained by subtracting anticipated inflation rate from the current bank discount rate. For Rubayah and Zaidi (2000), their findings reveal that both the personal savings rate and short-term interest rate are found to influence negatively and significantly the demand for life insurance but the current interest rate is found to have no significant influence on life insurance demand. The personal savings rate refers to the interest rate offered by banks on normal savings. The short-term interest rate refers to the interest rate on three-month treasury bills. The current interest rate refers to the base lending rate on bank borrowings.

For the lapsation of life insurance, the findings of the changes in the interest rates of alternative assets on lapsation are inconsistent. Broadly speaking, the findings tend to be not significant (Dar and Dodd, 1989; Outreville, 1990; Russell, 1997 – for the analysis of surrender activity using the company-specific data for 395 life insurance companies covering the period 1968-1993) except for the findings of Russell (1997) using the state-specific data (for all of the 50 states and the District of Columbia covering the period 1968-1993) and the findings of Kuo, Tsai and Chen (2003) which indicate that surrender activity and lapse rate are related positively and significantly to the changes in interest rates. The findings on interest rates from the various researchers are mixed and this provides weak evidence in support of IRH.

Dar and Dodds (1989) use a single alternative rate of return [i.e. the real rate of return on the 2.5% end-of-year flat yield of War loan (a perpetuity)] to capture the effect of the whole spectrum of alternative rates of return in order to verify the validity of the IRH. Meanwhile, the various interest rates examined in the study of Outreville (1990) consist of the following: the real interest rate on long-term alternative assets (being the difference between the nominal yield on industrial bonds and anticipated inflation), the long-term interest rate on industrial bonds, the interest rate on government bonds and the short-term interest rate on three-month treasury bills. Russell (1997) uses three types of interest rate in his study viz. the real rates of return for the average yields of long-term, intermediate-term and 90-day treasury bills. Kuo, Tsai and Chen (2003) use the 90-day treasury rate in order to proxy the rate of return on other assets that compete with life insurance.

For the studies in this thesis, for Malaysian data, three types of interest rate that are available in Malaysia are used to test the interest rate effect on the demand for and lapsation of life insurance. The average discount rate on three-month treasury bills (denoted MTBR3M) is used as one of the interest rate variables. The yields on treasury bills have been examined extensively by researchers in the past such as Outreville (1990), Russell (1997), Rubayah and Zaidi (2000) and Kuo, Tsai and Chen (2003). The Malaysian study also investigates the savings deposit rate (denoted MSDR) that has examined by Rubayah and Zaidi (2000). Further, since the 12-month fixed deposit rates (denoted MFDR) are available in the published report (i.e. Monthly Statistical Bulletin or MSB in short) of Malaysia, these interest rates are also included for examination.

On the other hand, for US data, the data series for the US Treasury three-month yield is not long enough for analysis. The data are only available for the period 1982-2003. Therefore, a decision is made to use the US Treasury one-year yield as the interest rate variable (denoted USTBR1Y) because it has a much longer data series (i.e. the data are available for 1962-2003). This means that, for the comparative study, the corresponding interest rate variable for the Malaysian case is the average discount rate on 12-month treasury bills (denoted MTBR1Y).

Inflation. Cargill and Troxel (1979) argue that the relationship between inflation and the demand for life insurance is unclear. Their relationship depends upon whether life insurance is purchased for the purpose of protection against premature death of the primary income earner in the family, or as a savings instrument, or as a combination of both. However, the consumers generally do not differentiate clearly their purpose of owning life insurance, either it is purchased purely for savings or protection purpose.

Based on the argument of Cargill and Troxel (1979), in an inflationary environment, rising inflation rates encourage the purchase of a larger amount of life insurance protection but discourage increased life insurance savings through cash values that are fixed in monetary terms. Based on this reasoning, the anticipated inflation is hypothesised to have a positive relationship with the demand for life insurance protection but a negative relationship with the demand for life insurance savings. On the other hand, inflation is hypothesised to relate positively to lapses.

For the demand for life insurance savings, the findings of Cargill and Troxel (1979) on inflation are inconsistent. Only the moderately defined savings model (i.e. the model that takes into account policy loans in defining the changes in life insurance reserves and dividend accumulations) in their study generates a significant result with the expected negative sign for this variable. There is only a weak relationship between inflation and the demand for life insurance savings. Meanwhile, the study of Dar and Dodds (1989) shows that inflation does not appear to have any important relationship with the demand for life insurance savings. For the demand for life insurance protection, the findings of Babbel (1981) are contrary to the proposition that rising inflation rates encourage the purchase of a larger amount of life insurance protection. Babbel's (1981) findings show that anticipated inflation has a significant negative relationship with the demand for life insurance protection in Brazil for both the pre- and post-indexing periods. For the demand for life insurance that does not differentiate between the savings and protection elements, the findings of Browne and Kim (1993) and Outreville (1996) reveal that inflation has a significant negative relationship with life insurance demand. However, the findings of Rubayah and Zaidi (2000) are not in line with the findings of Browne and Kim (1993) and Outreville (1996). Their findings indicate that inflation has an insignificant (positive) relationship with the demand for life insurance.

Cargill and Troxel (1979) use the forecasts of future CPIs (over a 14-month forecast horizon) in the Livingston Survey (that has been revised by Carlson) as the basis for anticipated inflation. Anticipated inflation is calculated as the percentage change in future CPIs. They do not use realised price changes (or CPIs) as an approximation for measuring anticipated inflation. Cargill and Troxel (1979) claim that realised price changes are not an appropriate measure for anticipated inflation because they provide only an indirect evidence of the relationship between anticipated inflation and life insurance demand. However, other researchers have used realised price changes or CPIs as the basis for computing anticipated inflation in their studies. Dar and Dodds (1989) use two different types of expected inflation rate formulated based on the adaptive expectation model. The model assumes that the economic agents form their expectations of inflation adaptively according to past inflation rates (which are the annual percentage changes in CPIs). The first type of inflation rate is defined as a geometric weighted average of current and past inflation rates. The second type of inflation rate is defined as a three-year arithmetic average of current and past inflation rates. (These two inflation variables are used in the surrender analysis as well.) Babbel (1981) assumes that the consumers form their expectations of future inflation rates based on past inflation rates according to the delayed information hypothesis. He uses the CPIs as the source for approximating the rates of price inflation. As there is no single nation-wide price index available in Brazil, he uses the weighted CPIs of the two most heavily populated cities in Brazil (i.e. Rio de Janeiro and Sao Paulo) as the indices in order to compute the expected rate of inflation. The inflation variable in Browne and Kim (1993) is an average inflation rate for the last eight years and the one in the study of Outreville (1996) is a weighted average of realised price changes over the last five years. Rubayah and Zaidi (2000) use the realised indices of CPI as the basis for anticipated inflation in their study.

For the lapsation of life insurance, the findings of Dar and Dodds (1989), Outreville (1990) and Russell (1997 – for the analysis using the company-specific data) indicate that inflation is not an important factor affecting lapsation in the form of either early lapsation or policy surrenders. Furthermore, the inflation variable is found to have an unexpected negative sign on its estimated parameters. However, only the inflation variable in Russell (1997) has the expected positive sign but it is only found to be statistically significant in the analysis using the state-specific data.

The inflation variables in Dar and Dodds (1989) are the same as those mentioned in the demand for life insurance section. Meanwhile, the inflation variable in Outreville (1990) and Russell (1997) is the annual change in CPIs.

For the Malaysian study, the average annual inflation rates (denoted MIA) as reported in MSB published by the central bank are used as a proxy for anticipated inflation. The reported inflation rates are calculated using the average annual CPIs that are a simple average of 12 monthly CPIs from January to December. Further, in a later stage, when the six missing (unpublished) data of the end-of-year CPIs (i.e. the CPIs at the end of December) are provided by the central bank, this has made the computation of the end-of-year inflation rates possible and the conversion of variables at market prices into constant price has been done appropriately (i.e. by deflating the stock and flow variables accordingly with the end-of-year and average annual CPIs). As a result, some analyses performed earlier are repeated using the end-of-year inflation rates (denoted MIE) as an alternative variable. On the other hand, for the comparative study, both the Malaysian and US data for the inflation variable are the end-of-year inflation rates (denoted MIE and USIE respectively).

Price of Insurance. The price of insurance is hypothesised to relate negatively to both the life insurance demand and lapses.

For the demand for life insurance, several researchers have examined the sensitivity of the premium level towards life insurance purchases. The findings reported with respect to the effect of the price of insurance on the demand for life insurance are consistent in the studies of Babbel (1985) and Browne and Kim (1993). The price of insurance is related inversely and significantly to the demand for life insurance, indicating that a high insurance cost tends to discourage the purchasing of life insurance.

The various insurance price indices in the study of Babbel (1985) are the net present cost per 1000 present-valued units of insurance expected to be in force over any arbitrary time horizon selected based on the published policy values for a male of age 35. Specifically, the price index refers to the ratio of the present value of expected premium cost (net of dividends and accumulation of cash values) to the 1000 present-valued units of indemnification benefits expected to be received, in excess of the actuarially fair cost. Two different discount rates, namely the yields of 10-year prime grade municipal bonds and double-A-rated corporate bonds, are used to discount the expected future cash flows from the policies. Browne and Kim (1993) use the policy loading charge as the price measure. It is the ratio of total life premiums to the amount of insurance in force. In fact, it is the cost per dollar of life insurance coverage.

For lapsation of life insurance, Outreville (1990) has shown that the price of insurance is related negatively and significantly to early lapsation. When it is more costly to obtain insurance protection, early cancellation of life policies would tend to be lower. The cost of group life insurance per US$1,000 of coverage is used as the price measure in the regression models using annual observations. It is the price calculated as the ratio of group life insurance premiums to total group life insurance in force per US$1,000 of insurance coverage. In fact, it is a proxy for the price of pure insurance protection. Group insurance is chosen because it is essentially a one year term insurance product. Meanwhile, a linear trend effect is included in the regression models using semi-annual observations in the absence of a suitable proxy for the price variable on a semi-annual basis in order to adjust the estimated coefficients of other explanatory variables for the existence of a common linear trend so that only the cyclical relationship is reflected in the estimated coefficients.

Initially, three different price measures are proposed to be included in the studies of this thesis: (a) the price of pure insurance protection per RM1,000 or US$1,000 of coverage, (b) the cost of insurance per RM1,000 or US$1,000 of coverage and (c) the present-valued unit of the expected receipt of insurance indemnification.

The first price measure, the price of pure insurance protection per RM1,000 or US$1,000 of coverage, refers to the ratio of total annual premium in force to total sums insured in force on temporary insurance for RM1,000 or US$1,000 of insurance coverage. It is a modified version of the price measure suggested by Outreville (1990). The modified price measure only focuses on temporary insurance of life insurance business and excludes other types of life insurance product. The price of pure insurance protection per RM1,000 or US$1,000 of coverage can be computed as below:

$$\text{The Price of Pure Insurance Protection per RM1,000 or US\$1,000 of Coverage} = \frac{\text{Annual Premium in Force on Temporary Insurance}}{\text{Sums Insured in Force on Temporary Insurance}} \times 1000$$

This price measure is not adopted in this study due to the limitations in the availability of the related data needed in its computation. Although the annual data on both the premium in force and sums insured in force on temporary insurance are available for 1972-2000 in the insurance annual reports of Malaysia, there are a number of missing data on annual premium in force for the period 1983-1987. For the US, although the data on the sums insured in force for group insurance (which normally is a temporary insurance) are available (for the period 1970-2001) in the Life Insurers Fact Book, the data on the annual premium for group insurance are not reported consistently in the Life Insurers Fact Book.

The second price measure is based on the price measure proposed by Browne and Kim (1993). For Malaysia, the cost of insurance per RM1,000 of coverage is defined as the ratio of total annual premium in force to total sums insured in force on combined life insurance business for RM1,000 of insurance coverage. The cost can be computed as shown below:

$$\text{The Cost of Insurance per RM1,000 of Coverage} = \frac{\text{Annual Premium in Force on Combined Life insurance Business}}{\text{Sums Insured in Force on Combined Life insurance Business}} \times 1000$$

The related data needed to compute this price measure can be obtained from the insurance annual reports of Malaysia so that there is no problem in calculating this price measure. All of the data are converted into 1987 constant prices using the CPIs before they are used in the computation of the cost of insurance.

For the US, although the data on sums insured in force for life insurance (for the individual, group and credit life policies) (for the period 1970-2001) are available in the Life Insurers Fact Book but the data on premium in force are not available. Only life insurance premium receipts (which comprise the first year, single and renewal income premium received by life insurers) are reported. Therefore, the cost of insurance using the second price measure cannot be computed.

The third price measure is based upon the price measure developed by Babbel (1985). It is the present-valued unit of the expected receipt of insurance indemnification.

This price measure is a price index that focuses on the present values of the expected costs and benefits. It is in fact the present-valued net expected cost-benefit ratio. Specifically, the price index refers to the ratio of the present value of expected premium costs (net of dividends and accumulation of cash values) to the present value of insurance indemnification (in the form of death benefits to be received), in excess of the actuarially fair cost. The detailed mathematical calculations of this price index are complex because they involve computations of the expected present values of the costs and benefits over time. Nevertheless, it can be expressed compactly in a simple way as shown below:

$$\text{The Expected Present-Value Unit of the Receipt of Insurance Indemnification} = \frac{EPV(C)_{/\$1000\text{ ins. in force}}}{EPV(B)_{/\$1000\text{ ins. in force}}} - 1$$

where
PV = the present-value operator
E = the expectation operator
C = the expected premium costs (net of dividends and accumulation of cash values)
B = the amount of death benefits (as the insurance indemnification to be received)

As the information needed to compute this price index is not readily available in the published reports of Malaysia, an effort has made to contact the Life Insurance Association of Malaysia (LIAM) in which all of the 18 life insurance companies operating in Malaysia joined as a member. In addition, five life insurance companies chosen based on their total assets also have been approached individually for the information. The five insurance companies contacted are as follows: American International Assurance, Great Eastern Life Assurance, Mayban Life Assurance, Malaysia National Insurance and Prudential Assurance. However, the response from LIAM and the insurance companies has been discouraging as LIAM does not compile this information and the insurance companies are reluctant to disclose this information for a number of reasons including preserving the confidentiality of company data. Therefore, this price measure cannot be computed due to the necessary data are not available for this purpose. For the US, considering that the same problems are likely to prevail in gathering the relevant data to compute this price measure, a decision has made not to pursue this matter. As a result, this price measure is not adopted in this study.

Based on the discussion above on the three proposed price measures, for Malaysia, only the second measure can be computed. The other two price measures cannot be computed due to the lack of availability for the relevant data needed for their computation. Therefore, only the second price measure being the cost of insurance per RM1,000 of coverage is adopted as the proxy for the price variable (denoted mp or mpn) in the Malaysian study. On the other hand, none of the price measures can be computed for the case of the US because the relevant data are not available. Since there is no proxy to be used for the price variable for the US, the price variable is not considered in the comparative study.

6.2.3 Demographic Data

A number of demographic variables such as the crude live-birth rate, death rate, total fertility rate and life expectancy are included in this study. However, at this stage, it is not clear how these demographic variables are related to the demand for (except for death rate and life expectancy) and lapsation of life insurance. Their relationships are to be explored in the analysis later. Only annual observations are available for the demographic variables.

Crude Live-birth Rate. The crude live-birth rate for Malaysia (denoted MCBR) and for the US (denoted USCBR) is defined as the annual number of live births per 1,000 population.

Death Rate. The death rate is hypothesised to relate positively to life insurance demand. Browne and Kim's (1993) study has examined the relationship between the probability of death and the demand for life insurance. Two proxies are used to represent the probability of death: the death rate among 30-34-year-old males (discussed here) and the average life expectancy (discuss below under the heading of "Life Expectancy"). The death rate is found to be an insignificant factor affecting life insurance demand.

For the studies in this thesis, the death rate for Malaysia (denoted MCDR) and for the US (denoted USCDR) is the crude death rate. It is the number of deaths per 1,000 population in a given year. In addition, for the US, the age-adjusted death rate (denoted USADR) is used as an alternative variable in the "sensitivity analysis" in order to test whether it has more explanatory power than the crude death rate. The age-adjusted death rates that are based on the 1990 population estimates (i.e. the data are available for 1960-1998) are used as an alternative death rate as they have a longer data series than the ones that are based on the 2000 population estimates (i.e. the data are only available for 1985-2001).

Total Fertility Rate. The total fertility rate for Malaysia (denoted MTFR) and for the US (denoted USTFR) for the studies in this thesis is defined as the sum of all age-specific fertility rates per woman over the reproductive age range (i.e. aged 15 to 49 years) in the given year.

Life Expectancy. The relationship between life expectancy and the demand for life insurance is unclear. From the literature review related to life insurance demand (refer to section 2.2), their relationship depends upon the role that life expectancy plays as a proxy variable. For example, Browne and Kim (1993) and Outreville (1996), studying the demand for life insurance, have examined life expectancy but they use a different proxy for life expectancy. The life expectancy variable in Browne and Kim (1993) is used as a proxy for the probability of death (as an alternative variable for the death rate among 30-34-year-old males) and it is proposed to have a negative relationship with life insurance demand. Meanwhile, the life expectancy variable in Outreville (1996) is used to proxy the actuarially fair price of life insurance (in the absence of a suitable proxy variable for the price of insurance) and it is proposed to have a positive relationship with life insurance demand. The findings for the two studies are not consistent. Life expectancy is found to be an insignificant factor affecting life insurance demand in the former study but it is found to affect positively and significantly the demand for life insurance in the latter study, implying that the price of life insurance has a significant relationship with life insurance demand but the probability of death is not an important factor in relation to the demand for life insurance.

From the above, life expectancy can be used to proxy either the actuarially fair price of life insurance or the probability of death. Nevertheless, we note that the fair premium for life insurance is related indirectly to life expectancy at birth, in which it is equivalent to the inverse of life expectancy at birth (i.e. $P_x=1/{}^0e_x$, where P_x is the fair premium for life insurance and ${}^0e_x$ is life expectancy at birth), when the interest rate is zero and there are no expenses incurred in issuing life policies, deriving from the original formula of $P_x=1/a_x-d$ (where P_x is the fair premium for life insurance, a_x is the annuity value and d is the discount rate). However, the probability of death is related more directly to life expectancy at birth. Life expectancy at birth is equivalent to the inverse of the probability of death, or strictly speaking, the hazard rate (i.e. ${}^0e_x=1/q$, where ${}^0e_x$ is life expectancy at birth and q is the probability of death), when the probability is the same for the population at all ages.

For the studies in this thesis, we adopt the latter proxy for life expectancy at birth because the probability of death and life expectancy at birth are more directly related to each other. As the death rate is hypothesised to relate positively to life insurance demand but the probability of death and life expectancy at birth are related inversely, therefore life expectancy at birth is hypothesised to relate negatively to life insurance demand. In particular, the life expectancy at birth for males and females of Malaysia (denoted MLEm and MLEf respectively) and of the US (denoted USLEm and USLEf respectively) are being examined in the studies of this thesis. It refers to the average length of the life span for males and for females if they continue to be subject to the selected cross-sectional mortality experience. Life expectancy at birth is chosen in favour of the life expectancy at other ages because it has the greatest number of data points available for analysis.

Tables 6.1 and 6.2 provide a summary table of the empirical studies conducted in the past that are related to the demand for and lapsation of life insurance respectively, listing the variables being examined and their proxies along with the findings indicating the relationship between the dependent and explanatory variables and their statistical significance. Meanwhile, Tables 6.3 and 6.4 are a summary table listing the variables and their operational definitions for the Malaysian study and the comparative study respectively.

6.3 Naming Convention for Variables

The naming conventions for the variables are such that the variables for the Malaysian data have a letter "M" or "m" in front of the variable names and for the US data have a letter "US" or "us" in front of the variable names.

The variables have names in upper-case, lower-case and a combination of upper- and lower-case. The variables with names in upper-case are variables of rate-value – e.g "MTBR1Y" refers to the average discount rate on 12-month Malaysian treasury bills and "USTBR1Y" refers to the US Treasury one-year yield. These variables are not subject to a transformation. The variables with names in lower-case are variables of level-value – e.g. "mipc" is the income per capita for Malaysia and "usipc" is the income per capita for the US. These variables have been subject to the logarithmic transformation. The variables with names in a combination of upper- and lower-case are variables of level-value that are not subject to a transformation – e.g. "MLEm" represents the life expectancy at birth for males in Malaysia and "USLEm" represents the life expectancy at birth for males in the US. For further details on the transformation of variables, refer to the discussion in section 7.2 entitled "Transformation of Variables".

A naming convention has been put in place in order to reflect the timing of the variables to distinguish whether they are of the current period (t) or of the previous period (t–1). The variables with an extension of underscore one (_1) are variables lagged one period (t–1) whereas the variables without such extension are variables of the current period (t).

Further, in order to differentiate among the original/non-differenced, the first-differenced and the second-differenced terms of a variable, a prefix "D" is used to indicate the first-differenced term and a prefix "DD" is for the second-differenced term. For the non-differenced term (which is the original term), no prefix of "D" is attached to the variable name.

For example, "DMTFR_1" refers to the first-differenced term of the total fertility rate for Malaysia lagged one period, which is the lag one period of the change in the total fertility rate of Malaysia.

The studies in this thesis use two different deflation approaches in some parts of its analysis: (a) the average annual CPIs are used as a single deflator for all of the variables (for both the flow and stock variables) and (b) the average and end-of-year CPIs are used as the deflators with respect to the flow and stock variables. As new variables appear when the second deflation approach is used, the new variables have the similar names as their original variables but with an "N" or "n" (which means "new") added at the end of the variable names just before the timing indicator is added. For example, both the mm2_1 and mm2n_1 are the financial development variables lagged one period for Malaysia, the former is deflated by the average annual CPIs but the latter is deflated appropriately using the end-of-year CPIs because M2 is a stock variable.

APPENDIX CHAPTER 6

Table 6.1
A Summary of Empirical Studies on the Relationship between Macroeconomic and Demographic Factors and the Demand for Life Insurance

Macroeconomic Variable	Past Study	Proxy Used	Relationship with Demand	Statistically Significant
Income	Cargill and Troxel (1979)	Disposable personal income divided by total household net worth [as a proxy for normalised disposable personal income]	Inconsistent but tend to be positive	Tend to be significant
		- For all of the three models with different definitions of life insurance savings in the full-period sample	Positive	Yes
		- For all of the three models with different definitions of life insurance savings in the early-sub-period sample	Inconsistent	No
		- For all of the three models with different definitions of life insurance savings in the late-sub-period sample	Positive	Yes
	Babbel (1981)	An index derived based upon real disposable personal income	Positive	Yes
	Babbel (1985)	Single-year income being the real amount of disposable personal income [as a proxy for human capital]	Positive	Yes
		Three-year moving average of the real amount of disposable personal income [as a proxy for permanent income]	Positive	Yes
	Truett and Truett (1990)	Real GNP per capita at current period (t) and at three periods in the future (t+3) for the Mexican data	Positive	Yes
		Real GDP per capita at current period (t) and at three periods in the future (t+3) for the US data	Positive	Yes
	Browne and Kim (1993)	National income per capita * National income is the income earned by the factors of production. It is defined as the GNP minus depreciation (capital consumption) and indirect business taxes.	Positive	Yes
	Outreville (1996)	Real GDP per capita	Positive	Yes
	Rubayah and Zaidi (2000)	GDP	Positive	Yes
		GDP divided by the number of population (This variable is aborted when subject to stepwise regression analysis.)	Positive	No
Financial Development	Outreville (1996)	The average value over a four-year period calculated as the ratio of quasi-money (M2–M1) to broad money (M2) [as a proxy for the complexity of the financial structure]	Positive	Yes
		The average value over a four-year period calculated as the ratio of M2 to the nominal GDP [as a proxy for financial deepening]	Positive	No
		The average value of M2 over a four-year period	Positive	No

Continue

Macroeconomic Variable	Past Study	Proxy Used	Relationship with Demand	Statistically Significant
Interest Rate	Cargill and Troxel (1979)	The yield on newly issued AAA utility bonds [as a proxy for the competing yield on alternative savings products]	Inconsistent	Inconsistent
		- For the full-period sample with moderately narrow definition and broad definition of life insurance savings models	Inconsistent but tend to be negative	Tend to be significant
		- For all of the three models with different definitions of life insurance savings in the early-sub-period sample	Inconsistent	Tend to be not significant
		- For the late-sub-period sample with moderately narrow definition and broad definition of life insurance savings models	Inconsistent but tend to be negative	Tend to be significant
	Dar and Dodds (1996)	The real rate of return on the 2.5% end-of-year flat yield of War loan (a perpetuity)	Negative	Yes
	Outreville (1996)	Current bank discount rate minus anticipated inflation [as a proxy for real interest rate]	Inconsistent	No
		Lending rate	Inconsistent	No
	Rubayah and Zaidi (2000)	The interest rate offered by banks on normal savings [as a proxy for personal or savings deposit rate]	Negative	Yes
		The interest rate on three-month treasury bills [as a proxy for short-term interest rate]	Negative	Yes
		Base lending rate on bank borrowings [as a proxy for current interest rate] (This variable is aborted when subject to stepwise regression analysis.)	Negative	No
Inflation	Cargill and Troxel (1979)	The rate of anticipated price changes being the percentage change in the CPI over a 14-month forecast horizon	Inconsistent	Tend to be not significant
		- For life insurance savings model with broad definition using the full-period sample	Positive	Yes
		- For life insurance savings model with moderately narrow definition using the late-sub-period sample	Negative	Yes
	Babbel (1981)	The percentage change in the weighted consumer prise indices of the two most heavily populated cities in Brazil	Negative	Yes
	Dar and Dodds (1989)	A geometric weighted average of current and past inflation rates	Not reported	No
		A three-year arithmetic average of current and past inflation rates	Not reported	No
	Browne and Kim (1993)	The average inflation rate over the last eight years	Negative	Yes
		The average value of the inflation rates over a two-year period	Negative	Yes
	Outreville (1996)	The weighted average of realised price changes over a five-year period	Negative	Yes
	Rubayah and Zaidi (2000)	Consumer price indices (This variable is aborted when subject to stepwise regression analysis.)	Positive	No

Continue

Macroeconomic Variable	Past Study	Proxy Used	Relationship with Demand	Statistically Significant
Price of Insurance	Babbel (1985)	The present value of the expected premium costs (net of dividends and accumulation of cash values) per 1000 present-valued units of indemnification benefits expected to be received, in excess of the actuarially fair cost [as a proxy for the real price of newly issued whole life insurance] * A total of 16 insurance price indices are estimated for each of the participating and non-participating forms of whole life insurance sold, where the expected/projected holding periods are of 10 and 20 years, the 10-year (medium-term) yields-to-maturity (YTM) of the prime grade municipal bonds and double-A-rated corporate bonds are used to discount the expected future cash flows, and where policy loans are or are not allowed.	Negative	Yes
	Browne and Kim (1993)	The cost per dollar of life insurance coverage calculated as the ratio of life insurance premiums to the amount of life insurance in force [as a proxy for insurance policy loading charge]	Negative	Yes
Death Rate	Browne and Kim (1993)	The death rate among 30-34-year-old males [as a proxy for the probability of death]	Not reported	No
Life Expectancy	Browne and Kim (1993)	Average life expectancy [as a proxy for the probability of death]	Not reported	No
	Outreville (1996)	Life expectancy at birth [as a proxy for the actuarially fair price of life insurance]	Positive	Yes

Table 6.2
A Summary of Empirical Studies on the Relationship between Macroeconomic Factors and Lapsation of Life Insurance

Macroeconomic Variable	Past Study	Proxy Used	Relationship with Lapsation	Statistically Significant
Income	Outreville (1990)	Real transitory income per capita	Negative	Yes
		The rate of change in disposable personal income	Negative	Yes
	Russell (1997)	Real income per capita	Positive	Yes – State and company data
Unemployment	Dar and Dodds (1989)	The growth rate in the level of unemployment	Positive	Yes
		Actual-to-trend unemployment	Positive	Yes
	Outreville (1990)	Unemployment rate	Positive	Yes
	Russell (1997)	Unemployment rate	Positive	Yes – State data
			Inconsistent	Tend to be not significant – Company data
Interest Rate	Dar and Dodds (1989)	The real rate of return on the 2.5% end-of-year flat yield of War loan (a perpetuity)	Negative	No
	Outreville (1990)	Nominal yield on industrial bonds minus anticipated inflation	Inconsistent	No
		Long-term interest rate on industrial bonds	Inconsistent	No
		Interest rate on government bonds	Inconsistent	No
		Short-term interest rate on three-month treasury bills	Inconsistent	No
	Russell (1997)	Average yield on long-term Treasuries minus annual change in CPI	Positive	Yes – State data
			Inconsistent	Tend to be not significant – Company data
		Average yield on intermediate-term Treasuries minus annual change in CPI	Positive	Yes – State data
			Inconsistent	Tend to be not significant – Company data
		Average yield on 90-day treasury bills minus annual change in CPI	Positive	Yes – State data
			Inconsistent	Tend to be not significant – Company data
Inflation	Dar and Dodds (1989)	A geometric weighted average of current and past inflation rates	Negative	No
		A three-year arithmetic average of current and past inflation rates	Negative	No
	Outreville (1990)	The change in realised price	Negative	No

Continue

Macroeconomic Variable	Past Study	Proxy Used	Relationship with Lapsation	Statistically Significant
Inflation	Russell (1997)	The change in CPI	Positive Positive	Yes – State data No – Company data
Price of Insurance	Outreville (1990)	The ratio of group life insurance premiums to total group life insurance in force per $1,000 of insurance coverage [as the price of pure insurance protection]	Negative	Yes
		Linear trend effect	Negative	Yes

Table 6.3
The Variables and Their Operational Definitions for the Malaysian Study

Proxy	Variable	Operational Definition	Expected Sign Demand	Expected Sign Lapse
DEMAND	mnd	New life insurance business by number		
DEMAND	mad	New life insurance business by amount		
DEMAND	mpd	New life insurance business by premium		
LAPSE	MFR1	Forfeiture rate (by amount) computed using MFR1 (the formula adopted by the central bank of Malaysia)		
LAPSE	MFR2	Forfeiture rate (by amount) computed using MFR2 (the improved formula which is simple in computation)		
LAPSE	MFR3	Forfeiture rate (by amount) computed using MFR3 (the improved formula which is complicated in computation) (recommended by Dr Puzey)		
LAPSE	MSR / MSRN	Surrender rate (by amount)		
ABS / EFH	mgdp	Gross domestic product	+	–
ABS / EFH	mipc	Income per capita	+	–
ABS / EFH	MSMR	Stock market return	+	–
ABS	MFD	The ratio of quasi-money to broad money (in percentage term)	+	
ABS	mm2 / mm2n	The broad definition of money	+	
EFH	MUR	Commonly defined unemployment rate		+
EFH	MRUR	Registered unemployment rate		+
DS / IRH	MSDR	Savings deposit rate	–	+
DS / IRH	MFDR	Fixed deposit rate	–	+
DS / IRH	MTBR3M	Average discount rate on three-month treasury bills	–	+
PPP	MIA	Average inflation rate	nc	+
PPP	MIE	End-of-year inflation rate	nc	+
PPP	mp / mpn	The cost of insurance per RM1,000 of coverage	–	–
DCP	MCBR	Crude live-birth rate	nc	nc
DCP	MCDR	Crude death rate	+	nc
DCP	MTFR	Total fertility rate	nc	nc
DCP	MLEm	Life expectancy at birth for males	–	nc
DCP	MLEf	Life expectancy at birth for females	–	nc

NB: "nc" denotes not clear about the expected sign.

Table 6.4
The Variables and Their Operational Definitions for the Comparative Study

Proxy	Variable Malaysia	Operational Definition Malaysia	Variable US	Operational Definition US	Expected Sign Demand	Expected Sign Lapse
DEMAND	mndif	The number of policies in force for combined life insurance business (comprise life and home service businesses)	usndif	The number of policies in force for all life policies (comprise individual, group and credit policies)		
DEMAND	madif	Sums insured in force for combined life insurance business (comprise life and home service businesses)	usadif	Sums insured in force for all life policies (comprise individual, group and credit policies)		
LAPSE	MSRN	Surrender rate (by amount)	USSR	Surrender rate (by amount)		
ABS / EFH	mgdp	Gross domestic product	usgdp	Gross domestic product	+	–
ABS / EFH	mipc	Income per capita	usipc	Income per capita	+	–
ABS / EFH	MSMR	Stock market return	USSMR	Stock market return	+	–
ABS	MFD	The ratio of quasi-money to broad money expressed in percentage term	USFD	The ratio of quasi-money to broad money expressed in percentage term	+	
ABS	mm2n	The broad definition of money	usm2	The broad definition of money	+	
EFH	MUR	Commonly defined unemployment rate	USRUR	Commonly defined unemployment rate		+
EFH	MRUR	Registered unemployment rate				+
DS / IRH	MTBR1Y	Average discount rate on 12-month treasury bills	USTBR1Y	US Treasury one-year yield	–	+
PPP	MIE	End-of-year inflation rate	USIE	End-of-year inflation rate	nc	+
DCP	MCBR	Crude live-birth rate	USCBR	Crude live-birth rate	nc	nc
DCP	MCDR	Crude death rate	USCDR	Crude death rate	+	nc
DCP			USADR	Age-adjusted death rate	+	nc
DCP	MTFR	Total fertility rate	USTFR	Total fertility rate	nc	nc
DCP	MLEm	Life expectancy at birth for males	USLEm	Life expectancy at birth for males	–	nc
DCP	MLEf	Life expectancy at birth for females	USLEf	Life expectancy at birth for females	–	nc

NB: “nc” denotes not clear about the expected sign.

CHAPTER 7
DATA ANALYSIS PROCEDURES

7.1 Overview of Data Analysis Procedures

A dynamic, general-to-specific (Gets) (Hendry and Krolzig 2001) approach is adopted in order to analyse the data. A general estimation equation of an autoregressive distributed lag (ADL) model that is congruent with the evidence from the available data is formulated to be subject to a subsequent simplification process. The general model is tested against a range of potential mis-specifications in order to ensure data coherence. If the general model passes all of the mis-specification tests, then the general model is subject to subsequent simplifications. In the simplification process, the statistically insignificant variables are eliminated, with various mis-specification tests checking the validity of the reduction, in order to ensure that a congruent specific model that loses no significant information about the desired relationship from the data sample available is obtained. Consequently, the specific model obtained is parsimonious, encompassing the general model, and is not dominated by any other model.

Initially, the analysis was carried out manually using the econometric package EViews (Quantitative Micro Software, 1994-2000). The manual simplification process checks for model mis-specifications using tests such as the residual serial correlation test (i.e. Lagrange Multiplier test), normality test (i.e. Jacque-Bera normality test) and heteroscedasticity test (i.e. White test) to ensure that the final simplified model is free of mis-specifications. After the simplifications, the redundant variables test (being a verification test) is used to confirm that the variables which have been removed sequentially from the general model are indeed redundant and are therefore appropriate to be deleted, i.e. these variables jointly have zero coefficients. Further, with the presence of a group of non-stationary variables in the final simplified model, these variables are subject to a cointegration test (i.e. Engle-Granger test) (being a test in extension to the unit root test) in order to determine whether they are cointegrated. If the variables are cointegrated, the spurious regression problem (i.e. a situation where the residuals of the regression model have a unit root caused by the non-stationary behaviour of the variables that are not cointegrated, which results in the residuals having a trend and becoming increasingly large over time) does not exist and a further step is taken to identify the cointegrating relationship among them as these variables have a long-term (or equilibrium) relationship.

The manual simplification method adopted is a lengthy and cumbersome process, and demands full concentration to ensure that the simplifications are done properly. In view of this, consideration has been given in trying the use of other statistical packages in order to explore the possibilities to automate the simplification process. First, the data were analysed using the backward method of stepwise regression analysis in SPSS (SPSS Inc., 1997). The results obtained from the backward method of stepwise regression analysis and the manual simplification method were then compared. The preliminary results indicate that the final simplified model obtained from the backward method of stepwise regression analysis is different from the model obtained from the manual simplification method. It has been observed that, although the manual simplification method adopted is cumbersome and lengthy, it does give careful consideration to a variable before it is deleted by judging not only the significance value of the t-test but also the potential problems of mis-specification. However, the backward method of stepwise regression analysis carries out the deletion based on a purely mathematical criterion, i.e. a variable is deleted when it meets the removal criterion which can be either an absolute value of or a probability value for the test statistic. Subsequently, we have discovered an econometric package called PcGets (Hendry and Krolzig 2001). PcGets is a computer-automated software for econometric model selection that is capable of implementing simplifications automatically and takes care of mis-specifications along the simplification process. Thus, a decision was made to use PcGets in order to facilitate the analyse in this thesis.

PcGets adopts a Gets approach to econometric modelling. It first tests the general model for congruence. Then it removes the completely irrelevant variables subject to retaining congruence. After that PcGets checks all of the initially feasible reduction paths to remove the less obviously irrelevant variables before it tests between the contending models by encompassing tests in order to obtain the specific model.

The studies in this thesis have used the two built-in pre-defined modelling strategies available in PcGets, namely the liberal and conservative strategies. One more option is available in PcGets, that is the expert user's strategy that allows the users to customise the modelling settings according to their desire. The expert user's strategy is not used here because the pre-defined liberal and conservative strategies are already very useful in performing the simplification in two contrasting manners so that the needs to customise the modelling settings do not arise. The liberal and conservative strategies are two extreme modelling strategies in which the liberal strategy is the opposite extreme to the conservative strategy. The liberal strategy focuses on minimising the non-selection probability of relevant variables so that there is a higher probability of retaining the relevant variables (but also at the risk of retaining the irrelevant variables). On the contrary, the conservative strategy focuses on minimising the non-deletion probability of irrelevant variables so that there is a higher probability of eliminating the irrelevant variables (but also at the risk of eliminating the relevant variables).

The two extreme modelling strategies are chosen for analysis so that a comparison can be made between the findings using the liberal strategy (that aims to keep as many as possible of the variables that matter) and the conservative strategy (that aims to avoid retaining irrelevant variables) in order to identify the variables that are strictly related to the demand for and lapsation of life insurance.

The step-by-step data analysis procedures are discussed in more detail below.

7.2 Transformation of Variables

A transformation is made to variables of level-value form. However, the variables of rate-value form are not subject to a transformation because they are already in a preferred form as they are a measure of change. They comprise variables expressed in percentage terms such as the various types of lapse rate, stock market return, financial development [expressed in percentage term calculated as the ratio of quasi-money (M2–M1) to broad money (M2)], unemployment rate, the various types of interest rate offered by alternative investment products, inflation rate, crude live-birth rate, death rate and total fertility rate.

The variables of level-value form are subject to a transformation by taking the natural logarithm of their level-values. The transformed variables are clearly monotonic functions of the underlying variables. The variables of level-value form are subject to the logarithmic transformation for ease of interpretation so that their relevant regression parameters can be interpreted as the elasticity of demand or lapsation with respect to the variables [i.e. $d(\ln Y)/d(\ln X)$]. The variables of level-value form such as the demand for life insurance defined by the amounts of new business and business in force, the value of GDP, the value of income per capita, the value of M2 and the cost of insurance per RM1,000 of coverage (or the price of insurance) are subject to the logarithmic transformation. However, the life expectancy variables are not subject to a transformation even though they are of level-value form so that their relevant regression parameters indicate the proportional or relative change in demand or lapsation [i.e. $\ln Y_t - \ln Y_{t-1} \approx (Y_t - Y_{t-1})/Y_{t-1}$] in response to an absolute change in the life expectancy at birth for males and females (i.e. $X_t - X_{t-1}$).

7.3 Examination of Time Series Graphs

A collection of time series graphs is plotted for each of the variables in their original (non-differenced) series in order to provide the first impression about the likely nature of the time series before a formal unit root test is applied to the individual variables to investigate their stationarity property. (Refer to Figures 7.1 and 7.2 for the time series graphs of the Malaysian and US data respectively.)

For the Malaysian data set, the time series graphs show that the dependent variables for the demand for life insurance by number, by amount and by premium (mnd, mad, mpd, mnifptp and maifpc) appear to trend upward from 1969 to 2001. Meanwhile, the dependent variables for lapsation of life insurance (MFR1, MFR2, MFR3, MSR and MSRN) seem to be volatile over time during 1969-2001. The explanatory variables such as the stock market return (MSMR), savings deposit rate (MSDR), fixed deposit rate (MFDR), the discount rates on treasury bills (MTBR3M and MTBR1Y) and inflation rates (MIA and MIE) tend to exhibit some large variations from time to time with noticeable ups and downs throughout the period under investigation. On the other hand, other explanatory variables tend to exhibit either an upward or a downward trend over time. The GDP (mgdp), income per capita (mipc), the measures for financial development (MFD, mm2, mm2n) together with the life expectancy at birth for males and females (MLEm and MLEf) appear to be increasing steadily over time. Meanwhile, the time series graphs for unemployment rates (MUR and MRUR), the prices of insurance (mp and mpn), crude live-birth rate (MCBR), crude death rate (MCDR) and total fertility rate (MTFR) tend to exhibit very similar patterns of behaviour. In general, they tend to sustain a downward movement from 1969 to 2001.

For the US data set, the time series graphs show that the dependent variable for life insurance demand by number (usnifptp) is trending downward but life insurance demand by amount (usaifpc) is trending upward whilst lapsation of life insurance (USSR) is volatile over time during 1969-2001. On the other hand, the explanatory variables such as the stock market return (USSMR), unemployment rate (USUR), the discount rate on treasury bills (USTBR1Y), inflation rate (USIE), crude live-birth rate (USCBR), crude death rate (USCDR) and total fertility rate (USTFR) tend to exhibit some large variations from time to time with noticeable ups and downs throughout the period under investigation. Other explanatory variables such as the GDP (usgdp), income per capita (usipc), the measures for financial development (USFD and usm2) together with the life expectancy at birth for males and females (USLEm and USLEf) appear to be trending upward over time while the age-adjusted death rate (USADR) clearly shows that it is trending downward over time.

These time series variables are subject to a formal unit root test later. In general, a constant is included in their Dickey-Fuller (DF) regressions for those time series that do not exhibit any trend and have a non-zero mean. On the other hand, a constant and a linear trend are added to their DF regressions for those time series that seem to contain a trend (whether deterministic or stochastic) (Quantitative Micro Software, 1994-2000).

7.4 Testing for Unit Root

A non-stationary time series has a unit root and contains a stochastic trend. A stationary time series does not contain a unit root but it may contain a deterministic trend. These two types of time series can yield time series graphs that resemble each other, exhibiting a trending behaviour. Thus, by looking at the time series graphs alone is not enough to tell whether a time series has a unit root. Therefore, a unit root test is applied to the variables to investigate formally their stationarity property.

Initially, a constant and a linear trend are added to the DF regressions of all the time series variables. If the results indicate that the trend is insignificant, the DF regressions of the respective time series variables are re-estimated with the inclusion of only a constant.

The DF unit root test is applied to the variables in their original (non-differenced) series (but other options are available such as in the first-differenced or second-differenced series). However, the parameters in the original series (i.e. $Y_t=\alpha+\beta t+\phi Y_{t-1}+e_t$) have been re-parameterised so that the dependent variable is expressed as a first-differenced series (i.e. $\Delta Y_t=\alpha+\beta t+\rho Y_{t-1}+e_t$) and with the inclusion of sufficient lags of ΔY_t (e.g. ΔY_{t-1}, ΔY_{t-2}, etc.) to yield approximately white noise residuals (in order to eliminate residual serial correlation).

The re-parameterisation is done for two reasons (Koop, 2000). First, it is to make the testing straightforward so that we are testing whether a regression coefficient is zero (i.e. $\rho=0$) in the re-parameterised equation (i.e. $\Delta Y_t=\alpha+\beta t+\rho Y_{t-1}+e_t$) rather than testing whether a regression coefficient is a unit root (i.e. $\phi=1$) in the original equation (i.e. $Y_t=\alpha+\beta t+\phi Y_{t-1}+e_t$). Second, it is to avoid the problem of multicollinearity because the explanatory variables in the re-parameterised equation such as Y_{t-1}, ΔY_{t-1}, ..., ΔY_{t-p+1} tend not to be highly correlated but the explanatory variables in the original equation such as Y_{t-1}, Y_{t-2}, ..., Y_{t-p} are often highly correlated.

The DF test takes the unit root as the null hypothesis. In particular, the test specification is $H_0:\rho=0$ against $H_1:\rho<0$. The significance level of 5% is adopted as a guide for decisions on hypotheses. If the DF test statistic is less negative than the critical value at 5%, the null hypothesis of a unit root is not rejected in favour of the one-sided alternative. It can be concluded that these time series variables are non-stationary. These non-stationary variables are subject to a further analysis in order to verify that they have a unit root by applying the DF unit root test again to these variables in their first-differenced series (but in a re-parameterised format where the dependent variable is expressed as a second-differenced series) in order to ensure that the first-differenced series of these non-stationary variables are in fact stationary.

Based on the explanation above, all of the time series variables in the studies of this thesis are subject to the DF unit root test. For the Malaysian data, the variables such as MSR, MSRN, MSMR, MFD, MUR, MRUR, MSDR, MFDR, MTBR3M, MTBR1Y, MIA, mp, mpn, MCDR and MLEm, a constant is included in their respective DF regressions. Meanwhile, for the variables such as mnd, mad, mpd, mnifptp, maifpc, MFR1, MFR2, MFR3, mgdp, mipc, mm2, mm2n, MIE, MCBR, MTFR and MLEf, a constant and a linear trend are added to their respective DF regressions. On the other hand, for the US data, the variables such as USSR, USSMR, USFD, USUR, USTBR1Y, USCBR, USCDR, USADR, USLEm and USLEf, a constant is included in their respective DF regressions. Meanwhile, for the variables such as usnifptp, usaifpc, usgdp, usipc, usm2, USIE and USTFR, a constant and a linear trend are added to their respective DF regressions.

The summary results of the DF unit root test for the Malaysian and US data are displayed in Tables 7.1 and 7.2 respectively. From the first part of the two tables showing the results for the variables in their original (non-differenced) series, the variables of the Malaysian data set such as mnd, mnifptp, maifpc, MFR1, MFR2, MFR3, MSMR, MRUR, MIA, MIE, mp, mpn, MCBR and MCDR, and the variables of the US data set such as usgdp, usipc, USSMR, USFD, usm2, USIE and USTFR are stationary (i.e. the DF test statistic is more negative than the critical value at 5%).

On the other hand, it is observed that the DF test statistic is less negative than the critical value at 5% for the following variables of the Malaysian data set: mad, mpd, MSR, MSRN, mgdp, mipc, MFD, mm2, mm2n, MUR, MSDR, MFDR, MTBR3M, MTBR1Y, MTFR, MLEm and MLEf, and for the following variables of the US data set: usnifptp, usaifpc, USSR, USUR, USTBR1Y, USCBR, USCDR, USADR, USLEm and USLEf . Therefore, the null hypothesis of a unit root is not rejected in favour of the one-sided alternative. It can be concluded that these time series variables are non-stationary. These non-stationary variables are subject to a further analysis in order to verify that they have a unit root by applying the DF unit root test again to these variables in their first-differenced series with a constant included in their respective DF regressions (but in a re-parameterised format where the dependent variable is expressed as a second-differenced series and with the inclusion of sufficient lags of the dependent variable) in order to ensure that the first-differenced series of these non-stationary variables are in fact stationary. (Refer to the second part of Tables 7.1 and 7.2 which shows the unit root test results for the non-stationary variables in their the first-differenced series.) (Refer to Figures 7.3 and 7.4 for the time series graphs of the non-stationary variables for the Malaysian and US data respectively.)

7.5 Formulation of General Unrestricted Model (GUM)

The empirical analysis commences from a GUM. The formulation of a GUM is based upon the evidence from the available data (Hendry and Krolzig 2001): the type of data (i.e. time series), the size of sample (i.e. small with 32 data points), the number of different potential variables (i.e. small with 11 potential variables), the findings of past empirical and theoretical studies, likely functional-form transformations (e.g. logarithmic transformation) and appropriate parameterisations (e.g. in original/non-differenced series or in differenced terms), known anomalies (e.g. measurement changes and breaks) and the availability of data.

For the studies in this thesis, a GUM is formulated as an autoregressive distributed lag model with one lag for each of the potential variables [i.e. ADL(1,1)]. Lagged variables are included in the GUM because time series variables often have a time lagged influence. The choice of the lag length in the GUM, which is set to be one, is kept small because of the small sample size. Thus, the GUM is formulated as shown below:

$$\boxed{Y_t = C_0 + b_0 Y_{t-1} + \sum_{i=1}^{k} \sum_{j=0}^{1} b_{i,j} X_{i,t-j} + e_t}$$

where

Y_t	=	the dependent variable
Y_{t-1}	=	the dependent variable lagged one period
$X_{i,t-j}$	=	the explanatory variables
C_0	=	the intercept
b_0	=	the regression coefficient of the dependent variable lagged one period
$b_{i,j}$	=	the regression coefficients of the explanatory variables
e_t	=	the error term

In the formulation of the GUM, care is taken not to mix the variables of different degrees of integration[1]. Since PcGets conducts all inferences with the assumption that the data are of zero integration [i.e. I(0) or stationary], the GUM is formulated in such a way that all of the data for the potential variables are of I(0). Appropriate parameterisation is given due consideration to the variables that have a unit root [i.e.

[1] I(0) variable is the variable of zero integration. It has a stationarity property. Therefore, it does not need any differencing to achieve stationarity. On the other hand, I(1) variable is the variable that has a unit root. It is a non-stationary variable and needs to be differenced once in order to achieve stationarity, that is its first-differenced term is stationary.

I(1)] so that their first-differenced terms [which are stationary, i.e. I(0)] are included in the GUM. Meanwhile, for variables that are stationary, their original (non-differenced) series are included in the GUM.

7.6 Testing for Mis-specifications

Once the GUM is formulated, the next step is to conduct the mis-specification tests in order to check the main attributes of congruence of the GUM (Hendry and Krolzig 2001). The mis-specification tests are conducted on the residuals and the parameters. The residuals are examined for autocorrelation, heteroscedasticity and normality in order to ensure that they are not serially correlated (i.e. the residuals are white-noise errors), homoscedastic and normally distributed. Meanwhile, the parameters are examined for constancy in order to ensure that they are stable over time.

The approximate F-test formulations are used to make decisions on the rejection of the null hypothesis. If the initial mis-specification tests are significant at the pre-specified level, the required significance level is lowered and the search paths are terminated only when the lower level is violated. For both the liberal and conservative strategies, the pre-specified significance level is 0.01 and the lowered significance level is 0.005.

The testing for congruence of the model is also maintained throughout the simplification process. Thus, in each instance, PcGets finds a valid parsimonious simplification of the GUM. The mis-specification tests serve as a diagnostic check ensuring that the specific model obtained is a congruent model.

Testing for Residual Autocorrelation. It is important that the residuals of the general model be examined for the evidence of serial correlation before any model is used for statistical inference. If the test indicates the presence of residual serial correlation, the ordinary least squares (OLS) standard errors are invalid and cannot be used for inference. The Lagrange Multiplier serial correlation test is used to test for p^{th}-order residual serial correlation. The test is valid for regression models with lagged dependent variables, whereas neither the Durbin-Watson test nor the residual correlogram test provides a valid test in that case. The null hypothesis of the Lagrange Multiplier serial correlation test is that there is no residual serial correlation up to the lag order specified. The test statistic of the Lagrange Multiplier serial correlation test is computed based on an auxiliary regression where the residuals (i.e. u_t – the deviations from the estimated regression line) are regressed on all of the original regressors ($X_{i,t}$) and the lagged residuals up to the lag order specified (u_{t-p}). For example, for the 4^{th}-order residual autocorrelation test, the auxiliary regression is formulated as such (Quantitative Micro Software, 1994-2000; Hendry and Krolzig, 2001):

$$u_t = \sum_{i=0}^{m} \beta_i X_{i,t} + \sum_{p=1}^{4} \alpha_p u_{t-p} + \varepsilon_t$$

where ε_t is an error term, $\varepsilon_t \sim IID(0, \sigma^2)$.

From the above, the error autocorrelation coefficient is estimated by the regression coefficient of the lagged residual. A decision is made using an F-test that is based on TR^2 (in which T is the sample size) in order to test the joint significance of all the lagged residuals, i.e. the lagged residuals collectively have zero coefficients.

In the analysis, the residuals (i.e. u_t – the deviations from the estimated regression line) are used in place of the (unknown) errors (i.e. e_t – the deviations from the true regression line). This is because the true regression line is unobservable, therefore the error (e_t), being the distance between the data point and the true regression line, is also not known. The substitution is made on the basis that errors (e_t) and residuals (u_t) are closely related. This substitution also applies to the heteroscedasticity test.

Testing for Heteroscedasticity. The heteroscedasticity test is conducted in order to ensure that the OLS estimators have minimum variance. In the presence of heteroscedasticity, the standard errors computed conventionally are no longer valid because they do not have minimum variance, even though the OLS estimators are still unbiased and consistent. The test investigates the presence of heteroscedasticity in the variance of the residuals. White's heteroscedasticity test using squares (but with no cross terms) is used for this purpose. The null hypothesis under White's heteroscedasticity test is that there is no heteroscedasticity in the variance of the residuals (i.e. the residuals are unconditional homoscedastic or they have constant variance) against the alternative that there is some evidence of heteroscedasticity of some unknown form in the variance of the residuals [i.e. the variance of the residuals depends on the time-t original ($X_{i,t}$) and squared ($X_{i,t}^2$) regressors]. The test statistic of White's heteroscedasticity test using squares (but with no cross terms) is computed based upon an auxiliary regression of the squared residuals (u_t^2) on a constant (C_1), the original regressors ($X_{i,t}$) and their original regressors squared ($X_{i,t}^2$) (but with no cross-product terms of the regressors) as shown below (Quantitative Micro Software, 1994-2000; Hendry and Krolzig, 2001):

$$u_t^2 = C_1 + \sum_{i=0}^{n} \delta_i X_{i,t} + \sum_{i=0}^{n} \gamma_i X_{i,t}^2 + v_t$$

where v_t is an error term, $v_t \sim IID(0, \sigma^2)$.

The F-test based on TR^2 (in which T is the sample size) is used to make a decision in testing the joint significance of all the terms (except the constant) in the auxiliary regression, i.e. all of the original and squared regressors collectively have zero coefficients.

Testing for Normality. The classical normal linear regression model assumes that the residuals (u_t) are normally and independently distributed, i.e. $u_t \sim IID(0, \sigma^2)$. In other words, the residuals are uncorrelated and independently distributed, with zero covariance or correlation among one another. They have zero mean value and a variance of σ^2.

The residuals are the combined influence on the dependent variable of a large number of explanatory variables that are not explicitly introduced into the estimated regression. Thus, it is hoped that the influence of these omitted or neglected variables is small and at best random.

The normality assumption for the residuals plays a critical role in the investigations in this thesis where there is a small sample size (Gujarati, 2003). Although, the OLS estimators derived from a small sample size are assumed to possess the desirable statistical properties of being minimum-variance unbiased estimators (i.e. the small-sample properties), it often happens that an estimator does not satisfy one or more of the desirable statistical properties mentioned (in which one way of rectifying the problem is to increase the sample size). Since there is a limitation on the size of the sample for the studies in this thesis, the assumption that the residuals follow the normal distribution is of paramount importance so that the OLS estimators are confirmed to have the desirable statistical properties mentioned above (i.e. unbiasedness and minimum variance) but also they are consistent (that is the estimators converge to their true population values as the sample size increases).

Further, with the normality assumption for the residuals, the probability distribution of the OLS estimators can be derived easily. Under the normality assumption, any linear function of normally distributed variables is itself normally distributed. The OLS estimators are linear functions of the residuals. Therefore, the OLS estimators are normally distributed, if the residuals are normally distributed. This makes hypothesis testing straightforward as it enables the use of t, F and χ^2 statistical tests for the estimated regression.

The Jacque-Bera normality test is used to examine whether a data series is normally distributed (Quantitative Micro Software, 1994-2000). Under the Jacque-Bera normality test, the null hypothesis is that the data series has a normal distribution. More formally, for the case here, the null hypothesis is that the residuals are normally distributed.

The Jacque-Bera normality test is an approximation to the χ^2 test with two degrees of freedom [$\chi^2(2)$]. The test statistic measures the difference between the skewness and kurtosis of the residuals and that of a normal distribution. The reported probability is the probability that the Jacque-Bera statistic exceeds the critical value under the null hypothesis.

Testing for Parameter Constancy. The Chow test is used to examine the constancy of parameters. The test estimates the regression model for a sub-sample consisting of the first T_1 observations. The estimated regression is then used to predict the values of the dependent variable in the remaining T_2 (=$T-T_1$) data points. A large difference between the actual and predicted values casts doubt on the stability of the estimated relation over the two sub-samples.

The null hypothesis of Chow test is that the parameter is constant. The test statistic of Chow test has an exact finite sample F-distribution only if the residuals are independent and normally distributed (IID). The test statistic of Chow test is computed as such (Hendry and Krolzig, 2001):

$$\boxed{F = \frac{(RSS_T - RSS_{T1})/(T - T_1)}{RSS_{T1}/(T_1 - k)}}$$

where

RSS_T	=	the full-sample residual sum of squares
RSS_{T1}	=	the sub-sample residual sum of squares
T	=	the full sample size
T_1	=	the size of sub-sample 1
T_2	=	the size of sub-sample 2
k	=	the number of regressors

7.7 Pre-search / Pre-selection Simplifications

Once the congruence of the GUM is established, the GUM is subject to three stages of cumulative simplification: the lag-order pre-selection, top-down and bottom-up simplications (Hendry and Krolzig, 2001). These are pre-search testings or pre-selection checks in the form of F-tests. Loose (i.e. non-stringent or high) significance levels are used to eliminate highly irrelevant variables, either individually or in blocks (such as all variables at a given lag). These three stages of simplification acting together are capable of filtering out many irrelevant variables but yet retaining almost all of the relevant variables that matter.

For time-series data, the first stage of simplification is the block tests of lag length. An F-test checks the longest-lag blocks until the null hypothesis is rejected at the pre-assigned selection criterion. A non-stringent significance level is used in the first stage of simplification. For the liberal and conservative strategies, the significance levels are 0.9 and 0.75 respectively. For the studies in this thesis, the longest lag is one. Therefore, PcGets conducts an F-test to check the significance of all the variables at lag one to examine whether a block of them can be eliminated from the GUM.

At the second stage of simplification, groups of variables are tested in the order of their t^2-statistics, starting from the smallest (i.e. the most insignificant) upwards, in which a cumulative F-test checks the increasing block sizes until the null hypothesis is rejected at the pre-assigned selection criterion when no further deletion is possible. Two rounds of top-down simplification are conducted in this stage. Likewise, non-stringent significance levels are used in the second stage of simplification. For the liberal strategy, the significance level for the first round of simplification is 0.9 and for the second round is 0.75. For the conservative strategy, the significance levels are 0.75 and 0.5 for the first and second rounds of simplification respectively. A high probability of eliminating the most irrelevant variables is employed at this stage in order to avoid the risk of omitting variables that have an effect that might matter but are not very significant in the GUM (so that the GUM is not heavily over-parameterised) because the insignificant variables deleted are permanently removed from the GUM.

At the third stage of simplification, the checks are carried out in the opposite direction, starting from the largest t^2-statistics (i.e. the most significant) downwards. A cumulative F-test checks the decreasing block sizes until the null hypothesis is not rejected at the pre-assigned selection criterion so that the variables that are highly significant are being retained. A more stringent significance level is used in the third stage of simplification. For the liberal strategy, the significance level is 0.125 and for the conservative strategy, it is 0.05.

7.8 Simplifications via Multiple Search Paths

In this step (Hendry and Krolzig, 2001), all of the paths that commence with an insignificant t-deletion are explored. The significance levels for the t-tests with respect to the liberal and conservative strategies are 0.1 and 0.025. As part of the simplification process, a non-null set of final models is selected. The final models are the distinct minimal congruent models found along all of the search paths. If a unique model results, it is selected. However, when more than one congruent final model is found, an encompassing test is employed in order to make a choice between the models.

7.9 Testing for Encompassing

Encompassing tests select between the contending models at the end of the search paths. Each contending model is tested against their union, dropping those which are dominated by and do not dominate other contending models. The significance level for the liberal strategy is 0.125 whereas for the conservative strategy is 0.05.

If a unique model results, it becomes the specific model. Otherwise, if some models are rejected, a union model is formulated based upon the remaining models (that are not rejected) and the encompassing test is used to select between them until no encompassing reductions result. If all of the models are rejected, the union is the specific model. If one model survives, it is the specific model. However, when all of the models are non-dominated final models, their union is formed. The union then constitutes a new starting point and the complete path-search algorithm is repeated until the union is unchanged between successive rounds (i.e. the new union coincides with the previous union). In this case, an information criterion is used to choose between the models in order to identify the specific model (Hendry and Krolzig, 2001).

7.10 Selection of Preferred Final Model Based on Information Criteria

When a union coincides with the original GUM or with a previous union, no further feasible reduction can be found. In such a situation and when there are several parsimoniously un-dominated models, an information criterion based on the Schwarz Criterion is employed by PcGets to select a model as the preferred final model (or the specific model) (Hendry and Krolzig, 2001).

7.11 Testing for Sub-sample Reliability

Once the specific model is obtained, the sub-sample reliability test is applied to the specific model in which the significance of every variable retained in the specific model is examined in two overlapping sub-samples (Hendry and Krolzig, 2001). The reliability test is a post-selection check The test is based on the Hoover-Perez overlapping split-sample criterion. It mimics the application of recursive estimation. The purpose of the test is to assess the reliability of the retained coefficients in order to help with evaluating the overall significance of the variables contained in the specific model (i.e. the full-sample). The split-sample reliability testing is particularly powerful for model selection when breaks occur over either of the sub-samples. For the liberal and conservative strategies, the significance levels for the reliability test are 0.125 and 0.05 respectively.

From the results showing the reliability varying from 0% to 100%, a conclusion can be made that some variables are definitely included while some have an uncertain role, noting that further simplification of the specific model may induce some violations of congruence or encompassing. A reliability of 100% implies that the variables in the specific model are significant and they are also significant in both the sub-samples. On the other hand, a reliability of 0% indicates the opposite, i.e. the variables in the specific model are insignificant and they are also insignificant in the two separate sub-samples.

7.12 Re-specification / Re-parameterisation of Estimation Equations

A need might arise to re-specify (re-parameterise) the prevailing specific model when the signs of the original (at time t) and lagged (at time t−1) regressors have a different sign and when their estimated coefficients are of roughly the same magnitude. In such a case, both the original and lagged regressors are dropped from the model and the differenced term of the variable is introduced instead in order to capture the short-run dynamics of this variable (Harris, 1995). The re-specified (re-parameterised) model is then subject to the simplification process until a final specific model is obtained.

7.13 Testing for Cointegration and Error Correction Model (ECM)

With the presence of a group of variables that have a unit root in the final specific model, these variables are subject to a cointegration test in order to determine whether they are cointegrated. This test is an extension to the unit root test conducted earlier. If these variables are cointegrated, a further step is taken to identify the cointegrating relationship among these variables which represents a long-term (or equilibrium) relationship among them (Koop, 2000; Gujarati, 2003).

For the purpose of testing for cointegration, the Engle-Granger test is used to determine whether the non-stationary variables (that have a unit root) are cointegrated. The Engle-Granger test uses the DF methodology to examine the properties of the residuals in order to investigate the presence of cointegration. However, in the cointegration test, the residuals (instead of the time series variables in the DF unit root test) are tested for a unit root. In other words, the null hypothesis in the Engle-Granger test is "no cointegration" (versus the unit root hypothesis in the DF unit root test) against the alternative hypothesis of "cointegration is present" (versus the stationary hypothesis in the DF unit root test). In particular, the test for cointegration involves the following steps:

Stept-1: Run the preliminary regression model of Y (i.e. the dependent variable that has a unit root) on X (i.e. the explanatory variable that has a unit root), i.e. $Y_t=\alpha+\beta X_t+e_t$, and save the residuals, i.e. $e_t=Y_t-\alpha-\beta X_t$.

Step-2: Perform a unit root test on the residuals (without including a deterministic trend in the DF regression) in their original (non-differenced) series but in a re-parameterised format where the dependent variable is expressed as a first-differenced series, i.e. $\Delta e_t=\alpha+\rho e_{t-1}+v_t$. The deterministic trend is not included so that it indicates that the residuals stay small and do not grow too large over time and hence the model returns to equilibrium. If such a trend were included, it would mean that the residuals could be growing steadily over time which violates the idea of cointegration.

Step-3: If the unit root hypothesis is rejected (i.e. the residuals are stationary), conclude that Y and X are cointegrated (and there is an equilibrium relationship between them). If we fail to reject the unit root hypothesis (i.e. the residuals have a unit root), conclude that cointegration does not exist (and there is no equilibrium relationship between Y and X).

If X and Y are cointegrated, they have a long-term (or equilibrium) relationship between them. As the residuals of the OLS regression model of Y on X are stationary, the spurious regression problem does not occur. In fact, the OLS regression model is the cointegrating regression model (or the long run / static regression model) and the coefficient of this regression is the long run multiplier (i.e. the long-run influence of X on Y).

If cointegration is present between Y and X, the Granger Representation Theorem states that their relationship can be expressed as an ECM that contains important economic information as shown below (Koop, 2000; Gujarati, 2003):

$$\Delta Y_t = \varphi + \lambda e_{t-1} + \omega_1 \Delta X_t + \varepsilon_t$$

where

ΔY_t	=	the dependent variable
ΔX_t	=	the explanatory variable
e_{t-1}	=	the equilibrium error term being the one-period lagged value of the residual from the cointegrating regression model
ε_t	=	the error term in the ECM
φ	=	the constant
λ	=	the regression coefficient of the equilibrium error term, which is the stability condition for an ECM and it is expected to be less than zero, $\lambda<0$
ω_1	=	the regression coefficient of the explanatory variable

The ECM indicates that changes in Y (ΔY) depend on changes in X (ΔX) and also the one-period lagged value of the residual from the cointegrating regression model (i.e. the equilibrium error term, e_{t-1}). If X changes, the equilibrium value of Y will change so that changes in X cause Y to change accordingly. Statistically, if the equilibrium error term is zero ($e_{t-1}=0$), this suggests that Y adjusts to changes in X in the same period. If the equilibrium error term is non-zero ($e_{t-1}\neq 0$), the model is out of equilibrium and Y will be pulled towards equilibrium in the next term. For example, if the equilibrium error term is positive ($e_{t-1}>0$), this implies that Y_{t-1} is above its equilibrium level. As λ

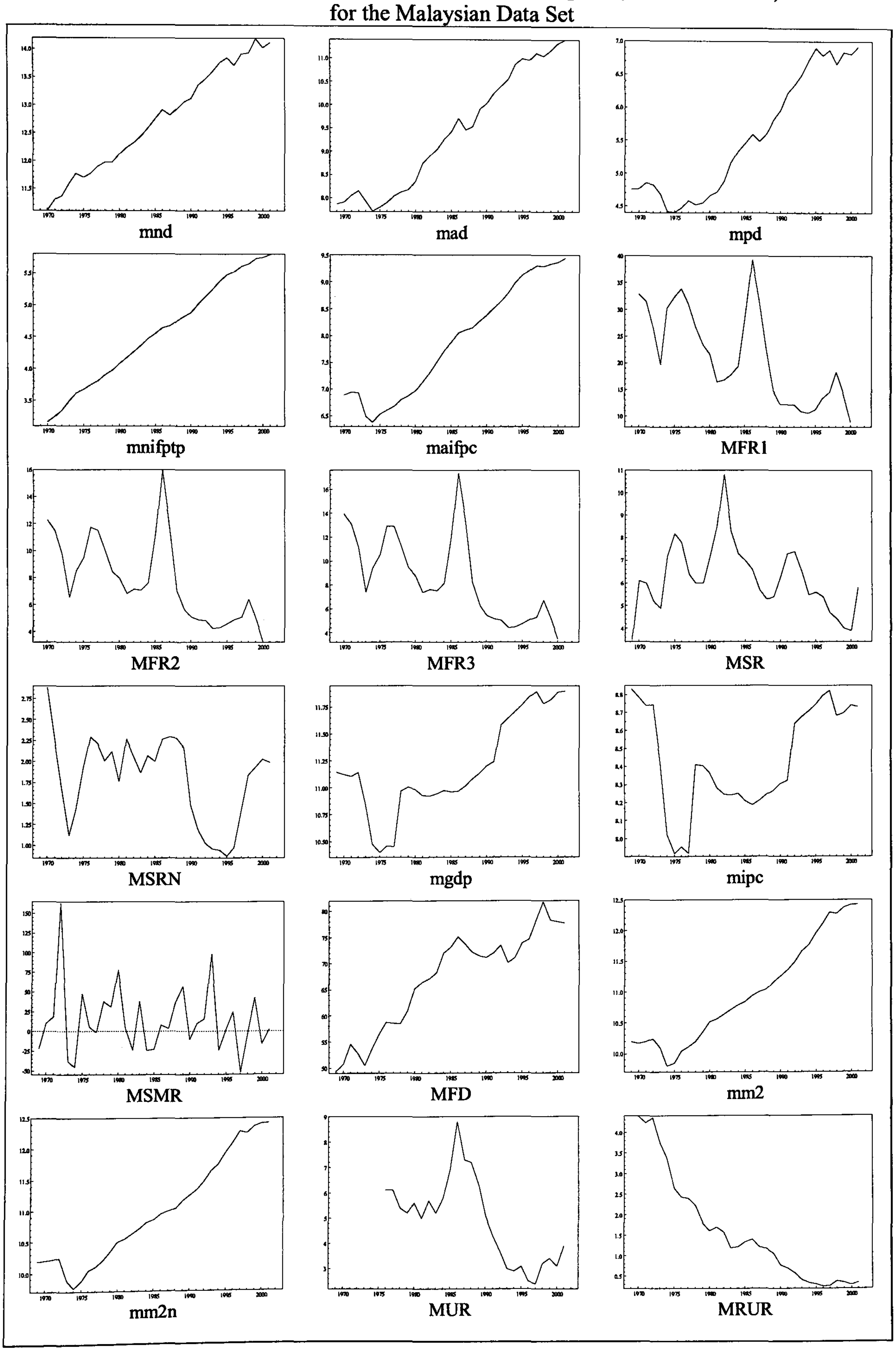
is expected to be negative ($\lambda<0$), the term λe_{t-1} is negative and this causes Y to fall in the next period (i.e. in period t). By the same token, if the equilibrium error term is negative ($e_{t-1}<0$), the opposite will hold. This implies that Y_{t-1} is below its equilibrium level. The term λe_{t-1} is positive and it leads Y to rise in the next period to restore the equilibrium. Meanwhile, the absolute value of φ determines the speed in which the equilibrium is restored.

7.14 Concluding Comments

PcGets is superior to SPSS as an automated software in performing the simplification of the general model in order to obtain the specific model. The SPSS carries out the reduction only based on a purely mathematical criterion but PcGets adopts a rigorous approach in simplifying the general model and ensures the congruence of the simplified model in each instance. The use of an automated software in the simplification process has saved the author considerable amounts of time that otherwise would have been used to carry out the simplification manually. This has allowed more time to be allocated to interpreting the results and other aspects of the investigation.

APPENDIX CHAPTER 7

Figure 7.1
Multiple Time Series Graphs for Variables in Their Original (Non-differenced) Series
for the Malaysian Data Set



Continue

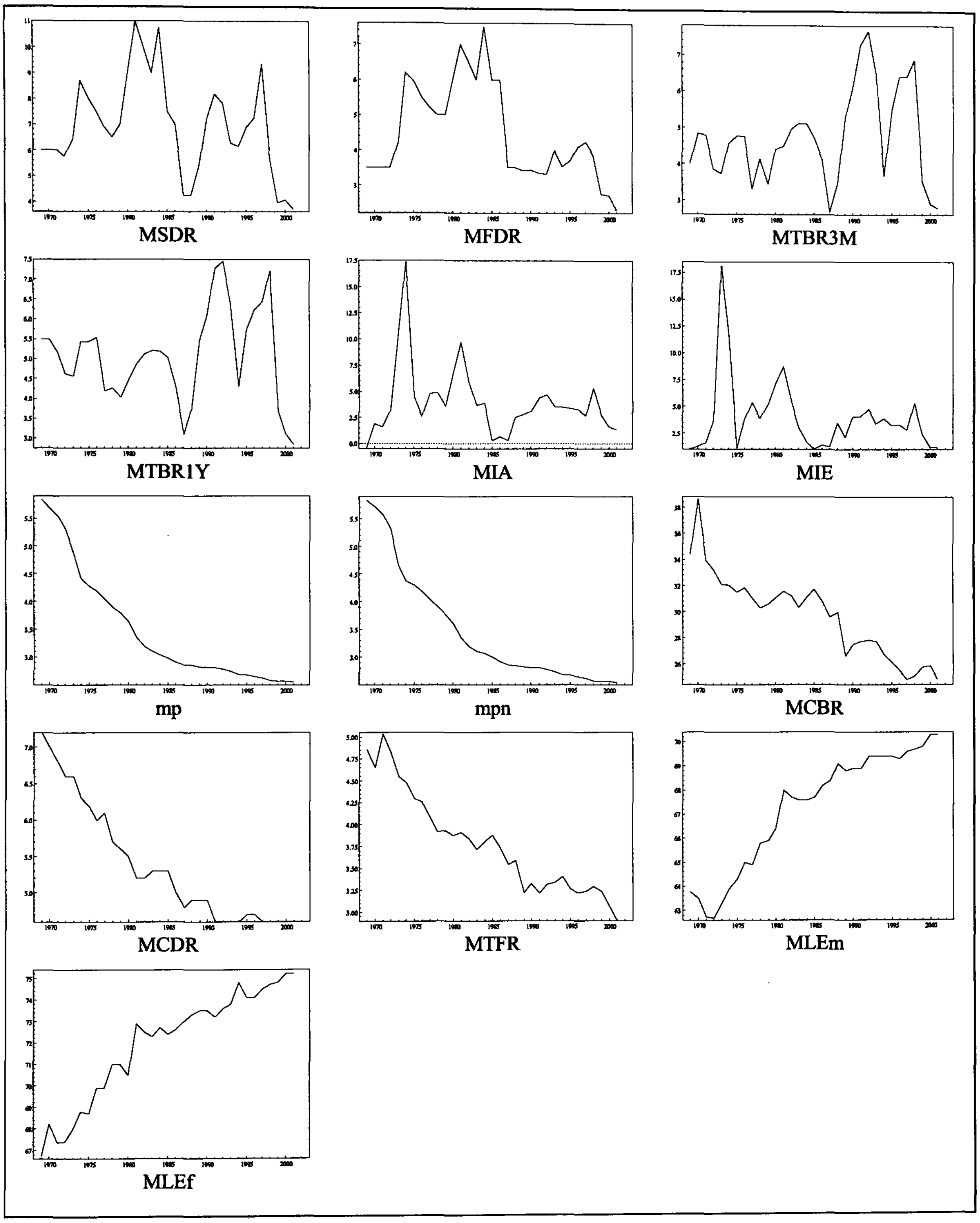

MSDR
MFDR
MTBR3M
MTBR1Y
MIA
MIE
mp
mpn
MCBR
MCDR
MTFR
MLEm
MLEf

Figure 7.2
Multiple Time Series Graphs for Variables in Their Original (Non-differenced) Series for the US Data Set

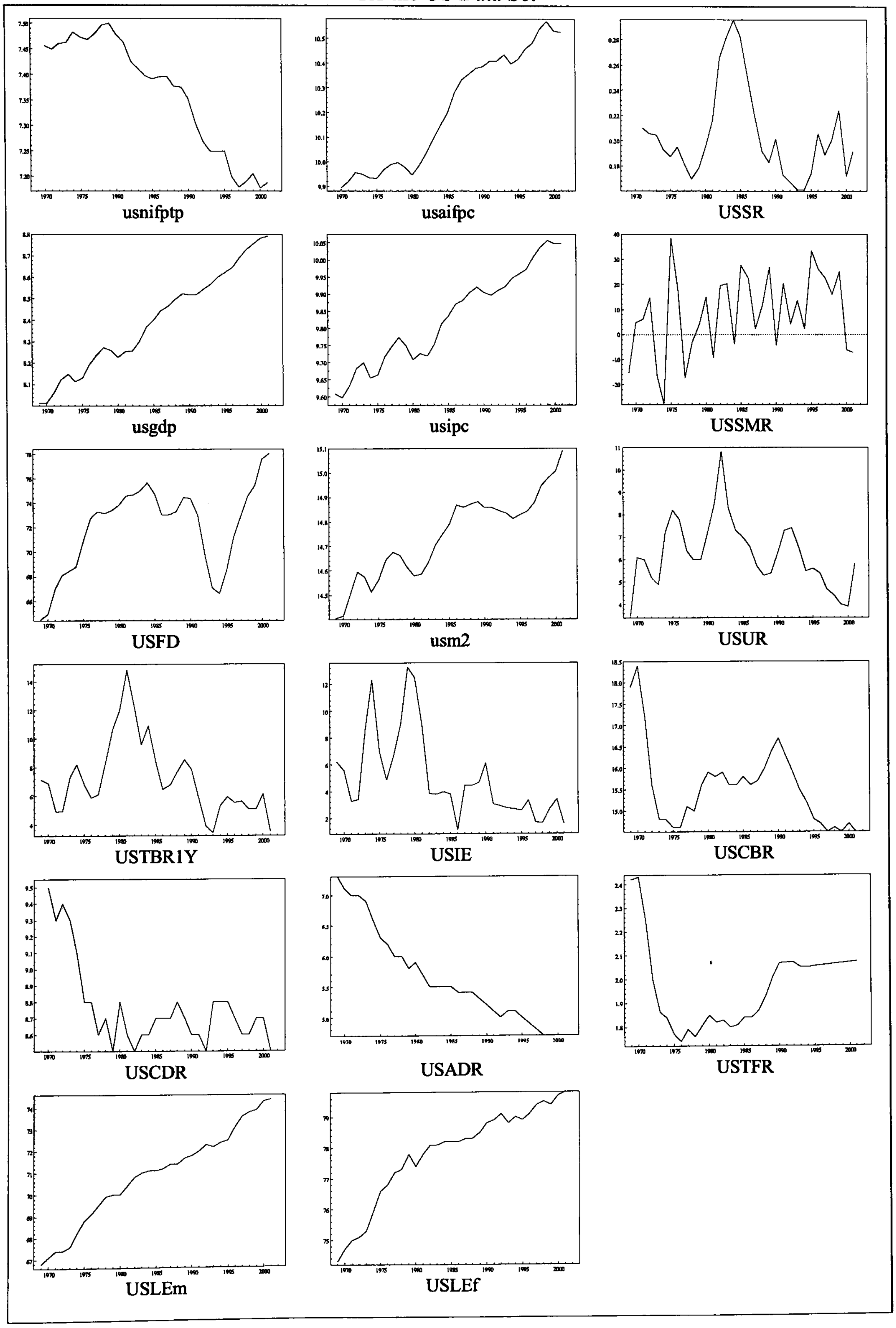


Table 7.1
Summary Results of (Augmented) Dickey-Fuller Unit Root Test for the Malaysian Data Set

Variable	n	Lag Length for ΔY_t	Test Statistic	Critical Value at 5%	Stationary
mnd	31	0	-3.325	-2.959	Yes
mad	32	0	-2.386	-2.956	No
mpd	32	0	-2.197	-2.956	No
mnifptp	29	2	-3.330	-2.966	Yes
maifpc	31	0	-3.106	-2.959	Yes
MFR1	29	1	-3.906	-2.966	Yes
MFR2	29	1	-3.990	-2.966	Yes
MFR3	29	1	-4.098	-2.966	Yes
MSR	30	1	-2.900	-2.963	No
MSRN	30	1	-2.629	-2.963	No
mgdp	32	0	-2.361	-2.956	No
mipc	32	0	-2.349	-2.956	No
MSMR	32	0	-6.411	-2.956	Yes
MFD	32	0	-1.550	-2.956	No
mm2	32	0	-2.745	-2.956	No
mm2n	32	0	-2.736	-2.956	No
MUR	25	0	-1.161	-2.985	No
MRUR	31	0	-3.161	-2.959	Yes
MSDR	32	0	-2.024	-2.956	No
MFDR	32	0	-1.385	-2.956	No
MTBR3M	32	0	-2.486	-2.956	No
MTBR1Y	32	0	-2.273	-2.956	No
MIA	32	0	-3.352	-2.956	Yes
MIE	30	2	-3.955	-2.963	Yes
mp	30	2	-6.333	-2.963	Yes
mpn	27	5	-3.258	-2.975	Yes
MCBR	32	0	-3.837	-2.956	Yes
MCDR	32	0	-3.106	-2.956	Yes
MTFR	32	0	-2.547	-2.956	No
MLEm	32	0	-0.754	-2.956	No
MLEf	32	0	-2.760	-2.956	No
Dmad	31	0	-4.562	-2.959	Yes
Dmpd	31	0	-4.109	-2.959	Yes
DMSR	30	0	-3.844	-2.963	Yes
DMSRN	30	0	-4.060	-2.963	Yes
Dmgdp	31	0	-4.099	-2.959	Yes
Dmipc	31	0	-4.147	-2.959	Yes
DMFD	31	0	-4.776	-2.959	Yes
Dmm2	31	0	-3.497	-2.959	Yes
Dmm2n	31	0	-3.509	-2.959	Yes
DMUR	24	0	-4.138	-2.991	Yes
DMSDR	31	0	-5.082	-2.959	Yes
DMFDR	31	0	-5.594	-2.959	Yes
DMTBR3M	31	0	-5.150	-2.959	Yes
DMTBR1Y	31	0	-4.929	-2.959	Yes
DMTFR	30	1	-4.670	-2.963	Yes
DMLEm	31	0	-5.375	-2.959	Yes
DMLEf	31	0	-8.891	-2.959	Yes

Table 7.2

Summary Results of (Augmented) Dickey-Fuller Unit Root Test for the US Data Set

Variable	n	Lag Length for ΔY_t	Test Statistic	Critical Value at 5%	Stationary
usnifptp	31	0	-2.236	-2.959	No
usaifpc	30	1	-2.244	-2.963	No
USSR	30	0	-1.631	-2.963	No
usgdp	31	1	-4.003	-2.959	Yes
usipc	31	1	-4.068	-2.959	Yes
USSMR	32	0	-5.584	-2.956	Yes
USFD	31	1	-3.014	-2.959	Yes
usm2	31	1	-3.463	-2.959	Yes
USUR	31	1	-2.802	-2.959	No
USTBR1Y	32	0	-1.470	-2.956	No
USIE	31	1	-4.037	-2.959	Yes
USCBR	32	0	-2.418	-2.956	No
USCDR	31	0	-2.954	-2.959	No
USADR	29	0	-2.294	-2.966	No
USTFR	32	0	-3.697	-2.956	Yes
USLEm	32	0	-1.156	-2.956	No
USLEf	32	0	-2.874	-2.956	No
Dusnifptp	30	0	-3.863	-2.963	Yes
Dusaifpc	30	0	-3.323	-2.963	Yes
DUSSR	29	0	-4.386	-2.966	Yes
DUSUR	31	0	-4.677	-2.959	Yes
DUSTBR1Y	31	0	-4.154	-2.959	Yes
DUSCBR	29	2	-4.220	-2.966	Yes
DUSCDR	30	0	-6.790	-2.963	Yes
DUSADR	28	0	-4.766	-2.971	Yes
DUSLEm	31	0	-4.327	-2.959	Yes
DUSLEf	31	0	-5.730	-2.959	Yes

Figure 7.3
Multiple Time Series Graphs for Variables in Their First-differenced Series
for the Malaysian Data Set

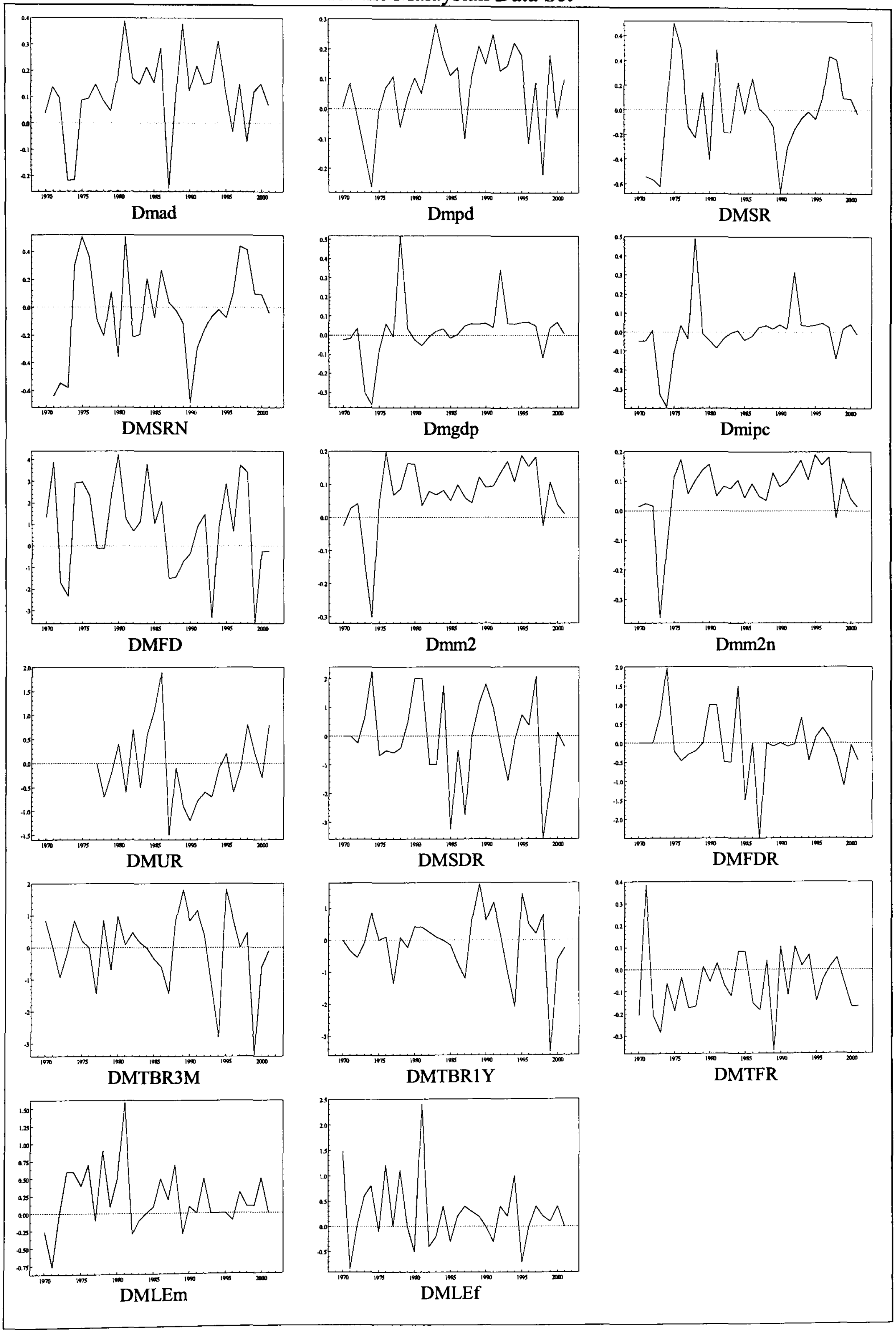
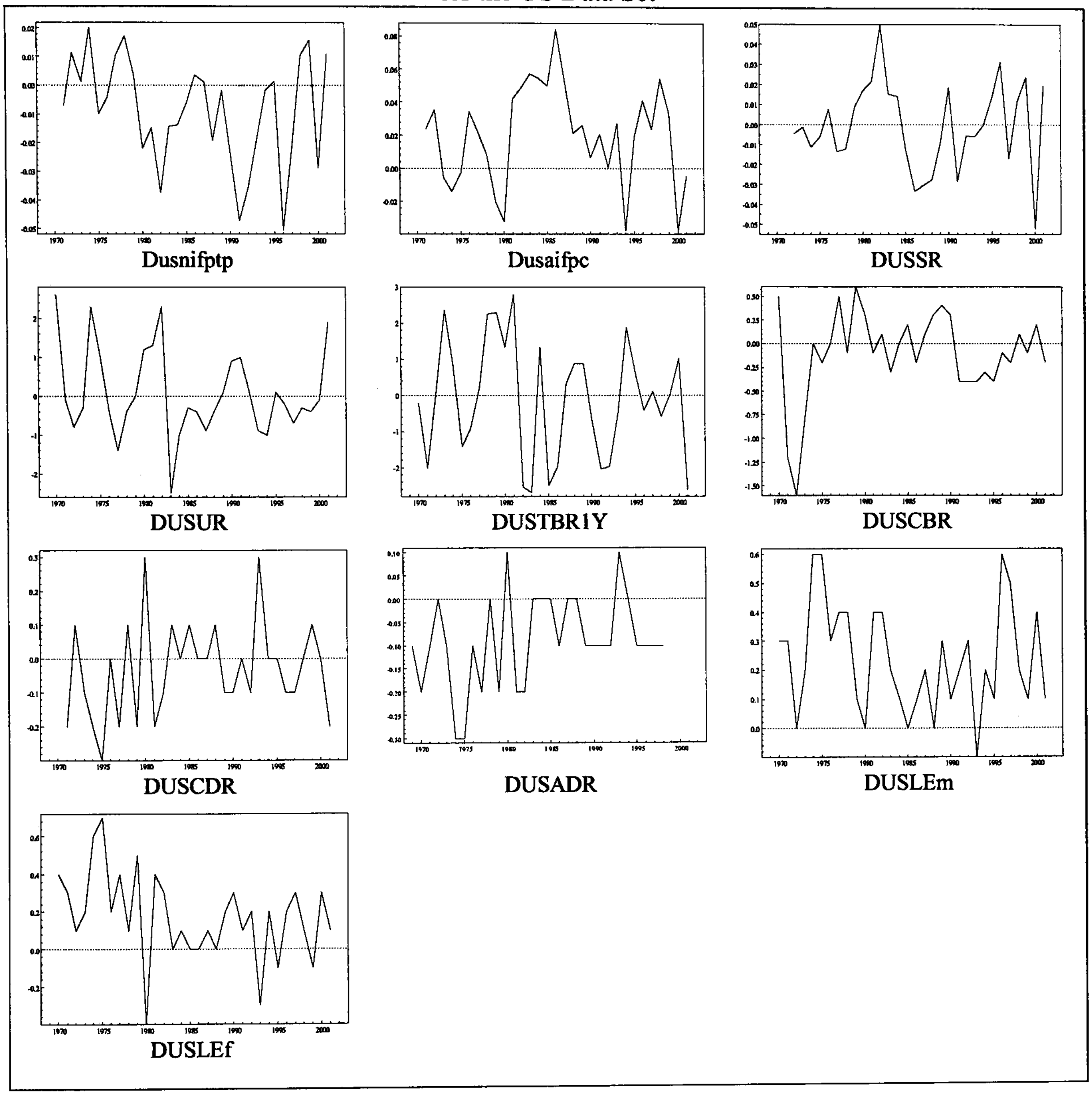


Figure 7.4
Multiple Time Series Graphs for Variables in Their First-differenced Series for the US Data Set



CHAPTER 8
EMPIRICAL FINDINGS – THE DEMAND FOR LIFE INSURANCE IN MALAYSIA

This chapter discusses the empirical findings on the demand for life insurance in Malaysia obtained using the two built-in pre-defined modelling strategies available in PcGets, namely the liberal and conservative strategies. There are two sets of empirical findings that have used the two modelling strategies for simplification. The first set is the regression models that use the average annual consumer price indices (CPIs) only as deflators (denoted SET-1). The second set is the regression models that use a combination of average and end-of-year CPIs as deflators (denoted SET-2). The analysis of SET-2 is made possible when the six missing (unpublished) end-of-year CPIs are provided by the central bank of Malaysia in a later stage. This has enabled the conversion of variables at market prices into constant price to be done appropriately by deflating the stock and flow variables accordingly with the end-of-year and average annual CPIs. Further, this also has enabled the computation of the end-of-year inflation rates (MIE).

Under both the liberal and conservative modelling strategies, the general unrestricted model (GUM) is formulated as an autoregressive distributed lag model with one lag for each of the potential variables [i.e. ADL(1,1)]. All of the data for the potential variables in the GUM are of zero integration [i.e. I(0) or stationary]. For variables that have a unit root [i.e. I(1)], their first-differenced terms [which are stationary, i.e. I(0)] are included in the GUM.

Only one proxy representing a variable is allowed to enter the GUM at a time in order to avoid the problem of multicollinearity. A total of 24 GUMs are formulated for each of the three demand models by number, by amount and by premium. This is because the potential explanatory variables comprise two proxies each for the income, financial development and life expectancy variables, three proxies for the interest rate variable and one proxy each for the stock market return, inflation, price, crude live-birth rate, crude death rate and total fertility rate variables.

8.1 Presentation of Test Results of the Liberal Strategy

In this section, the test results of the liberal strategy are presented whereas the test results of the conservative strategy are presented in section 8.2. The liberal strategy focuses on minimising the non-selection probability of relevant variables. The aim is to keep as many as possible of the variables that matter. Therefore, under this modelling strategy, there is a higher probability of retaining the relevant variables (but also at the risk of retaining the irrelevant variables).

8.1.1 Simplification Results for SET-1

For SET-1, all of the stock and flow variables are deflated by the average annual CPIs, although we note that this is not a completely correct way of deflating the stock variables. However, considering that the end-of-year CPIs have a few missing data and the average annual CPIs do not have any missing data and can be used for this purpose, the latter are used as deflators. The GUM formulated is as shown below (where "e" is the error term):

$$
\begin{aligned}
&\text{DEMAND}_t \\
&= C_0 + b_0\,(\text{DEMAND}_{t-1}) + b_1\,(\text{Dmgdp}_t \text{ or } \text{Dmipc}_t) + b_2\,(\text{Dmgdp}_{t-1} \text{ or } \text{Dmipc}_{t-1}) \\
&\quad + b_3\,(\text{MSMR}_t) + b_4\,(\text{MSMR}_{t-1}) + b_5\,(\text{DMFD}_t \text{ or } \text{Dmm2}_t) + b_6\,(\text{DMFD}_{t-1} \text{ or } \text{Dmm2}_{t-1}) \\
&\quad + b_7\,(\text{DMSDR}_t \text{ or } \text{DMFDR}_t \text{ or } \text{DMTBR3M}_t) + b_8\,(\text{DMSDR}_{t-1} \text{ or } \text{DMFDR}_{t-1} \text{ or } \\
&\quad \text{MTBR3M}_{t-1}) + b_9\,(\text{MIA}_t) + b_{10}\,(\text{MIA}_{t-1}) + b_{11}\,(\text{mp}_t) + b_{12}\,(\text{mp}_{t-1}) + b_{13}\,(\text{MCBR}_t) \\
&\quad + b_{14}\,(\text{MCBR}_{t-1}) + b_{15}\,(\text{MCDR}_t) + b_{16}\,(\text{MCDR}_{t-1}) + b_{17}\,(\text{DMTFR}_t) + b_{18}\,(\text{DMTFR}_{t-1}) \\
&\quad + b_{19}\,(\text{DMLEm}_t \text{ or } \text{DMLEf}_t) + b_{20}\,(\text{DMLEm}_{t-1} \text{ or } \text{DMLEf}_{t-1}) + e_t
\end{aligned}
$$

The DEMAND variable is new life insurance business defined in three different ways by number, by amount and by premium. For the demand model by number, since the original/non-differenced series of new life insurance business by number is stationary, the original/non-differenced series (i.e. mnd) is used for analysis. For the demand models by amount and by premium, the dependent variables (i.e. new life insurance business by amount and by premium) are expressed in their first-differenced terms (i.e. Dmad and Dmpd) because their original/non-differenced series (i.e. mad and mpd) are non-stationary but their first-differenced series are stationary. The inflation rate in SET-1 is the average inflation rate (MIA).

The (simplified) congruent models derived from the simplification of the GUMs (denoted Model), the simplified models obtained from the union models of the congruent models (labelled as D1, D2, etc.) and the final specific models (denoted FSM) are summarised in a table. Each table has the same structure and presentation in the Appendix. In the summary table, the regression coefficients, significance levels and reliability coefficients of the retained variables are reported. The significance levels are indicated by asterisk mark(s). Three asterisk marks indicate highly significant at 1% significance level, two asterisk marks indicate moderately significant at 5% significance level and one asterisk mark indicates marginally significant at 10% significance level. Meanwhile, "NS" is used to indicate that the retained variable is not significant. An insignificant variable is retained when its exclusion from the model induces some violations of congruence or encompassing. In each table, the regression coefficients are reported on top of the reliability coefficients and next to (and to the left of) the significance level indicators. The reliability coefficients are enclosed in parentheses. In addition to the above information, the adjusted-R^2 and σ values of the congruent models also are reported in the table. The congruent models are arranged in descending order based on their adjusted-R^2 values, or stated otherwise, in ascending order based on their σ values. Further, the probability values of the various mis-specification tests such as the Chow test [denoted Chow], normality test (denoted Normality Test), residual autocorrelation test (denoted AR 1-4 Test) and heteroscedasticity test (denoted Hetero Test) are reported at the bottom of the table. The same organisation of the table is used for reporting the results throughout this chapter.

Demand Model by Number. As a result of the simplification, the 24 GUMs converge into seven different congruent models. Only one set of the detailed simplification results for one of the GUMs (refer to Table 8.1) is presented in the appendix while the summary results of the seven congruent models are displayed in Table 8.2. Among the 15 variables that appear in the seven models, none has been retained consistently across all of the models except for mnd_1. For the purpose of a further simplification, two union models are formulated with the 13 variables and one of the two financial development variables (i.e. either DMFD or Dmm2_1) enters the union models at a time. This is done in such a way because MFD and mm2 are proxies measuring the level of financial development defined in a different way. The former is a more complicated indicator taking into consideration both M1 and M2 in its definition that is used to reflect the complexity of financial structure. The latter is a simpler indicator using only M2 as a measure that mainly focuses on private sector liquidity. The simplified models are D1 and D2. In fact, D2 is the same as Model-3. An encompassing test performed on D1 and D2 (or Model-3) shows that the latter is more dominant than the former. All of the four tests are rejected when testing whether D1 encompasses D2 but only two of the four tests are rejected (i.e. the Cox and Ericsson IV tests are significant) when testing whether D2 encompasses D1 (refer to Table 8.3). However, it is observed that Model-1 and Model-2 are superior to D2 (or Model-3) by crude observation based on their adjusted-R^2 and σ values. Therefore, attention is also given to Model-1 and Model-2 in order to obtain the final specific model(s). An encompassing test is conducted on Model-1 and Model-2 in order to select a non-dominated model between them. The results reveal that Model-1 is more dominant than Model-2. None of the tests is rejected when testing whether Model-1 encompasses Model-2 but one of the four tests is rejected (i.e. the Cox test is significant) when testing whether Model-2 encompasses Model-1 (refer to Table 8.4). When comparing Model-1 and D2 (or Model-3), it is noted that D2 is a subset of Model-1 (i.e. D2⊂Model-1). As D2 uses only a fraction of the same information contained in Model-1, this indicates that the latter model is more variance dominant than the former model. Therefore, Model-1 is more dominant than D2. As a result, Model-1 is regarded as the final specific model (i.e. FSM-1).

Demand Model by Amount. The simplification process has resulted in 10 different congruent models as exhibited in Table 8.5. A total of 22 variables are retained in the 10 models. Among them, mp_1 and DMTFR_1 are the two variables that have been retained consistently in all of the models. A union model comprising all of the 22 variables that appear in the 10 models is formulated to be subject to a further simplification. The simplified model is D3 and it is regarded as the final specific model (i.e. FSM-2).

Demand Model by Premium. The simplification of the 24 GUMs has derived two different congruent models. The summary results of the models are shown in Table 8.6. A total of eight variables appear in the two models. For the purpose of a further simplification, a union model is formulated with the inclusion of all the eight variables that appear in the congruent models. The simplified model is D4 which is the same as Model-2. However, by crude observation, Model-1 seems to be superior to D4 (or Model-2) in terms of their adjusted-R^2 and σ values. An encompassing test is conducted on Model-1 and D4 (or Model-2) in order to select a non-dominated model between them. The results indicate that two (i.e. the Cox and Ericsson IV tests) of the four tests are significant for both cases when testing whether Model-1 encompasses D4 and whether D4 encompasses Model-1 (refer to Table 8.7). As the encompassing test is not able to identify which model is a non-dominated model, a decision is made to adopt D4 (or Model-2) as the final specific model (i.e. FSM-3) as it is the model derived from further simplification of the union model.

8.1.2 Simplification Results for SET-2

For SET-2, the stock and flow variables are deflated respectively by the end-of-year and average annual CPIs. The GUM formulated is as follows (where "e" is the error term):

$$
\begin{aligned}
&\text{DEMAND}_t \\
&= C_0 + b_0\,(\text{DEMAND}_{t-1}) + b_1\,(\text{Dmgdp}_t \text{ or Dmipc}_t) + b_2\,(\text{Dmgdp}_{t-1} \text{ or Dmipc}_{t-1}) \\
&\quad + b_3\,(\text{MSMR}_t) + b_4\,(\text{MSMR}_{t-1}) + b_5\,(\text{DMFD}_t \text{ or Dmm2n}_t) + b_6\,(\text{DMFD}_{t-1} \text{ or Dmm2n}_{t-1}) \\
&\quad + b_7\,(\text{DMSDR}_t \text{ or DMFDR}_t \text{ or DMTBR3M}_t) + b_8\,(\text{DMSDR}_{t-1} \text{ or DMFDR}_{t-1} \text{ or} \\
&\quad \text{DMTBR3M}_{t-1}) + b_9\,(\text{MIE}_t) + b_{10}\,(\text{MIE}_{t-1}) + b_{11}\,(\text{mpn}_t) + b_{12}\,(\text{mpn}_{t-1}) + b_{13}\,(\text{MCBR}_t) \\
&\quad + b_{14}\,(\text{MCBR}_{t-1}) + b_{15}\,(\text{MCDR}_t) + b_{16}\,(\text{MCDR}_{t-1}) + b_{17}\,(\text{DMTFR}_t) + b_{18}\,(\text{DMTFR}_{t-1}) \\
&\quad + b_{19}\,(\text{DMLEm}_t \text{ or DMLEf}_t) + b_{20}\,(\text{DMLEm}_{t-1} \text{ or DMLEf}_{t-1}) + e_t
\end{aligned}
$$

The three DEMAND variables of new life insurance business by number, by amount and by premium are unaffected by the introduction of the new deflator (i.e. the end-of-year CPIs) as new life insurance business is a flow variable and has been deflated into constant dollar terms using the average annual CPIs. For identification purposes, an asterisk mark is added to their variable names in SET-2 in order to differentiate them from those in SET-1, i.e. mnd*, Dmad* and Dmpd* respectively for the demand variables by number, by amount and by premium in SET-2. The inflation rate in SET-2 is the end-of-year inflation rate (MIE). Two variables are affected by the introduction of the new deflator: the financial development (denoted mm2n) and price (denoted mpn) variables. The new variables have similar names as their original variables but with an "n" (which means "new") added at the end of their original variable names.

Demand Model by Number. Six different congruent models are obtained as a result of the simplification. The summary results of the models are shown in Table 8.8. A total of 11 variables appear in the six models but none has been retained consistently in all of the models except for mnd_1. Model-1 appears to be the (union) model that nests all of the contending congruent models. Model-1 is more dominant than other congruent models because it nests all of the contending explanatory variables of other models, or in other words, other congruent models use only a subset of the same information. Therefore, Model-1 is regarded as the final specific model (i.e. FSM-4).

Demand Model by Amount. For the demand model by amount, 12 different congruent models are obtained from the simplification as displayed in Table 8.9. A total of 21 variables are retained in the 12 models. Two of the variables have been retained consistently throughout the 12 models, namely mpn_1 and DMTFR_1. Two union models are formulated with the 19 variables and one of the two income variables (i.e. either Dmgdp or Dmipc) enters the models at a time to be subject to a further simplification. Dmgdp and Dmipc enter the union models separately because they are highly correlated (r=0.9995): this is as expected since the gross domestic product (GDP) is used as the basis to compute income per capita (mipc) – i.e. the income per capita is calculated as the GDP divided by mid-year national population. The simplified models are D5 and D6. They are identical and the same as Model-6. However, by crude observation, Model-1 and Model-2 seem to be superior to D5 or D6 (or Model-6) based upon their adjusted-R^2 and σ values. Therefore, consideration is also given to Model-1 and Model-2 in order to obtain the final specific model(s). In order to select a non-dominated model among Model-1, Model-2 and Model-6 to be the base model(s) for deriving the final specific model(s), encompassing tests are conducted on the following three pairs of models: (Model-1 and Model-2), (Model-1 and Model-6) and (Model-2 and Model-6). The first encompassing test results show that Model-1 and Model-2 are mutually non-dominating (refer to Table 8.10). Meanwhile, both the second and third encompassing test results show that the former models (i.e. Model-1 and Model-2) are more dominant than the latter model (i.e. Model-6). Two of the four tests are rejected (i.e. the Cox and Ericsson IV tests are significant) when testing whether Model-1 or Model-2 encompasses Model-6 but three of the four tests are rejected (i.e. the Cox, Ericsson IV and Joint Model tests are significant) when testing whether Model-6 encompasses Model-1 or Model-2 (refer to Tables 8.11 and 8.12). Thus, Model-1 and Model-2 are used as the base models to derive the final specific model(s). Model-1 and Model-2 are re-specified so that DMCBR is used in place of MCBR and MCBR_1 in order to capture the short-run dynamics of the change in crude live-birth rate. This is because the estimated coefficients for the two variables have a different sign and are of roughly the same magnitude: MCBR=–0.05843 and MCBR_1=0.06010 in Model-1; MCBR=–0.05887 and MCBR_1=0.06063 in Model-2. The two re-specified models [i.e. Re-specified Model-1 (or R-M1 in short) and Re-specified Model-2 (or R-M2 in short)] are mutually non-dominating (refer to Table 8.13) and are regarded as the final specific models (i.e. FSM-5 and FSM-6 respectively).

Demand Model by Premium. The simplification process has resulted in nine different congruent models. The summary results of the models are shown in Table 8.14. A total of 13 variables appear in the nine models. The price variable, mpn_1, is the only variable that has been retained consistently across all of the nine models. Two union models are formulated for the purpose of a further simplification. The union models include one of the two income variables (i.e. either Dmgdp or Dmipc) along with the other 11 variables. The simplified models are D7 and D8 which are the same as Model-2 and Model-1 respectively. The encompassing test performed on D7 (or Model-2) and D8 (or Model-1) shows that they are mutually non-dominating (refer to Table 8.15). Therefore, they are regarded as the final specific models (i.e. FSM-7 and FSM-8).

8.2 Presentation of Test Results of the Conservative Strategy

This section presents the test results of the conservative strategy. The conservative strategy is the opposite extreme modelling strategy to the liberal strategy. In contrast to the liberal strategy, the conservative strategy focuses on minimising the non-deletion probability of irrelevant variables. The aim is to avoid retaining as many as possible of the irrelevant variables. Therefore, under this modelling strategy, there is a higher probability of eliminating the irrelevant variables (but also at the risk of eliminating the relevant variables).

8.2.1 Simplification Results for SET-1

For SET-1, the average annual CPIs only are used as deflators.

Demand Model by Number. When subject to a more stringent simplification, the 24 GUMs converge into three different congruent models as shown in Table 8.16. Only mnd_1 has been retained consistently in all of the three models. A union model that includes all of the 11 retained variables is formulated for a further simplification. The simplified model is D9 in which it is equivalent to Model-1. It is also the final specific model (i.e. FSM-9).

Demand Model by Amount. The simplification process has resulted in four different congruent models. Their summary results are displayed in Table 8.17. A union model that consists of all the nine retained variables is formulated to be subject to a further simplification. The simplified model is D10 which is identical with Model-2. It is noted that Model-1 seems to be superior to D10 (or Model-2) by crude observation at their adjusted-R^2 and σ values. However, the encompassing test results indicate that D10 is more dominant than Model-1 (refer to Table 8.18). Therefore, D10 is the final specific model (i.e. FSM-10).

Demand Model by Premium. The simplifications produce five different congruent models. Their summary results are shown in Table 8.19. A total of eight variables appear in the five models. For the purpose of a further simplification, a union model is formulated with the inclusion of all the retained variables. The union model converges into Model-1 (or D11). D11 is then re-specified in which Dmp is introduced to replace mp and mp_1 for capturing the short-run dynamics of price change because the estimated parameters of mp (i.e. 1.77865) and mp_1 (i.e. –1.84274) have a different sign and their values are approximately of the same magnitude. The re-specified model is the final specific model (i.e. FSM-11).

8.2.2 Simplification Results for SET-2

For SET-2, the end-of-year and average annual CPIs are used as deflators as appropriate.

Demand Model by Number. The GUMs converge into two different congruent models as a result of the simplification. The summary results are shown in Table 8.20. Model-1 has all of the nine variables (that appear in the two congruent models) being retained in its congruent model. It is regarded as the final specific model (i.e. FSM-12).

Demand Model by Amount. Four different congruent models are obtained from the simplification. The summary results of the models are displayed in Table 8.21. A total of six variables are retained in the four models. A union model that includes all of the retained variables is formulated for a further simplification. The union model converges into Model-1 (or D12). It is also the final specific model (i.e. FSM-13).

Demand Model by Premium. The simplification process has resulted in four different congruent models as shown in Table 8.22. A union model comprising all of the six retained variables is formulated for a further simplification. The simplified model is D13 which in fact is Model-1. D13 is then re-specified so that Dmpn is used in place of mpn and mpn_1 to capture the short-run dynamics of price change because the values of mpn (i.e. 0.62248) approximate –mpn_1 (i.e. 0.65879). The re-specified model is the final specific model (i.e. FSM-14).

8.3 Presentation of Test Results for Cointegration and Error Correction Model (ECM)

The analysis of cointegration is performed on the demand models by amount and by premium. These are the models where the dependent variables such as the new life insurance business by amount (mad) and by premium (mpd) are non-stationary and have a unit root. For the demand model by amount, the cointegration test is conducted to investigate whether the amount of new life insurance business and the explanatory variables that also have a unit root (which are retained in FSM-5, FSM-6 and FSM-13) such as the GDP (mgdp), income per capita (mipc), savings deposit rate (MSDR), total fertility rate (MTFR) and life expectancy at birth for males (MLEm) are cointegrated. Likewise, for the demand model by premium, the cointegration test is performed to examine whether the premium of new life insurance business and the explanatory variables that have a unit root (which are retained in FSM-7, FSM-8 and FSM-14) such as the GDP (mgdp), income per capita (mipc), savings deposit rate (MSDR), total fertility rate (MTFR) and life expectancy at birth for males (MLEm) are cointegrated. The cointegration test is performed only for the regression models for SET-2 because the stock and flow variables have been deflated in a more appropriate manner.

Demand Model by Amount with GDP as Income Variable. To start off, the preliminary ordinary least squares (OLS) regression model is constructed as:

$$\boxed{mad_t = \alpha_0 + \alpha_1(mgdp_t) + \alpha_2(MSDR_t) + \alpha_3(MTFR_t) + \alpha_4(MLEm_t) + Resid1_t}$$

where Resid1 is the error term. The results of the preliminary regression model reveal that the coefficients of the interest rate and total fertility rate variables are statistically not different from zero (i.e. insignificant, that is $\alpha_2=\alpha_3=0$) (refer to Table 8.23). Therefore, the regression model is re-estimated by dropping the two insignificant variables:

$$\text{mad}_t = \alpha_5 + \alpha_6(\text{mgdp}_t) + \alpha_7(\text{MLEm}_t) + \text{Resid2}_t \qquad \text{(Eq8.1)}$$

where Resid2 is the error term. In the re-estimated regression model, the constant term and the income and life expectancy variables are highly significant (refer to Table 8.24). The re-estimated regression model passes the Chow test but only marginally passes the other mis-specification tests such as the normality test [i.e. the probability (=0.0069) is slightly above the lower bound of the significance level of 0.005], the residual autocorrelation test [i.e. the probability (=0.0138) is marginally larger than the pre-specified significance level of 0.01] and the heteroscedasticity test [i.e. the probability (=0.0097) is greater than the lower bound of the significance level of 0.005].

The residuals of the re-estimated regression model (i.e. Resid2) are saved and subject to unit root analysis. The Dickey-Fuller (DF) unit root test is applied to the residuals in their original (non-differenced) series but in a re-parameterised format where the dependent variable is expressed as a first-differenced series:

$$\text{DResid2}_t = \alpha + \rho(\text{Resid2}_{t-1}) + v_t$$

where "v" is the error term. The results of the DF unit root test indicate that the test statistic (i.e. –2.9489) is more negative than the critical value at 1% for the cointegration test (i.e. –2.5899) so that the unit root hypothesis is rejected (refer to Table 8.25). Therefore, the residuals are stationary. This implies that mad, mgdp and MLEm are cointegrated and there is a long-term relationship among them. As the residuals of the re-estimated regression model (i.e. Resid2) are stationary, the re-estimated regression model (i.e. Eq8.1) is the cointegrating regression model for mad, mgdp and MLEm. Since cointegration is present among mad, mgdp and MLEm a further step is taken to examine their short-run relationship through ECM. The ECM is formulated as an autoregressive distributed lag model with one lag for each of the potential variables [i.e. ADL(1,1)], in the similar manner in which the GUMs in the main analysis are formulated to be subject to simplification, as below:

$$\begin{aligned}\text{Dmad}_t = \ & \varphi + \lambda(\text{Resid2}_{t-1}) + \omega_0(\text{Dmad}_{t-1}) + \omega_1(\text{Dmgdp}_t) + \omega_2(\text{Dmgdp}_{t-1}) \\ & + \omega_3(\text{DMLEm}_t) + \omega_4(\text{DMLEm}_{t-1}) + \varepsilon_t\end{aligned}$$

where "ε" is the error term. The ECM results are presented in Table 8.26.

The results of the cointegrating regression model for mad, mgdp and MLEm and its ECM are discussed in detailed in sub-section 8.4.3.3

Demand Model by Amount with Income per Capita as Income Variable. At the beginning, the preliminary OLS regression model is constructed as:

$$mad_t = \alpha_8 + \alpha_9(mipc_t) + \alpha_{10}(MSDR_t) + \alpha_{11}(MTFR_t) + \alpha_{12}(MLEm_t) + Resid3_t$$

where Resid3 is the error term. As the results reveal that the coefficients of the interest rate and total fertility rate variables are insignificant (i.e. $\alpha_{10}=\alpha_{11}=0$) (refer to Table 8.27), the regression model is re-estimated by removing the two insignificant variables:

$$mad_t = \alpha_{13} + \alpha_{14}(mipc_t) + \alpha_{15}(MLEm_t) + Resid4_t$$

where Resid4 is the error term. In the re-estimated regression model, even though the constant term and the income and life expectancy variables are highly significant but the regression model fails to pass the normality test (i.e. p=0.0023) and only marginally passes the residual autocorrelation test [i.e. the probability (=0.0074) is slightly larger than the lower bound of the significance level of 0.005] (refer to Table 8.28). Therefore, further efforts are not pursued to perform the cointegration test and ECM.

Demand Model by Premium with GDP as Income Variable. The preliminary OLS regression model is constructed as:

$$mpd_t = \alpha_{16} + \alpha_{17}(mgdp_t) + \alpha_{18}(MSDR_t) + \alpha_{19}(MTFR_t) + \alpha_{20}(MLEm_t) + Resid5_t$$

where Resid5 is the error term. The results show that the coefficients of MSDR, MTFR and MLEm are statistically not different from zero (i.e. $\alpha_{18}=\alpha_{19}=\alpha_{20}=0$) (refer to Table 8.29). The regression model is re-estimated by removing the insignificant variables:

$$mad_t = \alpha_{21} + \alpha_{22}(mipc_t) + Resid6_t$$

where Resid6 is the error term. The mis-specification tests show that the re-estimated regression model fails to pass the residual autocorrelation test (p=0.0001) (which indicates the omission of important variables from the regression model) and the heteroscedasticity test (p=0.0036) but only marginally passes the normality test (i.e. p=0.0108 against the pre-specified significance level of 0.01) (refer to Table 8.30). As the long-run regression model has some problems with mis-specification, further analysis is not undertaken.

Demand Model by Premium with Income per Capita as Income Variable. The estimation of the long run regression model for this demand model also experiences the same problems faced by the corresponding demand model with GDP as the income variable. The preliminary OLS regression model is:

$$mpd_t = \alpha_{23} + \alpha_{24}(mgdp_t) + \alpha_{25}(MSDR_t) + \alpha_{26}(MTFR_t) + \alpha_{27}(MLEm_t) + Resid7_t$$

where Resid7 is the error term. The results show that the coefficients of the constant term, MSDR, MTFR and MLEm are insignificant (refer to Table 8.31). The regression model is re-estimated by excluding the insignificant variables:

$$mad_t = \alpha_{28}(mipc_t) + Resid8_t$$

where Resid8 is the error term. The results show that the re-estimated regression model has some mis-specification problems (refer to Table 8.32). As a result, the cointegration test and ECM are not conducted.

8.4 Discussion of Results

8.4.1 Comparing the Results between SET-1 and SET-2 for Different Modelling Strategies

In Tables 8.33 and 8.34 we re-compile the final specific models using the different deflation approaches for the liberal and conservative modelling strategies respectively. The results from the two tables show that, if the stock and flow variables are not deflated appropriately, the final specific models obtained are different under SET-1 and SET-2 (except for the demand models by amount of the conservative strategy where exactly the same group of variables are retained in FSM-10 and FSM-13).

Table 8.33 reveals that the retained variables in the demand models by number differ slightly between SET-1 and SET-2. Both SET-1 and SET-2 have 11 retained variables in which 10 of them are the same/equivalent variables except for the interest rate variable. SET-1 retains the average discount rate on three-month treasury bills while SET-2 retains the savings deposit rate as the interest rate variable. On the other hand, the retained variables in the demand models by amount and by premium differ more widely between SET-1 and SET-2 even though there are eight and four common variables being retained in their respective demand models. Table 8.34 shows that when the variables are subject to a more stringent simplification, the retained variables in the demand models by number and by premium differ slightly between SET-1 and SET-2 but in the demand models by amount, the group of variables being retained is the same for SET-1 (i.e. FSM-10) and SET-2 (i.e. FSM-13).

Further, we note that there is more variation in terms of the number and type of variables being retained in the final specific models of the liberal strategy than in those of the conservative strategy for both SET-1 and SET-2. This can be explained by the fact that variables are subject to a more lenient removal criterion under the liberal strategy but a more stringent removal criterion under the conservative strategy. As a result, there are fewer retained variables under the conservative strategy as compared with the liberal strategy.

Comparing the three demand models by number, by amount and by premium under both SET-1 and SET-2, the demand models by number emerge to have a better goodness of fit in terms of having a higher adjusted-R^2 value with a lower σ value than the demand models by amount and by premium. This indicates that the demand models using the number of policies as a measurement can explain a substantially greater proportion of the variance in new life insurance business with a considerably smaller regression standard error than the demand models using amount or premium as a measurement. Nevertheless, we note that the findings of the demand models by amount and by premium conform more closely to expectation than the findings of the demand models by number. (Refer to the detailed discussions on the individual demand models in the sub-section below.)

Among the variables that are retained in the final specific models under the liberal strategy, only two variables, namely the constant term and the change in total fertility rate in the previous period (DMTFR_1), have been retained consistently across all of the demand models (refer to Table 8.33). Further, the change in total fertility rate in the previous period also has been retained in all of the demand models under the conservative strategy (refer to Table 8.34). This suggests that the change in total fertility rate in the previous period appears to be likely to have an important relationship with new life insurance business by number, by amount and by premium.

8.4.2 Comparing the Results between the Liberal Strategy and Conservative Strategy of SET-1

Table 8.35 displays the results of SET-1 in which the average annual CPIs only are used as deflators for the different modelling strategies. For the demand models by number, a slightly smaller number of variables is retained in the final specific model of the conservative strategy (i.e. FSM-9) than in the final specific model of the liberal strategy (i.e. FSM-1), i.e. 10 versus 11 variables respectively. FSM-1 and FSM-9 have nine common variables. A more stringent simplification process is not able to eliminate the variables further. This indicates that the retained variables indeed have a significant relationship with life insurance demand by number. For the demand models by amount, the difference in the number of retained variables in the final specific models under the two modelling strategies is substantial, i.e. four versus 14 variables with respect to the conservative (i.e. FSM-10) and liberal (i.e. FSM-2) strategies in which the former model is a subset model of the latter (i.e. FSM-10⊂FSM-2). This suggests that these four variables have an important relationship with life insurance demand by amount. For the demand models by premium, even though six variables are retained in FSM-3 and in FSM-11, they only have three common variables indicating that these three variables are more certain to have an important association with life insurance demand by premium. Among the retained variables, the change in total fertility rate in the previous period (DMTFR_1) is the only variable that has been retained consistently in all of the demand models.

8.4.3 Comparing the Results between the Liberal Strategy and Conservative Strategy of SET-2

Table 8.36 exhibits the results of SET-2 in which both the end-of-year and average annual CPIs are used as deflators for the different modelling strategies. Extensive discussions focus on this table because this table reports the results of the analysis in which the stock and flow variables are deflated appropriately.

The discussion in this sub-section is divided into three parts: (a) the demand models by number, by amount and by premium, (b) the various factors that affect new life insurance business and (c) cointegration and ECM.

8.4.3.1 Demand Models by Number, by Amount and by Premium

Demand Model by Number. For the demand models by number, a slightly fewer number of variables is retained in the final specific model of the conservative strategy (i.e. nine variables in FSM-12) than in the final specific model of the liberal strategy (i.e. 11 variables in FSM-4). The nine variables retained under the conservative strategy are a subset of the 11 variables retained under the liberal strategy, i.e. FSM-12⊂FSM-4. When a more stringent deletion criterion is applied to the simplification, the anticipated stock market return and the change in savings deposit rate in the previous period are forced out of the model.

The demand (by number) in the previous period, the anticipated inflation rate and both the anticipated and past changes in total fertility rate have a significant positive relationship with new life insurance business by number. On the other hand, the anticipated stock market return, the change in the level of financial development (measured by M2) in the previous period, the change in savings deposit rate in the previous period, the inflation rate in the previous period, the anticipated price of insurance and the anticipated crude live-birth rate have a significant negative relationship with new life insurance business by number.

Comparing the results of the demand models by number of this study with those of Rubayah and Zaidi (2000) who have used the same representation for the demand variable and which is also Malaysian oriented, the findings of the two studies are not in total agreement. Rubayah and Zaidi (2000) find that gross domestic product, personal savings rate, income tax exemption and short-run interest rate have a significant relationship whereas income per capita, current interest rate and inflation do not have a significant relationship with life insurance demand by number. In contrast to the findings of Rubayah and Zaidi (2000), both the income variables (i.e. GDP and income per capita) and the average discount rate on three-month treasury bills [which is equivalent to the short-run interest rate in the study of Rubayah and Zaidi (2000)] are found not to have an important relationship with new life insurance business by number. These variables are not retained in any of the (simplified) congruent models related to FSM-4 and FSM-12 (refer to Tables 8.8 and 8.20). Further, in this study, the inflation variables are found to relate significantly to new life insurance business by number. However, the signs of their estimated coefficients are not consistent as they switch from positive (for the anticipated inflation rate) to negative (for the inflation rate in the previous period).

The findings of this study are not in line with the findings of Rubayah and Zaidi (2000). The conflicting results can be explained by two possible reasons stated below. First, it might be attributed to the method used to simplify the general model (GUM) into the final model (FSM). Rubayah and Zaidi (2000) use the stepwise regression analysis of SPSS for simplification but this study uses PcGets. Although the final model of Rubayah and Zaidi (2000) has been checked explicitly for mis-specifications and is confirmed free of the problems such as non-normality, heteroscedasticity, residual autocorrelation (but marginally pass the test) and multicollinearity, the deletion of variables under the stepwise regression analysis is based upon a purely mathematical criterion in which variables are deleted when they meet the removal criterion specified (as noted in Chapter 7). Alongside the simplification process, the model is not diagnosed for mis-specifications. In this respect, PcGets performs better than stepwise regression analysis in which the testing for congruence is maintained throughout the simplification process for the GUM and also for the simplified model in order to ensure that the final specific model obtained is always a congruent model. Second, it is possible that the final model of Rubayah and Zaidi (2000) suffers from the spurious regression problem (i.e. the problem occurs when the error terms or residuals of the regression model have a unit root) because the potential variables in their study have not been subjected to a unit root test in order to examine the stationarity property of the individual variables before the analysis is pursued. If the spurious regression problem exists, the usual OLS estimation can yield results that are misleading and incorrect. Thus, the problem of spurious regression would render the OLS estimation meaningless.

Demand Model by Amount. For the demand models by amount, there are 11 retained variables in the two final specific models of the liberal strategy (i.e. FSM-5 and FSM-6) but only four variables are retained in the final specific model of the conservative strategy (i.e. FSM-13). When subject to a more stringent simplification, only the anticipated change in savings deposit rate, the price of insurance in the previous period and the change in total fertility rate in the previous period, that are retained under the liberal strategy, are retained under the conservative strategy alongside the crude live-birth rate in the previous period.

When comparing the two final specific models of the liberal strategy (i.e. FSM-5 and FSM-6), the demand model with GDP as the income variable (i.e. FSM-5) appears to be slightly more efficiently estimated than the demand model with income per capita as the income variable (i.e. FSM-6) because, although both the models can explain roughly 70% of the variance of the change in new life insurance business by amount, the former has a slightly lower regression standard error than the latter [i.e. σ_{FSM-5}= 0.08177 and σ_{FSM-6}=0.08183].

The anticipated change in GDP or income per capita, the stock market return in the previous period, the anticipated change in savings deposit rate, the anticipated crude death rate, both the anticipated and past changes in total fertility rate and both the anticipated and past changes in the life expectancy at birth for males have a significant positive association with the change in new life insurance business by amount. On the other hand, the price of insurance in the previous period and the anticipated change in crude live-birth rate have a significant negative association with the change in new life insurance business by amount.

Babbel (1985) has used the amount of new life insurance business as the demand variable so that a comparison can be made between his findings and the findings mentioned above. His findings reveal that prices are related negatively whereas income is related positively (and both significantly) to the demand for whole life insurance. The findings of this study provide further evidence in support of the findings of Babbel

(1985). The findings that income is associated positively and significantly with the change in new life insurance business by amount of the liberal strategy (refer to FSM-5 and FSM-6 in Table 8.36) lend support to Babbel's (1985) findings on the income variable. However, in this study, the income variable is forced out of the model when subject to a more stringent simplification. Further, the findings on the price variable (that the price of insurance in the previous period is associated negatively and significantly with the change in new life insurance business by amount) in this study also confirm the findings of Babbel (1985) on the corresponding variable.

Demand Model by Premium. For the demand models by premium, the number of retained variables under the conservative strategy (i.e. four variables in FSM-14) is very much smaller than that under the liberal strategy (i.e. nine variables each in FSM-7 and FSM-8). Only the stock market return, price, crude live-birth rate and total fertility rate variables are retained in the model arising from the conservative strategy (i.e. FSM-14). The lagged variables of stock market return and of the change in total fertility rate are retained, but the anticipated change in price is retained in place of the price in the previous period, while the crude live-birth rate in the previous period is retained instead of the rate in the current period under the conservative strategy.

A comparison between the two final specific models of the liberal strategy shows that the model with income per capita as the income variable (i.e. FSM-8) appears to be slightly more efficiently estimated than the model with GDP as the income variable (i.e. FSM-7). FSM-8 has a slightly larger adjusted-R^2 value (i.e. 0.57576) and a slightly smaller σ value (i.e. 0.08756) than FSM-7 (i.e. adjusted-R^2=0.57453 and σ=0.08769) indicating that the former is able to explain a slightly greater proportion of the variance of the change in new life insurance business by premium with a slightly smaller regression standard error than the latter.

The anticipated change in GDP or income per capita, the stock market return in the previous period, the anticipated change in savings deposit rate, the anticipated price change, both the anticipated and past crude live-birth rates and the change in total fertility rate in the previous period are related positively and significantly to the change in new life insurance business by premium. On the other hand, the change in the demand (by premium) in the previous period, the price of insurance in the previous period and the anticipated change in the life expectancy at birth for males are related negatively and significantly to the change in new life insurance business by premium.

No researchers have used the premium of new life insurance business as the demand variable in the past. Therefore, a direct comparison with an equivalent past study is not available for this version of the demand model.

8.4.3.2 Analysis of Factors Affecting New Life Insurance Business

An examination across the various demand models in Table 8.36 shows that the group of variables that relates significantly to new life insurance business is not the same when the demand is defined by number, by amount and by premium.

Consumers' Ability to Buy and the Size of the Potential Market. Income levels have an important relationship with the growth of new life insurance business by amount and by premium but not by number. A higher growth rate of GDP and populations with a higher income tend to support a higher level of new life insurance business by amount and by premium. When the general economic conditions are improving or when populations have a higher disposable income, it is expected that populations are more able to purchase a larger amount of life insurance and more able to afford to pay a larger amount of premium. However, the findings are inconclusive as to whether the GDP or income per capita is a better proxy as an income variable. Two pairs of the final specific models, i.e. (FSM-5, FSM-6) and (FSM-7, FSM-8), do not exhibit a consistent result. The former pair indicates that the model with GDP as the income variable (i.e. FSM-5) is slightly more efficiently estimated whereas the latter pair shows that the model with income per capita as the income variable (i.e. FSM-8) is slightly more efficiently estimated. On the other hand, income levels do not appear to have an influence on the number of new life policies purchased by the consumers.

The findings on the performance of the stock market are new because the stock market return variable has not been investigated by researchers in the past. The performance of the stock market in the previous period is related positively and significantly to the growth of new life insurance business by amount and by premium. When investors enjoy an increase in capital from their stock market investment in the previous period, they become more able to afford the purchase of a larger amount of life insurance and the payment of a larger amount of premium. Another possible explanation may be that good stock market performance implies good future returns from financial products like life insurance. On the contrary, the anticipated performance of the stock market is found to relate negatively and significantly to the new life insurance business by number. The decline in the number of new life policies may be offset by a larger amount of life insurance being purchased per policy but further investigation in this respect is needed to confirm this phenomenon.

The findings on the relationship between financial development and new life insurance business are mixed and inconclusive. The level of financial development measured by the broad definition of money (M2) is found to be significant in the demand models by number but its estimated coefficients have an unexpected negative sign. Although the financial development using a more sophisticated measure is found to have a significant positive relationship with new life insurance business by amount, it does not appear in the final specific models (refer to FSM-5 and FSM-6). On the other hand, the development in the financial market is not an important factor to the growth of new life insurance business by premium.

Based on the above findings, factors such as income and the return generated from investing in the stock market that affect the consumers' ability to buy have the expected positive relationship with the growth of new life insurance business by amount and by premium. On the other hand, although the performance of the stock market (as the factor that affects the consumers' ability to buy) and the development of the financial market (as the factor that affects the size of the potential market) are found to have a significant relationship with the number of new life policies purchased by the consumers, they do not support a higher level of the number of new life policies.

Consumers' Decisions on Savings and the Accumulation of Financial Assets. Among the three types of interest rate (i.e. the average discount rate on three-month treasury bills, savings deposit rate and the 12-month fixed deposit rates) that are used to test the interest rate effect on new life insurance business, only the savings deposit rate emerges as having a significant relationship with new life insurance business.

Other interest rate variables are not retained in the demand models except for the following three types of interest rate that have been retained in the demand models by amount under the liberal strategy (refer to Table 8.9): the anticipated change in fixed deposit rate (i.e. DMFDR in Model-7) and both the anticipated (i.e. DMTBR3M in Model-8) and past (i.e. DMTBR3M_1 in Model-6) changes in the average discount rate on three-month treasury bills. However, the anticipated change in the average discount rate on three-month treasury bills in Model-8 is not significant. When the union models (that include all of the interest rate variables along with other variables that have been retained in the 12 congruent models) are formulated to be subject to a further simplification, only the change in the average discount rate on three-month treasury bills in the previous period is retained in the simplified models [i.e. D5 (or D6 or Model-6)] but the other interest rate variables are not retained in the models. The above result indicates that the average discount rate on three-month treasury bills has a more dominant interest rate effect than the other types of interest rate such as the savings and fixed deposits rates. However, D5 (or D6 or Model-6) is not a non-dominated model as compared with FSM-5 or FSM-6 and thus is not regarded as the final specific model. In FSM-5 and FSM-6, the change in savings deposit rate as the interest rate variable together with other variables jointly can explain a great amount of the variance of the change in new life insurance business by amount with a smaller regression standard error.

The signs of the estimated regression coefficients for the savings deposit rate variables are inconsistent. The anticipated change in savings deposit rate is related positively and significantly with the growth of new life insurance business by amount and by premium but the change in savings deposit rate in the previous period is related negatively and significantly with new life insurance business by number. For the former case, the findings indicate the opposite to the proposition that bank savings deposit is an alternative savings product to life insurance. One possible explanation of these unexpected findings may be that an insurance product is considered to be as good as bank savings deposits as a savings instrument. When the savings deposit rate increases, the insurance companies also might have taken the initiative to revise the interest rate being credited to life policies to be as competitive as the savings deposit rate. Therefore, this results in the demand for life insurance (by amount and by premium) not being affected negatively but instead growing in size. For the latter case, when the demand is defined by number, the estimated regression coefficient for the savings deposit rate variable has an expected negative sign indicating that the number of life policies purchased by the consumers declines when there is an increase in the savings deposit rate in the previous period. There is a lagged relationship between the change in savings deposit rate and new life insurance business by number of policies. The decrease in the number of new life policies purchased by consumers possibly is a response caused by a larger amount of life insurance that has been purchased in the previous period.

Based on the above findings, even though the average discount rate on treasury bills appears to have a more dominant interest rate effect over the savings and fixed deposits rates, the savings deposit rate emerges to be a better interest rate proxy (together with other variables collectively) in explaining life insurance demand. Although an increase in savings deposit rate tends to be associated with a decline in the number of new life policies being purchased by the consumers, it is surprising to note that the savings deposit rate seems not to be a yield which competes with life insurance (as a savings instrument) because an increase in the savings deposit rate tends to support a higher level of new sum insured and new premium for life insurance business.

Consumers' Purchasing Power in Acquiring Financial Assets. Inflation does not have an important relationship with the growth of new life insurance business by amount and by premium. The inflation variable is not retained in the demand models by amount (refer to Tables 8.9 and 8.21) but it has been retained once in Model-9 in the demand model by premium under the liberal strategy (refer to Table 8.14). In Model-9, the anticipated inflation rate has a significant negative relationship with the growth of new life insurance business by premium indicating that an inflationary environment affects the growth of new premium for life insurance business. This is in line with the expectation that, when life insurance is purchased as a savings instrument, rising inflation rates discourage life insurance savings. However, the inflation variable is not retained in the final specific models (refer to FSM-7 and FSM-8). On the other hand, the anticipated and past inflation rates are found to have a significant relationship with new life insurance business by number but their signs are inconsistent.

For the price variable, the findings show that the price of insurance tends to be related inversely and significantly to the demand for life insurance (but with the exception for the price variable in FSM-14), indicating that a high insurance cost tends to discourage the purchasing of life insurance. These findings are consistent with economic theory that an increase in price causes the demand to drop. However, the findings are contrary to the widely accepted belief that the consumers are insensitive to price variations in insurance products when making their decisions in purchasing life insurance because life insurance normally is regarded as a product which is sold, rather than bought (Babbel, 1985; Burkart, 2003).

Based on the above findings, inflation seems not to be an important factor affecting the growth of new life insurance business by amount and by premium but the findings are inconclusive for new life insurance business by number. On the other hand, the insurance cost appears to be a determining factor of the consumers' decisions in acquiring life insurance. The demand for life insurance is indeed dependent on prices.

Demographic Characteristics of the Population. The crude live-birth rate variables have been retained in all of the demand models. The signs for these variables are inconsistent. The crude live-birth rate is found to be related negatively to new life insurance business by number but positively to the growth of new life insurance business by premium. Meanwhile, the results are mixed for the crude live-birth rate in relation to the growth of new life insurance business by amount (refer to Table 8.9).

The anticipated crude death rate is retained in the final specific models in the demand models by amount under the liberal strategy (i.e. FSM-5 and FSM-6) only. It has a significant positive relationship with the growth of new life insurance business by amount. As the crude death rate refers to the deaths in a given year per 1000 people, it represents an "average" chance of dying (but this measure might be biased in a situation where there is a larger proportion of people at the older ages in the population). Therefore, the finding suggests that when the probability of death is high, it tends to support a higher level of the demand for life insurance (by amount).

The findings on the change in (period) total fertility rate are consistent across the three demand models by number, by amount and by premium. It has a positive and significant relationship with life insurance demand. The total fertility rate may be interpreted as the average number of children that would be born to a woman during her lifetime, under the assumption of no time trends in the period age specific fertility rates. It is related to the cohort's completed family size (http://www.stats.gov.lc/demoexp.htm). Hence, the findings suggest that when the completed family size is bigger, the purchase of new life insurance tends to increase.

For the life expectancy variables, only the life expectancy at birth for males appears to have a significant relationship with life insurance demand by amount and by premium. The life expectancy at birth for males has a more dominant gender effect than the life expectancy at birth for females in its relationship with the demand for life insurance by amount. Even though the variable of life expectancy at birth for females (DMLEf) has been retained in two congruent models (i.e. Model-4 and Model-5) in the demand models by amount, it is not retained in the final specific models (i.e. FSM-5 and FSM-6) when the union models (that comprise both the life expectancy variables for males and for female alongside the other variables that are retained in the 12 congruent models) are subject to a further simplification (refer to Table 8.9). The findings that males have a stronger gender effect than females with respect to life expectancy at birth could be explained by the fact that Malaysia has a traditional structure of family institution in which the father is the head and major breadwinner in a family. However, the findings on the life expectancy at birth for males are contradictory for the two demand models by amount and by premium. The change in the life expectancy at birth for males is found to be related negatively to the growth of new life insurance business by premium but it is surprising to note that it is related positively to the growth of new life business by amount. The former findings support our proposition that when the population has a longer life span (implying a low probability of death), this tends to be associated with a lower level of the demand for life insurance. However, the latter findings do not conform to our expectation.

Based on the above, the findings in relation to the demographic variables suggest that the total fertility rate is more certain to have an important relationship with new life insurance business by number, by amount and by premium. A bigger value for the completed family tends to support a higher level of the demand for life insurance (in terms of new business). Further, the anticipated crude death rate also appears to be an important factor. A high probability of death tends to induce the purchasing of life insurance. Meanwhile, the findings on other demographic variables such as the crude live-birth rate and life expectancy at birth are inconsistent. Therefore, a conclusive remark cannot be made with respect to them.

8.4.3.3 Cointegration and ECM

Only variables such as the new life insurance business by amount, GDP and life expectancy at birth for males are found to have a long-term relationship. Their cointegrating regression model is as below (where the t-values for the respective regression coefficients are presented in squared brackets) (refer to Table 8.24):

$$
\begin{array}{l}
mad_t = \underset{[-18.283]}{-26.16} + \underset{[8.532]}{1.31}(mgdp_t) + \underset{[10.888]}{0.31}(MLEm_t)
\end{array}
$$

In the run-long, the elasticity of life insurance demand (in terms of new life insurance business by amount) with respect to income is elastic. A 1% change in GDP causes approximately 1.31% change in the amount of new life insurance business. Meanwhile, when the life expectancy at birth for males increases by one year, it boosts the growth rate as much as 31% for new life insurance business by amount (i.e. the semi-elasticity of life insurance demand with respect to the life expectancy at birth for males).

On the other hand, the short-run behaviour among these variables can be examined via their ECM representation as shown below (where the t-values for the respective regression coefficients are presented in squared brackets) (refer to Table 8.26):

$$
\begin{aligned}
Dmad_t = {} & \underset{[3.321]}{0.11} - \underset{[-3.573]}{0.36}(Resid2_{t-1}) + \underset{[0.167]}{0.03}(Dmad_{t-1}) + \underset{[2.724]}{0.48}(Dmgdp_t) \\
& - \underset{[-1.338]}{0.25}(Dmgdp_{t-1}) + \underset{[0.080]}{0.004}(DMLEm_t) - \underset{[-0.773]}{0.04}(DMLEm_{t-1})
\end{aligned}
$$

In the short-run, only the anticipated change in GDP significantly has an impact on the change in the amount of new life insurance business. A 100 basis point rise in the growth rate of GDP would lead to a 48 basis point rise in the growth rate of life insurance demand and this happens instantly in the same period. Changes in other variables such as the demand in the previous period, the GDP in the previous period and both the anticipated and past changes in the life expectancy at birth for males are immaterial (because their estimated parameters are statistically not different from zero) to the change in the amount of new life insurance business.

The significant negative error correction term supports the existence of cointegration and there is a plausible adjustment speed by which just over a third of any deviation from the long-run relationship is made up each period.

8.5 Concluding Comments

In summary, the major findings of the demand for life insurance in Malaysia are as follows:

(a) The use of different deflation approaches affects the final specific models obtained under SET-1 and SET-2.

(b) The demand models by number appear to have a better goodness of fit (i.e. high adjusted-R^2 with low σ values) than the demand models by amount and by premium but the latter two demand models more closely conform to expectation in terms of the hypothesised signs for the estimated parameters than the former demand models.

(c) Only income and stock market return are found to have the expected positive effect on the consumers' ability to buy new life insurance (measured by amount and by premium).

(d) Only savings deposit rate is found to affect the consumers' decisions on savings and the accumulation of financial assets but it seems not to be a competing interest rate to life insurance as a savings instrument.

(e) The inflation rate is not an important factor affecting the purchase of new life insurance (by amount and by premium).

(f) The price of insurance is a key factor in the consumers' decisions to acquire life insurance. When the cost to obtain life insurance becomes more expensive, this tends to discourage the purchasing of life insurance (quantified by number, by amount and by premium).

(g) The findings on the demographic variables are mixed and inconsistent. Only the change in total fertility rate in the previous period consistently is found to have a significant positive relationship with new life insurance business by number, by amount and by premium.

(h) Only the GDP and life expectancy at birth for males are found to have a long-term relationship with new life insurance business by amount. In the short-run, only the changes in income level appear to affect significantly the amount of new life insurance business and the adjustment process towards equilibrium is plausible in response to the changes in income.

APPENDIX CHAPTER 8

Table 8.1
Detailed Simplification Results of a GUM for the Demand Model by Number
Using PcGets (Liberal Strategy)

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(1) Testing the General Model (GUM) for Mis-specifications (or for Congruence)

The GUM is formulated as an ADL(1,1) model. Next, the GUM is subject to the mis-specification tests such as Chow test, normality test, residual serial correlation test and heteroscedasticity test in order to check its main attributes of congruence. The results show that the GUM passes the first three initial mis-specification tests at the pre-specified significance level of 0.01. As the heteroscedasticity test consumes a considerable number of the degree of freedom, there are not enough observations relative to the number of regressors in order to perform the test. As a result, the heteroscedasticity test is not performed for the GUM but the specific model obtained at the end of the simplification process is checked for the potential problem of heteroscedasticity in order to ensure that the OLS estimators in the specific model have minimum variance. Based on the initial mis-specification test results for the GUM, the significance levels for the mis-specification tests are established for subsequent tests in the simplification process.

GUM Modelling mnd by GETS, 1971 - 2001

	Coeff	StdError	t-value	t-prob
Constant	6.29378	3.83935	1.639	0.1356
mnd_1	0.70066	0.16746	4.184	0.0024
Dmgdp	0.17387	0.18513	0.939	0.3721
Dmgdp_1	-0.05612	0.18280	-0.307	0.7658
MSMR	-0.00096	0.00077	-1.240	0.2462
MSMR_1	0.00038	0.00076	0.504	0.6264
Dmm2	0.46767	0.41710	1.121	0.2912
Dmm2_1	-1.27658	0.39830	-3.205	0.0107
DMTBR3M	-0.02555	0.01904	-1.342	0.2124
DMTBR3M_1	0.00120	0.02215	0.054	0.9581
MIA	0.02640	0.02003	1.318	0.2201
MIA_1	-0.03829	0.01166	-3.283	0.0095
mp	-0.67223	0.82106	-0.819	0.4341
mp_1	0.43738	0.79858	0.548	0.5972
MCBR	-0.06670	0.03654	-1.825	0.1012
MCBR_1	0.00453	0.02107	0.215	0.8346
MCDR	0.15754	0.20460	0.770	0.4610
MCDR_1	-0.09150	0.24341	-0.376	0.7157
DMTFR	0.52389	0.23266	2.252	0.0509
DMTFR_1	0.57411	0.18387	3.122	0.0123
DMLEf	-0.03410	0.04692	-0.727	0.4859
DMLEf_1	-0.00700	0.04666	-0.150	0.8840

RSS	0.06812	sigma	0.08700	R^2	0.99724	Radj^2	0.99080
LogLik	94.86816	AIC	-4.70117	HQ	-4.36944	SC	-3.68350
T	31	p	22	FpNull	0.00000	FpConst	0.00000

	value	prob	alpha
Chow(1998:1)	1.0872	0.4235	0.0100
normality test	1.2567	0.5335	0.0100
AR 1-4 test	3.9884	0.0808	0.0100

Significance levels (alpha) set for subsequent tests.

(2) Removal of Completely Irrelevant Variables Subject to Retaining Congruence – Pre-search / Pre-selection Simplifications

Once the congruence of the GUM is established, the GUM is subject to three stages of cumulative simplification: the lag-order pre-selection, top-down and bottom-up simplications in order to eliminate the highly irrelevant variables, either individually or in block.

(a) Lag-order Pre-selection Simplification

For time-series data, the first stage of simplification is the block test of lag length. PcGets conducts an F-test to check the significance of all the variables at lag one to examine whether a block of them can be eliminated from the GUM at the significance level of 0.9. The test result shows that all of the variables at lag one cannot be eliminated in a block.

```
Stage-0 (Step 1): F presearch testing (lag-order preselection)
  Check lag  1 : F-prob =0.0024, Tests failed =  1;  Invalid reduction.
```

(b) First Round of Top-down Simplification

At the second stage of simplification, groups of variables are tested in the order of their t^2-statistics, starting from the smallest upwards and a cumulative F-test checks the increasing block sizes until the null hypothesis is rejected (when no further deletion is possible). There are two rounds of top-down simplification. For the first round of simplification, the significance level is 0.9. The test results show that nine variables namely, DMTBR3M_1, DMLEf_1, MCBR_1, Dmgdp_1, MCDR_1, MSMR_1, mp_1, DMLEf and MCDR, are removed in the first round of top-down simplification.

```
Stage-0 (Step 2): F presearch testing (top-down)
  Remove  1 variable  with t-prob > 0.9581 : F-prob =0.9581, Tests failed =  0;
  Remove  2 variables with t-prob > 0.8840 : F-prob =0.9792, Tests failed =  0;
  Remove  3 variables with t-prob > 0.8346 : F-prob =0.9942, Tests failed =  0;
  Remove  4 variables with t-prob > 0.7658 : F-prob =0.9905, Tests failed =  0;
  Remove  5 variables with t-prob > 0.7157 : F-prob =0.9938, Tests failed =  0;
  Remove  6 variables with t-prob > 0.6264 : F-prob =0.9645, Tests failed =  0;
  Remove  7 variables with t-prob > 0.5972 : F-prob =0.9514, Tests failed =  0;
  Remove  8 variables with t-prob > 0.4859 : F-prob =0.9564, Tests failed =  0;
  Remove  9 variables with t-prob > 0.4610 : F-prob =0.9583, Tests failed =  0;
  Remove 10 variables with t-prob > 0.4341 : F-prob =0.5760, Tests failed =  1;  Invalid
reduction.
```

As a result, the simplified model is as shown below:

Stage-0: General model of mnd, 1971 - 2001

	Coeff	StdError	t-value	t-prob
Constant	6.06337	1.81762	3.336	0.0037
mnd_1	0.71076	0.08667	8.201	0.0000
Dmgdp	0.04049	0.12025	0.337	0.7402
MSMR	-0.00108	0.00042	-2.584	0.0187
Dmm2	0.44661	0.28383	1.574	0.1330
Dmm2_1	-1.16709	0.27047	-4.315	0.0004
DMTBR3M	-0.02510	0.01263	-1.987	0.0623
MIA	0.02940	0.00820	3.585	0.0021
MIA_1	-0.03674	0.00761	-4.829	0.0001
mp	-0.14757	0.04764	-3.098	0.0062
MCBR	-0.05653	0.02055	-2.751	0.0132
DMTFR	0.41789	0.11747	3.557	0.0023
DMTFR_1	0.54532	0.13036	4.183	0.0006

RSS	0.08821	sigma	0.07000	R^2	0.99643	Radj^2	0.99405
LogLik	90.86153	AIC	-5.02332	HQ	-4.82730	SC	-4.42198
T	31	p	13	FpNull	0.00000	FpGUM	0.95833

(c) Second Round of Top-down Simplification

For the second round of simplification, the significance level is 0.75. The test results show that two variables namely, Dmgdp and Dmm2, are removed in this round of top-down simplification. As the remaining 11 variables are significant, no variables can be removed from the model.

```
Stage-0 (Step 3): F presearch testing (top-down)
  Remove  1 variable  with t-prob > 0.7402 : F-prob =0.9724, Tests failed =  0;
  Remove  2 variables with t-prob > 0.1330 : F-prob =0.9091, Tests failed =  0;
F presearch testing stopped: none remaining variable with t-prob > 0.1000.
```

(d) Bottom-up Simplification

At the third stage of simplification, the checks are carried out in the opposite direction, starting from the largest t^2-statistics downwards. A cumulative F-test checks the decreasing block sizes until the null hypothesis is not rejected at the significance level of 0.125. The test results show that all of the 11 variables in the model are significant, and therefore all of them are retained in the model.

```
Stage-0 (Step 4): F presearch testing  (bottom-up)
  Found   11 variables with t-prob < 0.1000.
  Include 11 variables with t-prob < 0.1330 : F-prob =0.9091, Tests failed =  0;  Valid
reduction found.

Stage-0 (Step 5): No additional restriction imposed by the bottom-up reduction.
```

As a result, the simplified model is as shown below:

Stage-1: General model of mnd, 1971 - 2001

	Coeff	StdError	t-value	t-prob
Constant	7.20364	1.74105	4.138	0.0005
mnd_1	0.65772	0.08331	7.895	0.0000
MSMR	-0.00081	0.00039	-2.073	0.0514
Dmm2_1	-0.92012	0.23759	-3.873	0.0009
DMTBR3M	-0.02222	0.01285	-1.729	0.0992
MIA	0.01834	0.00543	3.377	0.0030
MIA_1	-0.03012	0.00677	-4.447	0.0002
mp	-0.17024	0.04713	-3.612	0.0017
MCBR	-0.06876	0.01983	-3.468	0.0024
DMTFR	0.46502	0.11729	3.965	0.0008
DMTFR_1	0.55964	0.12915	4.333	0.0003

RSS	0.10346	sigma	0.07192	R^2	0.99581	Radj^2	0.99371
LogLik	88.38947	AIC	-4.99287	HQ	-4.82700	SC	-4.48403
T	31	p	11	FpNull	0.00000	FpGUM	0.90908

(3) Removal of Less Obviously Irrelevant Variables Subject to Retaining Congruence – Simplifications via Multiple Search Paths

At this stage, all of the paths that commence with an insignificant t-deletion are explored. The significance level for the t-tests is 0.1. As part of the simplification process, a non-null set of final models is selected. The final models are the distinct minimal congruent models found along all of the search paths. If a unique model results, it is selected. However, when more than one congruent final model is found, an encompassing test is employed in order to make a choice between the models. The results show that only one congruent final model is found, therefore it is regarded as the specific model.

```
Stage-1: Multiple-path encompassing search

  All variables are significant: General -> Specific.

Specific model of mnd, 1971 - 2001
```

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Constant	7.20364	1.74105	4.138	0.0005	0.7051	0.0002	0.4885
mnd_1	0.65772	0.08331	7.895	0.0000	0.0000	0.0000	1.0000
MSMR	-0.00081	0.00039	-2.073	0.0514	0.0004	0.5772	0.5268
Dmm2_1	-0.92012	0.23759	-3.873	0.0009	0.9149	0.0001	0.4255
DMTBR3M	-0.02222	0.01285	-1.729	0.0992	0.0435	0.3409	0.7000
MIA	0.01834	0.00543	3.377	0.0030	0.0106	0.0968	1.0000
MIA_1	-0.03012	0.00677	-4.447	0.0002	0.0386	0.0155	1.0000
mp	-0.17024	0.04713	-3.612	0.0017	0.5454	0.0469	0.5364
MCBR	-0.06876	0.01983	-3.468	0.0024	0.3672	0.0002	0.7000
DMTFR	0.46502	0.11729	3.965	0.0008	0.0563	0.0001	1.0000
DMTFR_1	0.55964	0.12915	4.333	0.0003	0.0003	0.0000	1.0000

RSS	0.10346	sigma	0.07192	R^2	0.99581	Radj^2	0.99371
LogLik	88.38947	AIC	-4.99287	HQ	-4.82700	SC	-4.48403
T	31	p	11	FpNull	0.00000	FpGUM	0.90908

	value	prob
Chow(1998:1)	1.6728	0.2105
normality test	1.4281	0.4896
AR 1-4 test	2.0736	0.1321
hetero test	10.2591	0.9632

(4) Testing for Encompassing between the Contending Models

Since the simplification via multiple search paths finds only one unique model, it is selected as the specific model. Therefore, under such a situation, the need to employ an encompassing test in order to select between the contending models at the end of the search paths does not arise.

(5) Final Specific Model for the GUM (Model-1 in Table 8.2)

Once the specific model is obtained, the sub-sample reliability test (being a post-selection check) is applied to the specific model in which the significance of every variable retained in the specific model is examined in two overlapping sub-samples. The significance level for the reliability test is 0.125. Refer to the specific model in (3) above.

Table 8.2

Summary Results of Specific Models for the Demand Models by Number (Liberal Strategy) for the Sample Period 1971-2001

(for Variables being Made Constant Using the Average Annual CPIs as Deflators)

No.	Model	1 FSM-1	2	3	4	5	6	7	D1		D2 = Model-3	
1	Constant	7.20364 *** (0.4885)	6.73627 *** (1.0000)	6.26346 *** (1.0000)	5.93584 *** (1.0000)	3.56829 ** (1.0000)	3.39062 ** (1.0000)		Constant	4.46718 *** (1.0000)	Constant	6.26346 *** (1.0000)
2	mnd_1	0.65772 *** (1.0000)	0.69384 *** (1.0000)	0.70352 *** (1.0000)	0.72173 *** (1.0000)	0.83079 *** (1.0000)	0.83840 *** (1.0000)	1.00752 *** (1.0000)	mnd_1	0.78690 *** (1.0000)	mnd_1	0.70352 *** (1.0000)
3	MSMR	-0.00081 * (0.5268)	-0.00114 ** (0.7000)	-0.00087 ** (0.5126)		-0.00118 ** (0.7000)	-0.00133 ** (0.7000)		MSMR	-0.00177 *** (1.0000)	MSMR	-0.00087 ** (0.5126)
4	MSMR_1				0.00071 * (0.4000)				MSMR_1		MSMR_1	
5	DMFD						-0.01780 * (0.4000)		DMFD	-0.02324 ** (1.0000)		
6	Dmm2_1	-0.92012 *** (0.4255)	-0.89870 *** (1.0000)	-0.86376 *** (1.0000)	-0.99494 *** (1.0000)						Dmm2_1	-0.86376 *** (1.0000)
7	DMSDR_1					-0.02517 ** (1.0000)			DMSDR_1	-0.03317 ** (1.0000)	DMSDR_1	
8	DMTBR3M	-0.02222 * (0.7000)							DMTBR3M	0.03449 * (0.7000)	DMTBR3M	
9	MIA	0.01834 *** (1.0000)	0.01631 *** (0.7000)	0.01657 *** (0.7000)	0.01865 *** (0.7000)				MIA		MIA	0.01657 *** (0.7000)
10	MIA_1	-0.03012 *** (1.0000)	-0.02760 *** (1.0000)	-0.02860 *** (1.0000)	-0.02788 *** (1.0000)				MIA_1		MIA_1	-0.02860 *** (1.0000)
11	mp	-0.17024 *** (0.5364)		-0.14526 *** (0.7000)	-0.17057 *** (1.0000)				mp		mp	-0.14526 *** (0.7000)
12	MCBR	-0.06876 *** (0.7000)	-0.05230 ** (1.0000)	-0.05935 *** (1.0000)	-0.05412 ** (0.7000)	-0.04324 * (1.0000)	-0.03970 * (1.0000)		MCBR	-0.05314 ** (1.0000)	MCBR	-0.05935 *** (1.0000)
13	MCDR_1		-0.19524 *** (0.4000)						MCDR_1		MCDR_1	
14	DMTFR	0.46502 *** (1.0000)	0.37626 *** (1.0000)	0.45287 *** (1.0000)	0.50076 *** (1.0000)	0.29923 ** (1.0000)	0.35460 ** (1.0000)		DMTFR	0.50157 *** (1.0000)	DMTFR	0.45287 *** (1.0000)
15	DMTFR_1	0.55964 *** (1.0000)	0.55520 *** (1.0000)	0.57657 *** (1.0000)	0.49878 *** (1.0000)	0.45467 *** (1.0000)	0.45320 *** (1.0000)		DMTFR_1	0.63076 *** (1.0000)	DMTFR_1	0.57657 *** (1.0000)
	Number of GUM(s)	2	2	4	4	4	4	4				
	Adjusted-R^2	0.99371	0.99313	0.99312	0.99283	0.98997	0.98958	0.98681		0.99133		0.99312
	Sigma	0.07192	0.07518	0.07525	0.07684	0.09087	0.09259	0.10419		0.08449		0.07525
	Probability:											
	Chow (1998: 1)	0.2105	0.0396	0.0620	0.1709	0.0304	0.0527	0.0249		0.0069		0.0620
	Normality Test	0.4896	0.8272	0.3663	0.2876	0.4696	0.2537	0.0363		0.6736		0.3663
	AR 1-4 Test	0.1321	0.0414	0.0418	0.2180	0.5524	0.1341	0.5809		0.3777		0.0418
	Hetero Test	0.9632	0.8759	0.8734	0.6069	0.0885	0.1423	0.0238		0.2277		0.8734

Dependent Variable: mnd

Note:
In the summary table, the regression coefficients, significance levels and reliability coefficients of the retained variables are reported. The significance levels are indicated by asterisk mark(s). Three asterisk marks indicate highly significant at 1% significance level, two asterisk marks indicate moderately significant at 5% significance level and one asterisk mark indicates marginally significant at 10% significance level. Meanwhile, "NS" is used to indicate that the retained variable is not significant. In each table, the regression coefficients are reported on top of the reliability coefficients and next to (and to the left of) the significance level indicators. The reliability coefficients are enclosed in parentheses.

Table 8.3
Full Results of Encompassing Test for D1 and D2 (Liberal Strategy)

Encompassing test statistics: 1971 to 2001

D1 is: mnd on

Constant	mnd_1	MSMR	DMFD	DMSDR_1
DMTBR3M	MCBR	DMTFR	DMTFR_1	

D2 is: mnd on

mnd_1	Constant	MSMR	Dmm2_1	MIA
MIA_1	mp	MCBR	DMTFR	DMTFR_1

Instruments used:

Constant	mnd_1	MSMR	DMFD	DMSDR_1
DMTBR3M	MCBR	DMTFR	DMTFR_1	Dmm2_1
MIA	MIA_1	mp		

sigma[D1] = 0.0844939 sigma[D2] = 0.0752542 sigma[Joint] = 0.0667222

Test	D1 vs. D2				D2 vs. D1			
Cox	N(0,1)	=	-6.233	[0.0000]**	N(0,1)	=	-2.941	[0.0033]**
Ericsson IV	N(0,1)	=	4.036	[0.0001]**	N(0,1)	=	2.139	[0.0325]*
Sargan	Chi^2(4)	=	10.776	[0.0292]*	Chi^2(3)	=	6.8502	[0.0768]
Joint Model	F(4,18)	=	4.3201	[0.0127]*	F(3,18)	=	2.9047	[0.0631]

Table 8.4
Summary Results of Encompassing Test for Model-1 and Model-2 (Liberal Strategy)

Encompassing test statistics: 1971 to 2001

sigma[Model-1] = 0.071924 sigma[Model-2] = 0.0751782 sigma[Joint] = 0.0723615

Test	Model-1 vs. Model-2				Model-2 vs. Model-1			
Cox	N(0,1)	=	-1.239	[0.2155]	N(0,1)	=	-2.583	[0.0098]**
Ericsson IV	N(0,1)	=	0.9433	[0.3455]	N(0,1)	=	1.889	[0.0589]
Sargan	Chi^2(1)	=	0.76816	[0.3808]	Chi^2(2)	=	3.3971	[0.1829]
Joint Model	F(1,19)	=	0.75890	[0.3945]	F(2,19)	=	1.8334	[0.1871]

Table 8.5

Summary Results of Specific Models for the Demand Models by Amount (Liberal Strategy) for the Sample Period 1971-2001 (for Variables being Made Constant Using the Average Annual CPIs as Deflators)

No.	Model	1	2	3	4	5	6	7	8	9	10	D3 FSM-2	
1	Constant	-1.25077 *** (1.0000)	-0.98777 *** (0.7000)	-0.88607 ** (1.0000)	-1.71068 *** (1.0000)	-0.61957 ** (0.4000)	-0.53062 ** (0.4000)	-1.49194 *** (1.0000)		-1.04767 *** (0.7000)		Constant	-1.31060 *** (1.0000)
2	Dmad_1	0.25944 ** (0.7000)			0.38534 ** (0.7000)							Dmad_1	0.33582 *** (0.7000)
3	MSMR		0.00104 ** (0.4000)									MSMR	
4	MSMR_1			0.00093 * (1.0000)			0.00094 * (1.0000)	0.00131 ** (1.0000)		0.00138 ** (1.0000)	0.00120 ** (1.0000)	MSMR_1	
5	DMFD	-0.01930 ** (0.4433)									0.02213 * (0.7000)	DMFD	
6	DMFD_1				-0.04420 *** (1.0000)							DMFD_1	-0.03261 ** (1.0000)
7	DMSDR	0.07314 *** (1.0000)	0.05927 *** (1.0000)	0.04812 *** (1.0000)					0.04787 *** (1.0000)			DMSDR	0.04464 *** (1.0000)
8	DMFDR					0.09223 *** (1.0000)	0.08694 *** (1.0000)					DMFDR	
9	DMTBR3M_1				0.05959 *** (1.0000)							DMTBR3M_1	0.04327 ** (1.0000)
10	MIA				0.02804 * (1.0000)			0.04466 ** (1.0000)		0.04132 ** (0.7000)		MIA	
11	MIA_1			0.01159 * (1.0000)								MIA_1	
12	mp	0.62163 ** (0.4303)		0.61978 ** (0.7000)	1.50827 ** (0.7000)	1.02124 *** (0.4756)	0.77228 ** (0.4383)	2.16764 *** (0.7000)	1.11187 *** (0.7000)	2.03179 *** (0.7000)		mp	0.76184 *** (1.0000)
13	mp_1	-1.03376 *** (0.4899)	-0.43272 *** (1.0000)	-0.90878 *** (0.7000)	-1.89054 *** (0.4544)	-1.08916 *** (0.5081)	-0.86889 *** (0.4057)	-2.33107 *** (0.7000)	-1.04321 *** (0.7000)	-2.08153 *** (0.7000)	-0.10742 *** (0.4777)	mp_1	-1.14743 *** (0.7000)
14	MCBR	-0.07927 *** (1.0000)	-0.04106 ** (0.5271)	-0.04783 * (0.7000)	-0.07427 ** (0.4474)							MCBR	-0.07221 *** (0.4872)
15	MCBR_1	0.07141 *** (1.0000)	0.05178 *** (0.7000)	0.06403 *** (1.0000)	0.07423 *** (0.4630)	0.03637 *** (1.0000)	0.03598 *** (1.0000)	0.04142 *** (0.7000)		0.04585 *** (1.0000)	0.01597 *** (0.7000)	MCBR_1	0.06133 *** (0.4356)
16	MCDR	0.58084 *** (1.0000)	0.42990 *** (1.0000)	0.29089 * (1.0000)	0.60098 *** (1.0000)			0.18455 NS (0.6000)				MCDR	0.59474 *** (1.0000)
17	DMTFR	0.69073 *** (1.0000)	0.43453 *** (0.7000)	0.36865 ** (0.7000)	0.45876 ** (0.4372)							DMTFR	0.58945 *** (0.5399)
18	DMTFR_1	0.97205 *** (1.0000)	0.72949 *** (1.0000)	0.78322 *** (1.0000)	1.14208 *** (1.0000)	0.46449 *** (1.0000)	0.44519 *** (1.0000)	0.63643 *** (1.0000)	0.53930 *** (1.0000)	0.57030 *** (1.0000)	0.49903 *** (1.0000)	DMTFR_1	1.15440 *** (1.0000)
19	DMLEm	0.22650 *** (1.0000)		0.12803 ** (1.0000)	0.31908 *** (1.0000)					0.07284 NS (0.3000)		DMLEm	0.28878 *** (1.0000)
20	DMLEm_1	0.10651 ** (0.4984)										DMLEm_1	0.09648 ** (0.4742)
21	DMLEf		0.12286 *** (1.0000)			0.08780 ** (1.0000)		0.07036 * (0.7000)	0.08828 ** (1.0000)			DMLEf	
22	DMLEf_1		0.05786 * (0.4000)									DMLEf_1	
	Number of GUM(s)	2	2	2	2	4	2	2	2	2	2		
	Adjusted-R^2	0.70875	0.65975	0.65808	0.57803	0.53669	0.49512	0.48401	0.45818	0.45812	0.36593		0.75177
	Sigma	0.08028	0.08677	0.08698	0.09663	0.10126	0.10570	0.10686	0.10950	0.10950	0.11845		0.07412
	Probability:												
	Chow (1998: 1)	0.7173	0.6155	0.4935	0.3000	0.6816	0.7223	0.2428	0.9909	0.3262	0.9379		0.0165
	Normality Test	0.5616	0.0848	0.3622	0.8923	0.3153	0.4058	0.0186	0.7585	0.0166	0.0755		0.0332
	AR 1-4 Test	0.2592	0.5209	0.3107	0.3028	0.7822	0.9551	0.6535	0.5031	0.6049	0.8451		0.0142
	Hetero Test	0.2698	0.2306	0.4092	0.9843	0.0565	0.0820	0.2963	0.1374	0.5919	0.7019		0.8450

Dependent Variable: Dmad

Note: Two GUMs are removed because their congruent models have negative adjusted-R-squared values. Therefore, only 22 GUMs have been estimated.

Table 8.6

Summary Results of Specific Models for the Demand Models by Premium (Liberal Strategy) for the Sample Period 1971-2001 (for Variables being Made Constant Using the Average Annual CPIs as Deflators)

No.	Model	1	2	D4 = Model-2 FSM-3	
1	Constant	-0.94042 *** (1.0000)	-0.50967 ** (0.5201)	Constant	-0.50967 ** (0.5201)
2	MSMR_1	0.00120 ** (1.0000)		MSMR_1	
3	DMSDR		0.03787 *** (1.0000)	DMSDR	0.03787 *** (1.0000)
4	MIA	0.03332 ** (1.0000)		MIA	
5	mp	1.77865 *** (1.0000)	0.68114 *** (1.0000)	mp	0.68114 *** (1.0000)
6	mp_1	-1.84274 *** (1.0000)	-0.77072 *** (1.0000)	mp_1	-0.77072 *** (1.0000)
7	MCBR_1	0.04287 *** (1.0000)	0.03285 *** (1.0000)	MCBR_1	0.03285 *** (1.0000)
8	DMTFR_1	0.33384 ** (1.0000)	0.28081 ** (1.0000)	DMTFR_1	0.28081 ** (1.0000)
	Number of GUM(s)	18	6		
	Adjusted-R^2	0.52511	0.52370		0.52370
	Sigma	0.09264	0.09278		0.09278
	Probability:				
	Chow (1998: 1)	0.0393	0.1210		0.1210
	Normality Test	0.1351	0.9468		0.9468
	AR 1-4 Test	0.0142	0.2902		0.2902
	Hetero Test	0.1250	0.6142		0.6142

Dependent Variable: Dmpd

Table 8.7

Summary Results of Encompassing Test for Model-1 and D4 (Liberal Strategy)

```
Encompassing test statistics: 1971 to 2001

Sigma[Model-1] = 0.0926385  sigma[D4] = 0.0927758  sigma[Joint] = 0.0896515

Test         Model-1 vs. D4                      D4 vs. Model-1
Cox          N(0,1)    =   -2.737 [0.0062]**     N(0,1)    =   -3.505 [0.0005]**
Ericsson IV  N(0,1)    =    2.156 [0.0311]*      N(0,1)    =    2.747 [0.0060]**
Sargan       Chi^2(1)  =   2.4593 [0.1168]       Chi^2(2)  =   3.5230 [0.1718]
Joint Model  F(1,23)   =   2.6259 [0.1188]       F(2,23)   =   1.8864 [0.1743]
```

Table 8.8

Summary Results of Specific Models for the Demand Models by Number (Liberal Strategy) for the Sample Period 1971-2001 (for Variables being Made Constant Using a Combination of Average and End-of-Year CPIs as Deflators)

No.	Model	1 FSM-4	2	3	4	5	6
1	Constant	7.50164 *** (1.0000)	6.73419 *** (1.0000)	4.34160 ** (0.7000)	2.84226 * (1.0000)		
2	mnd_1	0.64559 *** (1.0000)	0.68423 *** (1.0000)	0.78738 *** (1.0000)	0.86807 *** (1.0000)	1.00752 *** (1.0000)	1.00520 *** (1.0000)
3	MSMR	-0.00073 * (0.5414)			-0.00092 * (0.4910)		
4	Dmm2n_1	-0.89788 *** (1.0000)	-1.03562 *** (1.0000)				
5	DMSDR_1	-0.01863 * (0.7000)		-0.02672 ** (1.0000)	-0.02698 ** (0.7000)		
6	MIE	0.01472 *** (0.5155)	0.01746 *** (0.4660)	0.01339 ** (0.7000)	0.01007 * (0.7000)		0.01389 ** (0.5114)
7	MIE_1	-0.01911 *** (0.7000)	-0.02387 *** (0.7000)				
8	mpn	-0.17223 *** (1.0000)	-0.18586 *** (1.0000)	-0.09424 * (0.7000)			
9	MCBR	-0.07425 *** (1.0000)	-0.06320 *** (1.0000)	-0.04259 * (0.7000)	-0.03608 * (1.0000)		
10	DMTFR	0.58812 *** (1.0000)	0.56905 *** (1.0000)	0.41813 *** (1.0000)	0.33991 ** (1.0000)		0.23878 * (0.7000)
11	DMTFR_1	0.65441 *** (1.0000)	0.53256 *** (1.0000)	0.37995 *** (1.0000)	0.46293 *** (1.0000)		0.24490 * (1.0000)
	Number of GUM(s)	1	11	2	2	2	2
	Adjusted-R^2	0.99504	0.99395	0.99094	0.99082	0.98681	0.98923
	Sigma	0.06388	0.07058	0.08637	0.08691	0.10419	0.09415
	Probability:						
	Chow (1998: 1)	0.1554	0.2944	0.0770	0.0231	0.0249	0.0408
	Normality Test	0.2293	0.2477	0.8461	0.4202	0.0363	0.2111
	AR 1-4 Test	0.3185	0.3926	0.2655	0.0680	0.5809	0.1056
	Hetero Test	0.8697	0.7201	0.8587	0.2726	0.0238	0.0683

Dependent Variable: mnd*

Note: Four GUMs are removed because they do not pass the residual autocorrelation test. Therefore, only 20 GUMs have been estimated.

Table 8.9

Summary Results of Specific Models for the Demand Models by Amount (Liberal Strategy) for the Sample Period 1971-2001 (for Variables being Made Constant Using a Combination of Average and End-of-Year CPIs as Deflators)

No.	Model	1	2	3	4	5	6	7	8	9	10	11	12
1	Constant	-1.09169 *** (1.0000)	-1.08666 *** (1.0000)	-0.97604 ** (1.0000)	-0.92852 ** (1.0000)	-0.92351 ** (1.0000)	-1.31650 *** (1.0000)	-0.54272 ** (0.7000)	-0.88592 ** (1.0000)				
2	Dmad_1						0.28006 * (0.7000)						
3	Dmgdp	0.37293 *** (0.7000)			0.29051 ** (0.7000)						0.33512 ** (0.7000)		
4	Dmipc		0.37381 *** (0.7000)			0.28793 ** (0.7000)						0.33049 ** (0.7000)	
5	MSMR_1	0.00097 ** (1.0000)	0.00098 ** (1.0000)	0.00147 ** (1.0000)			0.00143 ** (0.7000)	0.00184 *** (1.0000)	0.00228 *** (1.0000)		0.00132 ** (1.0000)	0.00133 ** (1.0000)	
6	DMFD										0.02498 ** (0.7000)	0.02490 ** (0.7000)	
7	DMFD_1						-0.03152 ** (1.0000)						
8	DMSDR	0.04772 *** (1.0000)	0.04790 *** (1.0000)	0.03747 *** (1.0000)	0.05256 *** (1.0000)	0.05266 *** (1.0000)				0.04814 *** (1.0000)			
9	DMFDR							0.06865 *** (1.0000)					
10	DMIBR3M								0.03042 NS (0.6000)				
11	DMIBR3M_1						0.05192 ** (1.0000)						
12	mpn			0.66889 ** (0.4384)			0.83631 *** (0.7000)	0.92257 *** (0.4253)	0.91092 *** (0.4227)				
13	mpn_1	-0.43044 *** (1.0000)	-0.43104 *** (1.0000)	-0.96180 *** (0.4827)	-0.34617 *** (1.0000)	-0.34650 *** (1.0000)	-1.19340 *** (0.5013)	-0.99594 *** (0.4668)	-1.08438 *** (0.5362)	-0.10673 *** (0.7000)	-0.10768 ** (0.7000)	-0.10981 ** (0.5497)	-0.08751 ** (0.4935)
14	MCBR	-0.05843 ** (0.7000)	-0.05887 ** (0.7000)	-0.04206 * (0.7000)	-0.03492 * (0.5106)	-0.03532 * (0.5156)	-0.06180 ** (0.1093)						
15	MCBR_1	0.06010 *** (0.7000)	0.06063 *** (0.7000)	0.05675 ** (0.7000)	0.04943 *** (0.7000)	0.05000 *** (0.7000)	0.05906 ** (0.7000)	0.03385 *** (1.0000)	0.02192 * (0.1301)	0.01797 *** (1.0000)			0.01471 *** (0.4679)
16	MCDR	0.49951 *** (1.0000)	0.50025 *** (1.0000)	0.32740 ** (1.0000)	0.34750 ** (1.0000)	0.34724 ** (1.0000)	0.53120 *** (1.0000)		0.19681 NS (0.6000)		0.08791 *** (0.7000)	0.09100 *** (0.7000)	
17	DMIFR	0.55677 *** (0.7000)	0.55678 *** (0.7000)	0.31946 * (0.7000)	0.38757 *** (0.7000)	0.38680 *** (0.7000)	0.39777 ** (0.4776)		0.19778 NS (0.0249)	0.27306 * (0.7000)			
18	DMIFR_1	0.94049 *** (1.0000)	0.94221 *** (1.0000)	0.79340 *** (1.0000)	0.78554 *** (1.0000)	0.78614 *** (1.0000)	1.03565 *** (1.0000)	0.49582 *** (1.0000)	0.68280 *** (1.0000)	0.59857 *** (1.0000)	0.53528 *** (1.0000)	0.53677 *** (1.0000)	0.39418 ** (1.0000)
19	DMLEm	0.10563 * (1.0000)	0.10536 * (1.0000)	0.12533 ** (0.7000)			0.26140 *** (1.0000)		0.08135 NS (0.3000)				
20	DMLEm_1	0.08120 * (0.7000)	0.08280 * (0.7000)										
21	DMLEf				0.07119 ** (1.0000)	0.07165 ** (1.0000)							
22													
	Number of GUM(s)	1	1	2	1	1	2	8	2	2	1	1	2
	Adjusted-R^2	0.68223	0.68175	0.63722	0.62979	0.62823	0.61354	0.57992	0.51107	0.48549	0.37881	0.37488	0.24760
	Sigma	0.08386	0.08392	0.08960	0.09051	0.09070	0.09248	0.09642	0.10402	0.10670	0.11724	0.11762	0.12903
	Probability:												
	Chow (1998: 1)	0.4108	0.4232	0.5587	0.4844	0.4949	0.2836	0.6224	0.2804	0.9552	0.9245	0.9290	0.9861
	Normality Test	0.9491	0.9421	0.2508	0.0308	0.0292	0.2279	0.0943	0.0633	0.6755	0.4884	0.4730	0.0366
	AR 1-4 Test	0.4785	0.4954	0.2716	0.6147	0.6229	0.2993	0.9903	0.9829	0.7237	0.9590	0.9622	0.8994
	Hetero Test	0.1855	0.1903	0.1921	0.1652	0.1751	0.4071	0.0624	0.4956	0.1943	0.5387	0.5314	0.7254

No.	D5 = Model-6		D6 = Model-6		Re-specified Model-1 FSM-5		Re-specified Model-2 FSM-6	
1	Constant	-1.31650 *** (1.0000)	Constant	-1.31650 *** (1.0000)	Constant	-1.08805 *** (1.0000)	Constant	-1.08277 *** (1.0000)
2	Dmad_1	0.28006 * (0.7000)	Dmad_1	0.28006 * (0.7000)				
3	Dmgdp				Dmgdp	0.37563 *** (0.7000)		
4			Dmipc				Dmipc	0.37664 *** (0.7000)
5	MSMR_1	0.00143 ** (0.7000)	MSMR_1	0.00143 ** (0.7000)	MSMR_1	0.00098 ** (1.0000)	MSMR_1	0.00099 ** (1.0000)
6	DMFD		DMFD					
7	DMFD_1	-0.03152 ** (1.0000)	DMFD_1	-0.03152 ** (1.0000)				
8	DMSDR		DMSDR		DMSDR	0.04763 *** (1.0000)	DMSDR	0.04781 *** (1.0000)
9	DMFDR		DMFDR					
10	DMIBR3M		DMIBR3M					
11	DMIBR3M_1	0.05192 ** (1.0000)	DMIBR3M_1	0.05192 ** (1.0000)				
12	mpn	0.83631 *** (0.7000)	mpn	0.83631 *** (0.7000)				
13	mpn_1	-1.19340 *** (0.5013)	mpn_1	-1.19340 *** (0.5013)	mpn_1	-0.43445 *** (1.0000)	mpn_1	-0.43526 *** (1.0000)
14	MCBR	-0.06180 ** (0.1093)	MCBR	-0.06180 ** (0.1093)				
15	MCBR_1	0.05906 ** (0.7000)	MCBR_1	0.05906 ** (0.7000)				
16	MCDR	0.53120 *** (1.0000)	MCDR	0.53120 *** (1.0000)	MCDR	0.51065 *** (1.0000)	MCDR	0.51198 *** (1.0000)
17	DMIFR	0.39777 ** (0.4776)	DMIFR	0.39777 ** (0.4776)	DMIFR	0.56556 *** (0.7000)	DMIFR	0.56604 *** (0.7000)
18	DMIFR_1	1.03565 *** (1.0000)	DMIFR_1	1.03565 *** (1.0000)	DMIFR_1	0.94846 *** (1.0000)	DMIFR_1	0.95062 *** (1.0000)
19	DMLEm	0.26140 *** (1.0000)	DMLEm	0.26140 *** (1.0000)	DMLEm	0.10800 ** (1.0000)	DMLEm	0.10786 ** (1.0000)
20	DMLEm_1		DMLEm_1		DMLEm_1	0.08285 ** (0.7000)	DMLEm_1	0.08455 ** (0.7000)
21	DMLEf		DMLEf					
22					DMCBR	-0.06014 *** (0.7000)	DMCBR	-0.06067 *** (0.7000)
	Number of GUM(s)							
	Adjusted-R^2	0.61354		0.61354		0.69786		0.69737
	Sigma	0.09248		0.09248		0.08177		0.08183
	Probability:							
	Chow (1998: 1)	0.2836		0.2836		0.4500		0.4644
	Normality Test	0.2279		0.2279		0.9658		0.9598
	AR 1-4 Test	0.2993		0.2993		0.4550		0.4731
	Hetero Test	0.4071		0.4071		0.2077		0.2052

Dependent Variable: Dmad*

Table 8.10

Summary Results of Encompassing Test for Model-1 and Model-2 (Liberal Strategy)

```
Encompassing test statistics: 1971 to 2001

sigma[Model-1] = 0.0838563  sigma[Model-2] = 0.0839203  sigma[Joint] =
0.0861224

Test          Model-1 vs. Model-2                   Model-2 vs. Model-1
Cox           N(0,1)    =    0.1511 [0.8799]        N(0,1)    =  -0.2653 [0.7908]
Ericsson IV   N(0,1)    =   -0.1183 [0.9058]        N(0,1)    =   0.2075 [0.8356]
Sargan        Chi^2(1)  = 0.014021 [0.9057]         Chi^2(1)  = 0.042976 [0.8358]
Joint Model   F(1,18)   = 0.013293 [0.9095]         F(1,18)   = 0.040807 [0.8422]
```

Table 8.11

Summary Results of Encompassing Test for Model-1 and Model-6 (Liberal Strategy)

```
Encompassing test statistics: 1971 to 2001

sigma[Model-1] = 0.0838563  sigma[Model-6] = 0.0924769  sigma[Joint] =
0.0785295

Test          Model-1 vs. Model-6                   Model-6 vs. Model-1
Cox           N(0,1)    =   -4.834 [0.0000]**       N(0,1)    =   -5.549 [0.0000]**
Ericsson IV   N(0,1)    =    3.016 [0.0026]**       N(0,1)    =    3.186 [0.0014]**
Sargan        Chi^2(4)  =   5.8452 [0.2110]         Chi^2(3)  =   7.1834 [0.0663]
Joint Model   F(4,15)   =   1.6663 [0.2099]         F(3,15)   =   3.3206 [0.0486]*
```

Table 8.12

Summary Results of Encompassing Test for Model-2 and Model-6 (Liberal Strategy)

```
Encompassing test statistics: 1971 to 2001

sigma[Model-2] = 0.0839203  sigma[Model-6] = 0.0924769  sigma[Joint] =
0.0784052

Test          Model-2 vs. Model-6                   Model-6 vs. Model-2
Cox           N(0,1)    =   -4.900 [0.0000]**       N(0,1)    =   -5.617 [0.0000]**
Ericsson IV   N(0,1)    =    3.052 [0.0023]**       N(0,1)    =    3.222 [0.0013]**
Sargan        Chi^2(4)  =   5.9068 [0.2062]         Chi^2(3)  =   7.2176 [0.0653]
Joint Model   F(4,15)   =   1.6917 [0.2041]         F(3,15)   =   3.3470 [0.0476]*
```

Table 8.13

Summary Results of Encompassing Test for R-M1 and R-M2 (Liberal Strategy)

```
Encompassing test statistics: 1971 to 2001

sigma[R-M1] = 0.0817686  sigma[R-M2] = 0.0818349  sigma[Joint] = 0.0838575

Test          R-M1 vs. R-M2                         R-M2 vs. R-M1
Cox           N(0,1)    =    0.1613 [0.8719]        N(0,1)    =  -0.2766 [0.7821]
Ericsson IV   N(0,1)    =   -0.1296 [0.8969]        N(0,1)    =   0.2220 [0.8243]
Sargan        Chi^2(1)  = 0.016825 [0.8968]         Chi^2(1)  = 0.049171 [0.8245]
Joint Model   F(1,19)   = 0.015998 [0.9007]         F(1,19)   = 0.046827 [0.8310]
```

Table 8.14
Summary Results of Specific Models for the Demand Models by Premium (Liberal Strategy) for the Sample Period 1971-2001
(for Variables being Made Constant Using a Combination of Average and End-of-Year CPIs as Deflators)

No.	Model	1	2	3	4	5	6	7	8	9	D7 = Model-2 FSM-7		D8 = Model-1 FSM-8	
1	Constant	-0.60140 ** (0.7000)	-0.60684 ** (0.7000)	-0.53681 ** (0.5026)	-0.48951 ** (0.5410)	-0.55046 ** (0.1949)					Constant	-0.60684 ** (0.7000)	Constant	-0.60140 ** (0.7000)
2	Dmpd_1	-0.30920 * (0.7000)	-0.30776 * (0.7000)								Dmpd_1	-0.30776 * (0.7000)	Dmpd_1	-0.30920 * (0.7000)
3	Dmgdp		0.35429 *** (1.0000)								Dmgdp	0.35429 *** (1.0000)		
4	Dmipc	0.35624 *** (1.0000)											Dmipc	0.35624 *** (1.0000)
5	MSMR_1	0.00093 ** (0.7000)	0.00092 ** (0.7000)	0.00156 *** (1.0000)	0.00148 *** (1.0000)	0.00141 ** (1.0000)		0.00157 *** (1.0000)		0.00102 * (0.7000)	MSMR_1	0.00092 ** (0.7000)	MSMR_1	0.00093 ** (0.7000)
6	DMSDR	0.03316 ** (1.0000)	0.03302 ** (1.0000)				0.03192 ** (1.0000)		0.02669 * (0.7000)		DMSDR	0.03302 ** (1.0000)	DMSDR	0.03316 ** (1.0000)
7	MIE									-0.01686 ** (0.4217)	MIE		MIE	
8	mpn			0.62416 ** (0.7000)	0.69139 ** (1.0000)	0.57646 ** (0.5486)		0.93417 *** (1.0000)			mpn		mpn	
9	mpn_1	-0.17089 *** (1.0000)	-0.17078 *** (1.0000)	-0.70383 *** (1.0000)	-0.77200 *** (1.0000)	-0.66458 ** (0.7000)	-0.11328 *** (0.7000)	-0.88938 *** (1.0000)	-0.11262 *** (1.0000)	-0.07995 ** (0.7000)	mpn_1	-0.17078 *** (1.0000)	mpn_1	-0.17089 *** (1.0000)
10	MCBR	0.04519 *** (1.0000)	0.04503 *** (1.0000)	0.03258 *** (0.7000)		0.03362 *** (0.7000)					MCBR	0.04503 *** (1.0000)	MCBR	0.04519 *** (1.0000)
11	MCBR_1				0.03031 ** (0.7000)		0.01678 *** (1.0000)		0.01609 *** (1.0000)	0.01348 *** (1.0000)	MCBR_1		MCBR_1	
12	DMTFR_1	0.27792 ** (1.0000)	0.27749 ** (1.0000)	0.23219 * (1.0000)	0.27773 ** (1.0000)		0.26446 * (1.0000)	0.27918 * (1.0000)	0.31090 ** (1.0000)		DMTFR_1	0.27749 ** (1.0000)	DMTFR_1	0.27792 ** (1.0000)
13	DMLEm	-0.17867 *** (1.0000)	-0.17757 *** (1.0000)	-0.08935 * (0.7000)		-0.10675 ** (1.0000)	-0.09515 ** (1.0000)				DMLEm	-0.17757 *** (1.0000)	DMLEm	-0.17867 *** (1.0000)
	Number of GUM(s)	1	1	1	8	3	2	2	2	2				
	Adjusted-R^2	0.57576	0.57453	0.47050	0.44930	0.42207	0.39440	0.31822	0.31789	0.31350		0.57453		0.57576
	Sigma	0.08756	0.08769	0.09782	0.09976	0.10220	0.10461	0.11100	0.11102	0.11138		0.08769		0.08756
	Probability:													
	Chow (1998: 1)	0.4701	0.4623	0.2044	0.1576	0.3087	0.5490	0.2708	0.4909	0.2715		0.4623		0.4701
	Normality Test	0.9422	0.9526	0.2931	0.2586	0.2260	0.0966	0.3573	0.4020	0.2249		0.9526		0.9422
	AR 1-4 Test	0.3099	0.3087	0.1463	0.1183	0.2271	0.4521	0.3251	0.3553	0.5891		0.3087		0.3099
	Hetero Test	0.8569	0.8450	0.6715	0.7241	0.6088	0.5022	0.5993	0.1555	0.7211		0.8450		0.8569

Dependent Variable: Dmpd*

Note: Two GUMs are removed because their congruent models have negative Adjusted-R-squared values. Therefore, only 22 GUMs have been estimated.

Table 8.15
Summary Results of Encompassing Test for D7 and D8 (Liberal Strategy)

```
Encompassing test statistics: 1971 to 2001

sigma[D7] = 0.0876853  sigma[D8] = 0.0875593  sigma[Joint] = 0.0894535

Test          D7 vs. D8                             D8 vs. D7
Cox           N(0,1)    =  -0.4531 [0.6505]         N(0,1)    =    0.3381 [0.7353]
Ericsson IV   N(0,1)    =   0.3810 [0.7032]         N(0,1)    =   -0.2852 [0.7755]
Sargan        Chi^2(1)  =  0.14456 [0.7038]         Chi^2(1)  = 0.081584 [0.7752]
Joint Model   F(1,21)   =  0.13890 [0.7131]         F(1,21)   = 0.078166 [0.7825]
```

Table 8.16
Summary Results of Specific Models for the Demand Models by Number (Conservative Strategy) for the Sample Period 1971-2001 (for Variables being Made Constant Using the Average Annual CPIs as Deflators)

No.	Model	1	2	3	D9 = Model-1 FSM-9	
1	Constant	6.73627 ***	5.59068 ***		Constant	6.73627 ***
		(1.0000)	(0.7000)			(1.0000)
2	mnd_1	0.69384 ***	0.73558 ***	1.00752 ***	mnd_1	0.69384 ***
		(1.0000)	(1.0000)	(1.0000)		(1.0000)
3	MSMR	-0.00114 **			MSMR	-0.00114 **
		(0.6152)				(0.6152)
4	Dmm2_1	-0.89870 ***	-0.81063 ***		Dmm2_1	-0.89870 ***
		(0.7000)	(0.7000)			(0.7000)
5	MIA	0.01631 ***	0.01931 ***		MIA	0.01631 ***
		(0.7000)	(0.7000)			(0.7000)
6	MIA_1	-0.02760 ***	-0.02769 ***		MIA_1	-0.02760 ***
		(1.0000)	(1.0000)			(1.0000)
7	mp		-0.15039 ***		mp	
			(0.7000)			
8	MCBR	-0.05230 **	-0.05105 **		MCBR	-0.05230 **
		(1.0000)	(0.7000)			(1.0000)
9	MCDR_1	-0.19524 ***			MCDR_1	-0.19524 ***
		(0.2156)				(0.2156)
10	DMTFR	0.37626 ***	0.45029 ***		DMTFR	0.37626 ***
		(1.0000)	(1.0000)			(1.0000)
11	DMTFR_1	0.55520 ***	0.43377 ***		DMTFR_1	0.55520 ***
		(1.0000)	(1.0000)			(1.0000)
	Number of GUM(s)	2	4	18		
	Adjusted-R^2	0.99313	0.99203	0.98681		0.99313
	Sigma	0.07518	0.08099	0.10419		0.07518
	Probability:					
	Chow (1998: 1)	0.0396	0.1954	0.0249		0.0396
	Normality Test	0.8272	0.9588	0.0363		0.8272
	AR 1-4 Test	0.0414	0.1631	0.5809		0.0414
	Hetero Test	0.8759	0.9850	0.0238		0.8759

Dependent Variable: mnd

Table 8.17
Summary Results of Specific Models for the Demand Models by Amount (Conservative Strategy) for the Sample Period 1971-2001 (for Variables being Made Constant Using the Average Annual CPIs as Deflators)

No.	Model	1	2	3	4	D10 = Model-2 FSM-10	
1	Constant	-1.04767 *** (0.6242)				Constant	
2	MSMR_1	0.00138 ** (1.0000)				MSMR_1	
3	DMSDR		0.04714 *** (1.0000)			DMSDR	0.04714 *** (1.0000)
4	MIA	0.04132 ** (0.7000)				MIA	
5	mp	2.03179 *** (0.5811)			0.75445 ** (0.6243)	mp	
6	mp_1	-2.08153 *** (0.6004)	-0.11079 *** (0.5563)	-0.08886 ** (0.5036)	-0.70140 ** (0.6371)	mp_1	-0.11079 *** (0.5563)
7	MCBR_1	0.04585 *** (0.7000)	0.01780 *** (0.7000)	0.01488 *** (0.4588)		MCBR_1	0.01780 *** (0.7000)
8	DMTFR_1	0.57030 *** (1.0000)	0.51426 *** (1.0000)	0.38674 ** (1.0000)		DMTFR_1	0.51426 *** (1.0000)
9	DMLEm	0.07284 NS (0.0000)				DMLEm	
	Number of GUM(s)	6	8	6	2		
	Adjusted-R^2	0.45812	0.44973	0.25533	0.05623		0.44973
	Sigma	0.10950	0.11035	0.12837	0.14452		0.11035
	Probability:						
	Chow (1998: 1)	0.3262	0.9987	0.9858	0.9866		0.9987
	Normality Test	0.0166	0.4464	0.0261	0.0134		0.4464
	AR 1-4 Test	0.6049	0.4540	0.9032	0.7415		0.4540
	Hetero Test	0.5919	0.1192	0.8267	0.0278		0.1192

Dependent Variable: Dmad

Note: Two GUMs are removed because there is nothing to model. Therefore, only 22 GUMs have been estimated.

Table 8.18
Summary Results of Encompassing Test for Model-1 and D10 (Conservative Strategy)

```
Encompassing test statistics: 1971 to 2001

sigma[Model-1] = 0.109505   sigma[D10] = 0.110349   sigma[Joint] = 0.0986635

Test          Model-1 vs. D10                      D10 vs. Model-1
Cox           N(0,1)    =   -4.901 [0.0000]**    N(0,1)    =   -4.850 [0.0000]**
Ericsson IV   N(0,1)    =    3.681 [0.0002]**    N(0,1)    =    3.708 [0.0002]**
Sargan        Chi^2(1)  =   5.1404 [0.0234]*     Chi^2(5)  =   9.4128 [0.0937]
Joint Model   F(1,22)   =   6.3321 [0.0197]*     F(5,22)   =   2.3549 [0.0743]
```

Table 8.19

Summary Results of Specific Models for the Demand Models by Premium (Conservative Strategy) for the Sample Period 1971-2001

(for Variables being Made Constant Using the Average Annual CPIs as Deflators)

No.	Model	1	2	3	4	5	D11 = Model-1		Re-specified D11 FSM-11	
1	Constant	-0.94042 *** (1.0000)				0.14651 *** (1.0000)	Constant	-0.94042 *** (1.0000)	Constant	-0.85714 *** (1.0000)
2	Dmm2		0.86789 *** (1.0000)				Dmm2			
3	MSMR_1	0.00120 ** (0.7000)					MSMR_1	0.00120 ** (0.7000)	MSMR_1	0.00122 ** (1.0000)
4	MIA	0.03332 ** (0.7000)				-0.01851 *** (0.4195)	MIA	0.03332 ** (0.7000)	MIA	0.03704 ** (0.7000)
5	mp	1.77865 *** (1.0000)			0.86367 *** (0.6043)		mp	1.77865 *** (1.0000)		
6	mp_1	-1.84274 *** (1.0000)		-0.10720 *** (0.7000)	-0.81929 *** (0.5920)		mp_1	-1.84274 *** (1.0000)		
7	MCBR_1	0.04287 *** (1.0000)		0.01482 *** (0.7000)			MCBR_1	0.04287 *** (1.0000)	MCBR_1	0.03328 *** (1.0000)
8	DMTFR_1	0.33384 ** (0.7000)					DMTFR_1	0.33384 ** (0.7000)	DMTFR_1	0.34533 ** (1.0000)
9									Dmp	2.11420 *** (1.0000)
	Number of GUM(s)	11	2	1	7	1				
	Adjusted-R^2	0.52511	0.35751	0.23697	0.23456	0.18542		0.52511		0.50331
	Sigma	0.09264	0.10775	0.11743	0.11761	0.12133		0.09264		0.09474
	Probability:									
	Chow (1998: 1)	0.0393	0.6514	0.6267	0.6476	0.6007		0.0393		0.0599
	Normality Test	0.1351	0.5935	0.0072	0.3371	0.4593		0.1351		0.1547
	AR 1-4 Test	0.0142	0.3748	0.6567	0.2503	0.1537		0.0142		0.1089
	Hetero Test	0.1250	0.6695	0.6729	0.2434	0.8841		0.1250		0.2584

Dependent Variable: Dmpd

Note: Two GUMs are removed because their congruent models have negative adjusted-R-squared values. Therefore, only 22 GUMs have been estimated.

Table 8.20

Summary Results of Specific Models for the Demand Models by Number (Conservative Strategy) for the Sample Period 1971-2001 (for Variables beingMade Constant Using a Combination of Average and End-of-Year CPIs as Deflators)

No.	Model	1 FSM-12	2
1	Constant	6.73419 *** (1.0000)	
2	mnd_1	0.68423 *** (1.0000)	1.00752 *** (1.0000)
3	Dmm2n_1	-1.03562 *** (1.0000)	
4	MIE	0.01746 *** (0.4660)	
5	MIE_1	-0.02387 *** (0.6089)	
6	mpn	-0.18586 *** (1.0000)	
7	MCBR	-0.06320 *** (1.0000)	
8	DMTFR	0.56905 *** (1.0000)	
9	DMTFR_1	0.53256 *** (1.0000)	
	Number of GUM(s)	12	8
	Adjusted-R^2	0.99395	0.98681
	Sigma	0.07058	0.10419
	Probability:		
	Chow (1998: 1)	0.2944	0.0249
	Normality Test	0.2477	0.0363
	AR 1-4 Test	0.3926	0.5809
	Hetero Test	0.7201	0.0238

Dependent Variable: mnd*

Note: Four GUMs are removed because they do not pass the residual autocorrelation test. Therefore, only 20 GUMs have been estimated.

Table 8.21

Summary Results of Specific Models for the Demand Models by Amount (Conservative Strategy) for the Sample Period 1971-2001 (for Variables being Made Constant Using a Combination of Average and End-of-Year CPIs as Deflators)

No.	Model	1	2	3	4	D12 = Model-1 FSM-13	
1	Constant			0.13640 ***		Constant	
				(1.0000)			
2	DMSDR	0.04596 ***				DMSDR	0.04596 ***
		(1.0000)					(1.0000)
3	mpn				0.65080 **	mpn	
					(0.5827)		
4	mpn_1	-0.10746 ***	-0.08751 **		-0.60050 **	mpn_1	-0.10746 ***
		(0.5551)	(0.4935)		(0.5996)		(0.5551)
5	MCBR_1	0.01739 ***	0.01471 ***			MCBR_1	0.01739 ***
		(0.7000)	(0.4679)				(0.7000)
6	DMTFR_1	0.52059 ***	0.39418 **	0.41763 **		DMTFR_1	0.52059 ***
		(1.0000)	(1.0000)	(1.0000)			(1.0000)
	Number of GUM(s)	8	6	2	8		
	Adjusted-R^2	0.43216	0.24760	0.13787	0.06095		0.43216
	Sigma	0.11210	0.12903	0.13812	0.14415		0.11210
	Probability:						
	Chow (1998: 1)	0.9991	0.9861	0.9866	0.9884		0.9991
	Normality Test	0.3995	0.0366	0.3437	0.0261		0.3995
	AR 1-4 Test	0.4436	0.8994	0.8506	0.7986		0.4436
	Hetero Test	0.1815	0.7254	0.4819	0.0213		0.1815

Dependent Variable: Dmad*

Table 8.22

Summary Results of Specific Models for the Demand Models by Premium (Conservative Strategy) for the Sample Period 1971-2001 (for Variables being Made Constant Using a Combination of Average and End-of-Year CPIs as Deflators)

No.	Model	1	2	3	4	D13 = Model-1		Re-specified D13 FSM-14	
1	MSMR_1	0.00133 **	0.00138 **			MSMR_1	0.00133 **	MSMR_1	0.00145 **
		(0.7000)	(0.6330)				(0.7000)		(0.7000)
2	mpn	0.62248 **	0.91043 ***		0.62768 ***	mpn	0.62248 **		
		(0.1944)	(0.7000)		(0.6236)		(0.1944)		
3	mpn_1	-0.65876 ***	-0.87015 ***	-0.09023 ***	-0.59057 ***	mpn_1	-0.65876 ***		
		(0.6257)	(0.7000)	(0.7000)	(0.6134)		(0.6257)		
4	MCBR			0.01299 ***		MCBR			
				(0.7000)					
5	MCBR_1	0.00864 *				MCBR_1	0.00864 *	MCBR_1	0.00492 ***
		(0.1926)					(0.1926)		(1.0000)
6	DMTFR_1	0.28265 **				DMTFR_1	0.28265 **	DMTFR_1	0.28684 **
		(0.3000)					(0.3000)		(0.6000)
7								Dmpn	0.78023 ***
									(0.7000)
	Number of GUM(s)	2	10	1	2				
	Adjusted-R^2	0.37800	0.24878	0.17513	0.12697		0.37800		0.38508
	Sigma	0.10602	0.11651	0.12209	0.12561		0.10602		0.10542
	Probability:								
	Chow (1998: 1)	0.2513	0.3410	0.6832	0.7129		0.2513		0.2293
	Normality Test	0.1596	0.8648	0.0360	0.0869		0.1596		0.1974
	AR 1-4 Test	0.3023	0.4531	0.6588	0.6053		0.3023		0.3058
	Hetero Test	0.8667	0.2180	0.7203	0.8571		0.8667		0.6874

Dependent Variable: Dmpd*

Note: One GUM is removed because there is nothing to model and eight GUMs are removed because their congruent models have negative adjusted-R-squared values. Therefore, only 15 GUMs have been estimated.

Table 8.23

Preliminary Regression Model for the Demand Model by Amount with GDP as Income Variable

Modelling mad by OLS, 1969 - 2001

	Coeff	StdError	t-value	t-prob
Constant	-18.12961	6.51101	-2.784	0.0095
mgdp	1.26680	0.16833	7.526	0.0000
MSDR	-0.02517	0.02944	-0.855	0.3998
MTFR	-0.39814	0.33911	-1.174	0.2503
MLEm	0.22346	0.08399	2.661	0.0128

sigma	0.280666	RSS	2.20565422
R^2	0.957724	F(4,28) =	158.6 [0.000]**
log-likelihood	-2.1845	DW	0.805
no. of observations	33	no. of parameters	5
mean(mad)	9.39875	var(mad)	1.58097

	value	prob
Chow(1998:1)	0.0589	0.9808
normality test	8.2211	0.0164
AR 1-4 test	4.0226	0.0123
hetero test	2.8855	0.0276

Table 8.24

Re-estimated Regression Model for the Demand Model by Amount with GDP as Income Variable

Modelling mad by OLS, 1969 - 2001

	Coeff	StdError	t-value	t-prob
Constant	-26.15567	1.43062	-18.283	0.0000
mgdp	1.31458	0.15407	8.532	0.0000
MLEm	0.30984	0.02846	10.888	0.0000

sigma	0.282979	RSS	2.40231979
R^2	0.953954	F(2,30) =	310.8 [0.000]**
log-likelihood	-3.59377	DW	0.777
no. of observations	33	no. of parameters	3
mean(mad)	9.39875	var(mad)	1.58097

	value	prob
Chow(1998:1)	0.2351	0.8711
normality test	9.9493	0.0069
AR 1-4 test	3.8477	0.0138
hetero test	4.2080	0.0097

Table 8.25
Unit Root Test Results for the Residuals of the Re-estimated Regression Model for the Demand Model by Amount with GDP as Income Variable

```
Unit-root tests for 1970 (1) to 2001 (1)

Augmented Dickey-Fuller test for Resid2; regression of DResid2 on:

               Coefficient    Std.Error      t-value
Resid2_1          -0.41839      0.14188      -2.9489
Constant          0.014257     0.038755      0.36787

sigma = 0.21921  DW = 1.833  DW-Resid2 = 0.8206  ADF-Resid2 = -2.949***
Critical values used in the cointegration test: 1% = -2.5899
RSS = 1.441591614 for 2 variables and 32 observations
```

Table 8.26
ECM for the Demand Model by Amount with GDP as Income Variable

```
Modelling Dmad by OLS, 1971 - 2001

                    Coeff     StdError   t-value    t-prob
Constant          0.11421     0.03439     3.321     0.0029
Resid2_1         -0.35558     0.09953    -3.573     0.0015
Dmad_1            0.02874     0.17230     0.167     0.8689
Dmgdp             0.47587     0.17467     2.724     0.0118
Dmgdp_1          -0.24815     0.18550    -1.338     0.1935
DMLEm             0.00441     0.05492     0.080     0.9366
DMLEm_1          -0.04305     0.05572    -0.773     0.4473

sigma                   0.125127  RSS                 0.375762497
R^2                     0.433983  F(6,24) =       3.067 [0.023]*
log-likelihood           24.4111  DW                         2.14
no. of observations           31  no. of parameters             7
mean(Dmad)              0.112258  var(Dmad)             0.0214152

                      value        prob
Chow(1998:1)         0.0999      0.9592
Normality test       0.0297      0.9853
AR   1-4 test        1.3076      0.3010
hetero test          0.2949      0.9768
```

Table 8.27
Preliminary Regression Model for the Demand Model by Amount
with Income per Capita as Income Variable

```
Modelling mad by OLS, 1969 - 2001

                   Coeff      StdError   t-value     t-prob
Constant     -18.54715       7.81534    -2.373     0.0247
mipc           1.29251       0.23318     5.543     0.0000
MSDR          -0.04409       0.03476    -1.269     0.2150
MTFR          -0.64702       0.41640    -1.554     0.1314
MLEm           0.29423       0.09826     2.994     0.0057

sigma                    0.336941   RSS                   3.17882125
R^2                      0.939071   F(4,28) =       107.9 [0.000]**
log-likelihood           -8.21502   DW                         0.757
no. of observations            33   no. of parameters              5
mean(mad)                 9.39875   var(mad)                 1.58097

                       value        prob
Chow(1998:1)          0.1604       0.9219
Normality test        9.2701       0.0097
AR   1-4 test         4.4941       0.0075
hetero test           2.8548       0.0289
```

Table 8.28
Re-estimated Regression Model for the Demand Model by Amount
with Income per Capita as Income Variable

```
Modelling mad by OLS, 1969 - 2001

                   Coeff      StdError   t-value     t-prob
Constant     -31.70427       2.27175   -13.956     0.0000
mipc           1.33282       0.22254     5.989     0.0000
MLEm           0.44382       0.02619    16.945     0.0000

sigma                    0.353511   RSS                    3.7490965
R^2                       0.92814   F(2,30) =       193.7 [0.000]**
log-likelihood           -10.9376   DW                         0.685
no. of observations            33   no. of parameters              3
mean(mad)                 9.39875   var(mad)                 1.58097

                       value        prob
Chow(1998:1)          0.6510       0.5892
Normality test       12.1893       0.0023
AR   1-4 test         4.4154       0.0074
hetero test           2.2443       0.0929
```

Table 8.29

Preliminary Regression Model for the Demand Model by Premium with GDP as Income Variable

Modelling mpd by OLS, 1969 - 2001

	Coeff	StdError	t-value	t-prob
Constant	-11.89928	6.15498	-1.933	0.0634
mgdp	1.20621	0.15913	7.580	0.0000
MSDR	-0.02810	0.02783	-1.010	0.3213
MTFR	-0.34781	0.32057	-1.085	0.2872
MLEm	0.08115	0.07939	1.022	0.3155

sigma	0.265319	RSS	1.97103451
R^2	0.926619	F(4,28) =	88.39 [0.000]**
log-likelihood	-0.328813	DW	0.7
no. of observations	33	no. of parameters	5
mean(mpd)	5.54789	var(mpd)	0.813944

	value	prob
Chow(1998:1)	0.2723	0.8447
normality test	9.3093	0.0095
AR 1-4 test	5.5860	0.0025
hetero test	2.4794	0.0498

Table 8.30

Re-estimated Regression Model for the Demand Model by Premium with GDP as Income Variable

Modelling mpd by OLS, 1969 - 2001

	Coeff	StdError	t-value	t-prob
Constant	-15.12907	1.67668	-9.023	0.0000
mgdp	1.84745	0.14969	12.342	0.0000

sigma	0.38278	RSS	4.54212877
R^2	0.830897	F(1,31) =	152.3 [0.000]**
log-likelihood	-14.1036	DW	0.456
no. of observations	33	no. of parameters	2
mean(mpd)	5.54789	var(mpd)	0.813944

	value	prob
Chow(1998:1)	0.0482	0.9857
normality test	9.0656	0.0108
AR 1-4 test	8.4542	0.0001
hetero test	6.9319	0.0036

Table 8.31
Preliminary Regression Model for the Demand Model by Premium
with Income per Capita as Income Variable

Modelling mpd by OLS, 1969 - 2001

	Coeff	StdError	t-value	t-prob
Constant	-12.27949	7.24272	-1.695	0.1011
mipc	1.25444	0.21609	5.805	0.0000
MSDR	-0.04477	0.03221	-1.390	0.1755
MTFR	-0.59499	0.38589	-1.542	0.1343
MLEm	0.14572	0.09106	1.600	0.1208

sigma	0.312254	RSS	2.73006889
R^2	0.89836	F(4,28) =	61.87 [0.000]**
log-likelihood	-5.70399	DW	0.695
no. of observations	33	no. of parameters	5
mean(mpd)	5.54789	var(mpd)	0.813944

	value	prob
Chow(1998:1)	0.1490	0.9294
normality test	8.9484	0.0114
AR 1-4 test	5.6558	0.0024
hetero test	2.6198	0.0405

Table 8.32
Re-estimated Regression Model for the Demand Model by Premium
with Income per Capita as Income Variable

Modelling mpd by OLS, 1969 - 2001

Coeff	StdError	t-value	t-prob	
mipc	0.65866	0.01693	38.903	0.0000

sigma	0.821349	RSS	21.5876347
log-likelihood	-39.8226	DW	0.0333
no. of observations	33	no. of parameters	1
mean(mpd)	5.54789	var(mpd)	0.813944

	value	prob
Chow(1998:1)	2.2535	0.1033
normality test	10.8280	0.0045
AR 1-4 test	77.6318	0.0000
hetero test	19.5690	0.0001

Table 8.33

Summary Results of Final Specific Models (FSMs) for Life Insurance Demand Models by Number, by Amount and by Premium
for Variables being Made Constant Using Different Deflation Approaches
Using Liberal Strategy (LS) as the Modelling Starategy

Demand Model by	Number		Amount			Premium		
	FSM-1 (LS)	FSM-4 (LS)	FSM-2 (LS)	FSM-5 (LS)	FSM-6 (LS)	FSM-3 (LS)	FSM-7 (LS)	FSM-8 (LS)
Constant	7.20364 ***	7.50164 ***	-1.31060 ***	-1.08805 ***	-1.08277 ***	-0.50967 **	-0.60684 **	-0.60140 **
	(0.4885)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(0.5201)	(0.7000)	(0.7000)
mnd_1 / Dmad_1 / Dmpd_1	0.65772 ***	0.64559 ***	0.33582 ***				-0.30776 *	-0.30920 *
	(1.0000)	(1.0000)	(0.7000)				(0.7000)	(0.7000)
Dmgdp				0.37563 ***			0.35429 ***	
				(0.7000)			(1.0000)	
Dmipc					0.37664 ***			0.35624 ***
					(0.7000)			(1.0000)
MSMR	-0.00081 *	-0.00073 *						
	(0.5268)	(0.5414)						
MSMR_1				0.00098 **	0.00099 **		0.00092 **	0.00093 **
				(1.0000)	(1.0000)		(0.7000)	(0.7000)
DMFD_1			-0.03261 **					
			(1.0000)					
Dmm2_1 / Dmm2n_1	-0.92012 ***	-0.89788 ***						
	(0.4255)	(1.0000)						
DMSDR			0.04464 ***	0.04763 ***	0.04781 ***	0.03787 ***	0.03302 **	0.03316 **
			(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)
DMSDR_1		-0.01863 *						
		(0.7000)						
DMTBR3M	-0.02222 *							
	(0.7000)							
DMTBR3M_1			0.04327 **					
			(1.0000)					
MIA / MIE	0.01834 ***	0.01472 ***						
	(1.0000)	(0.5155)						
MIA_1 / MIE_1	-0.03012 ***	-0.01911 ***						
	(1.0000)	(0.7000)						
mp / mpn	-0.17024 ***	-0.17223 ***	0.76184 ***			0.68114 ***		
	(0.5364)	(1.0000)	(1.0000)			(1.0000)		
mp_1 / mpn_1			-1.14743 ***	-0.43445 ***	-0.43526 ***	-0.77072 ***	-0.17078 ***	-0.17089 ***
			(0.7000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)
MCBR	-0.06876 ***	-0.07425 ***	-0.07221 ***				0.04503 ***	0.04519 ***
	(0.7000)	(1.0000)	(0.4872)				(1.0000)	(1.0000)
MCBR_1			0.06133 ***			0.03285 ***		
			(0.4356)			(1.0000)		
DMCBR				-0.06014 ***	-0.06067 ***			
				(0.7000)	(0.7000)			
MCDR			0.59474 ***	0.51065 ***	0.51198 ***			
			(1.0000)	(1.0000)	(1.0000)			
DMTFR	0.46502 ***	0.58812 ***	0.58945 ***	0.56556 ***	0.56604 ***			
	(1.0000)	(1.0000)	(0.5399)	(0.7000)	(0.7000)			
DMTFR_1	0.55964 ***	0.65441 ***	1.15440 ***	0.94846 ***	0.95062 ***	0.28081 **	0.27749 **	0.27792 **
	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)
DMLEm			0.28878 ***	0.10800 **	0.10786 **		-0.17757 ***	-0.17867 ***
			(1.0000)	(1.0000)	(1.0000)		(1.0000)	(1.0000)
DMLEm_1			0.09648 **	0.08285 **	0.08455 **			
			(0.4742)	(0.7000)	(0.7000)			
Adjusted-R^2	0.99371	0.99504	0.75177	0.69786	0.69737	0.52370	0.57453	0.57576
Sigma	0.07192	0.06388	0.07412	0.08177	0.08183	0.09278	0.08769	0.08756
Probability:								
Chow (1998: 1)	0.2105	0.1554	0.0165	0.4500	0.4644	0.1210	0.4623	0.4701
Normality Test	0.4896	0.2293	0.0332	0.9658	0.9598	0.9468	0.9526	0.9422
AR 1-4 Test	0.1321	0.3185	0.0142	0.4550	0.4731	0.2902	0.3087	0.3099
Hetero Test	0.9632	0.8697	0.8450	0.2077	0.2052	0.6142	0.8450	0.8569
Dependent Variable:	mnd	mnd*	Dmad	Dmad*	Dmad*	Dmpd	Dmpd*	Dmpd*

Note: The results for SET-1 have a plain background; the results for SET-2 have a shaded background.

Table 8.34

Summary Results of Final Specific Models (FSMs) for Life Insurance Demand Models by Number, by Amount and by Premium for Variables being Made Constant Using Different Deflation Approaches Using Conservative Strategy (CS) as the Modelling Starategy

Demand Model by	Number		Amount		Premium	
	FSM-9 (CS)	FSM-12 (CS)	FSM-10 (CS)	FSM-13 (CS)	FSM-11 (CS)	FSM-14 (CS)
Constant	6.73627 ***	6.73419 ***			-0.85714 ***	
	(1.0000)	(1.0000)			(1.0000)	
mnd_1	0.69384 ***	0.68423 ***				
	(1.0000)	(1.0000)				
MSMR	-0.00114 **					
	(0.6152)					
MSMR_1					0.00122 **	0.00145 **
					(1.0000)	(0.7000)
Dmm2_1 / Dmm2n_1	-0.89870 ***	-1.03562 ***				
	(0.7000)	(1.0000)				
DMSDR			0.04714 ***	0.04596 ***		
			(1.0000)	(1.0000)		
MIA / MIE	0.01631 ***	0.01746 ***			0.03704 **	
	(0.7000)	(0.4660)			(0.7000)	
MIA_1 / MIE_1	-0.02760 ***	-0.02387 ***				
	(1.0000)	(0.6089)				
mpn		-0.18586 ***				
		(1.0000)				
mp_1 / mpn_1			-0.11079 ***	-0.10746 ***		
			(0.5563)	(0.5551)		
Dmp / Dmpn					2.11420 ***	0.78023 ***
					(1.0000)	(0.7000)
MCBR	-0.05230 **	-0.06320 ***				
	(1.0000)	(1.0000)				
MCBR_1			0.01780 ***	0.01739 ***	0.03328 ***	0.00492 ***
			(0.7000)	(0.7000)	(1.0000)	(1.0000)
MCDR_1	-0.19524 ***					
	(0.2156)					
DMTFR	0.37626 ***	0.56905 ***				
	(1.0000)	(1.0000)				
DMTFR_1	0.55520 ***	0.53256 ***	0.51426 ***	0.52059 ***	0.34533 **	0.28684 **
	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(0.6000)
Adjusted-R^2	0.99313	0.99395	0.44973	0.43216	0.50331	0.38508
Sigma	0.07518	0.07058	0.11035	0.11210	0.09474	0.10542
Probability:						
Chow (1998: 1)	0.0396	0.2944	0.9987	0.9991	0.0599	0.2293
Normality Test	0.8272	0.2477	0.4464	0.3995	0.1547	0.1974
AR 1-4 Test	0.0414	0.3926	0.4540	0.4436	0.1089	0.3058
Hetero Test	0.8759	0.7201	0.1192	0.1815	0.2584	0.6874
Dependent Variable:	mnd	mnd*	Dmad	Dmad*	Dmpd	Dmpd*

Note: The results for SET-1 have a plain background; the results for SET-2 have a shaded background.

Table 8.35

Summary Results of Final Specific Models (FSMs) for Life Insurance Demand Models by Number, by Amount and by Premium for Variables being Made Constant Using the Average Annual CPIs as Deflators Using Liberal Strategy (LS) and Conservative Strategy (CS) as the Modelling Starategies

Demand Model by	Number		Amount		Premium	
	FSM-1 (LS)	FSM-9 (CS)	FSM-2 (LS)	FSM-10 (CS)	FSM-3 (LS)	FSM-11 (CS)
Constant	7.20364 ***	6.73627 ***	-1.31060 ***		-0.50967 **	-0.85714 ***
	-0.48850	(1.0000)	(1.0000)		(0.5201)	(1.0000)
mnd_1 / Dmad_1	0.65772 ***	0.69384 ***	0.33582 ***			
	-1.00000	(1.0000)	(0.7000)			
MSMR	-0.00081 *	-0.00114 **				
	-0.52680	(0.6152)				
MSMR_1						0.00122 **
						(1.0000)
DMFD_1			-0.03261 **			
			(1.0000)			
Dmm2_1	-0.92012 ***	-0.89870 ***				
	-0.42550	(0.7000)				
DMSDR			0.04464 ***	0.04714 ***	0.03787 ***	
			(1.0000)	(1.0000)	(1.0000)	
DMTBR3M	-0.02222 *					
	-0.70000					
DMTBR3M_1			0.04327 **			
			(1.0000)			
MIA	0.01834 ***	0.01631 ***				0.03704 **
	-1.00000	(0.7000)				(0.7000)
MIA_1	-0.03012 ***	-0.02760 ***				
	-1.00000	(1.0000)				
mp	-0.17024 ***		0.76184 ***		0.68114 ***	
	-0.53640		(1.0000)		(1.0000)	
mp_1			-1.14743 ***	-0.11079 ***	-0.77072 ***	
			(0.7000)	(0.5563)	(1.0000)	
Dmp						2.11420 ***
						(1.0000)
MCBR	-0.06876 ***	-0.05230 **	-0.07221 ***			
	-0.70000	(1.0000)	(0.4872)			
MCBR_1			0.06133 ***	0.01780 ***	0.03285 ***	0.03328 ***
			(0.4356)	(0.7000)	(1.0000)	(1.0000)
MCDR			0.59474 ***			
			(1.0000)			
MCDR_1		-0.19524 ***				
		(0.2156)				
DMTFR	0.46502 ***	0.37626 ***	0.58945 ***			
	-1.00000	(1.0000)	(0.5399)			
DMTFR_1	0.55964 ***	0.55520 ***	1.15440 ***	0.51426 ***	0.28081 **	0.34533 **
	-1.00000	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)
DMLEm			0.28878 ***			
			(1.0000)			
DMLEm_1			0.09648 **			
			(0.4742)			
Adjusted-R^2	0.99371	0.99313	0.75555	0.44973	0.52370	0.50331
Sigma	0.07192	0.07518	0.07355	0.11035	0.09278	0.09474
Probability:						
Chow (1998: 1)	0.2105	0.0396	0.0110	0.9987	0.1210	0.0599
Normality Test	0.4896	0.8272	0.0817	0.4464	0.9468	0.1547
AR 1-4 Test	0.1321	0.0414	0.0472	0.4540	0.2902	0.1089
Hetero Test	0.9632	0.8759	0.8873	0.1192	0.6142	0.2584
Dependent Variable:	mnd	mnd	Dmad	Dmad	Dmpd	Dmpd

Note: The results for liberal strategy have a plain background; the results for conservative strategy have a shaded background.

Table 8.36

Summary Results of Final Specific Models (FSMs) for Life Insurance Demand Models by Number, by Amount and by Premium for Variables being Made Constant Using a Combination of Average and End-of-Year CPIs as Deflators Using Liberal Strategy (LS) and Conservative Strategy (CS) as the Modelling Starategies

Demand Model by	Number		Amount			Premium		
	FSM-4 (LS)	FSM-12 (CS)	FSM-5 (LS)	FSM-6 (LS)	FSM-13 (CS)	FSM-7 (LS)	FSM-8 (LS)	FSM-14 (CS)
Constant	7.50164 ***	6.73419 ***	-1.08805 ***	-1.08277 ***		-0.60684 **	-0.60140 **	
	(1.0000)	(1.0000)	(1.0000)	(1.0000)		(0.7000)	(0.7000)	
mnd_1 / Dmpd_1	0.64559 ***	0.68423 ***				-0.30776 *	-0.30920 *	
	(1.0000)	(1.0000)				(0.7000)	(0.7000)	
Dmgdp			0.37563 ***			0.35429 ***		
			(0.7000)			(1.0000)		
Dmipc				0.37664 ***			0.35624 ***	
				(0.7000)			(1.0000)	
MSMR	-0.00073 *							
	(0.5414)							
MSMR_1			0.00098 **	0.00099 **		0.00092 **	0.00093 **	0.00145 **
			(1.0000)	(1.0000)		(0.7000)	(0.7000)	(0.7000)
Dmm2n_1	-0.89788 ***	-1.03562 ***						
	(1.0000)	(1.0000)						
DMSDR			0.04763 ***	0.04781 ***	0.04596 ***	0.03302 **	0.03316 **	
			(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	
DMSDR_1	-0.01863 *							
	(0.7000)							
MIE	0.01472 ***	0.01746 ***						
	(0.5155)	(0.4660)						
MIE_1	-0.01911 ***	-0.02387 ***						
	(0.7000)	(0.6089)						
mpn	-0.17223 ***	-0.18586 ***						
	(1.0000)	(1.0000)						
mpn_1			-0.43445 ***	-0.43526 ***	-0.10746 ***	-0.17078 ***	-0.17089 ***	
			(1.0000)	(1.0000)	(0.5551)	(1.0000)	(1.0000)	
Dmpn								0.78023 ***
								(0.7000)
MCBR	-0.07425 ***	-0.06320 ***				0.04503 ***	0.04519 ***	
	(1.0000)	(1.0000)				(1.0000)	(1.0000)	
MCBR_1					0.01739 ***			0.00492 ***
					(0.7000)			(1.0000)
DMCBR			-0.06014 ***	-0.06067 ***				
			(0.7000)	(0.7000)				
MCDR			0.51065 ***	0.51198 ***				
			(1.0000)	(1.0000)				
DMTFR	0.58812 ***	0.56905 ***	0.56556 ***	0.56604 ***				
	(1.0000)	(1.0000)	(0.7000)	(0.7000)				
DMTFR_1	0.65441 ***	0.53256 ***	0.94846 ***	0.95062 ***	0.52059 ***	0.27749 **	0.27792 **	0.28684 **
	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(0.6000)
DMLEm			0.10800 **	0.10786 **		-0.17757 ***	-0.17867 ***	
			(1.0000)	(1.0000)		(1.0000)	(1.0000)	
DMLEm_1			0.08285 **	0.08455 **				
			(0.7000)	(0.7000)				
Adjusted-R^2	0.99504	0.99395	0.69786	0.69737	0.43216	0.57453	0.57576	0.38508
Sigma	0.06388	0.07058	0.08177	0.08183	0.11210	0.08769	0.08756	0.10542
Probability:								
Chow (1998: 1)	0.1554	0.2944	0.4500	0.4644	0.9991	0.4623	0.4701	0.2293
Normality Test	0.2293	0.2477	0.9658	0.9598	0.3995	0.9526	0.9422	0.1974
AR 1-4 Test	0.3185	0.3926	0.4550	0.4731	0.4436	0.3087	0.3099	0.3058
Hetero Test	0.8697	0.7201	0.2077	0.2052	0.1815	0.8450	0.8569	0.6874
Dependent Variable:	mnd*	mnd*	Dmad*	Dmad*	Dmad*	Dmpd*	Dmpd*	Dmpd*

Note: The results for liberal strategy have a plain background; the results for conservative strategy have a shaded background.

CHAPTER 9
EMPIRICAL FINDINGS – LAPSATION OF LIFE INSURANCE IN MALAYSIA

This chapter discusses the empirical findings on lapsation of life insurance in Malaysia obtained using the two built-in pre-defined liberal and conservative modelling strategies available in PcGets. This chapter has the same structure as the previous chapter on the demand for life insurance in Malaysia. There are two sets of empirical findings that have used the two modelling strategies for simplification. The first set contains the regression models that use the average annual consumer price indices (CPIs) only as deflators (denoted SET-1). The second set contains the regression models that use a combination of average and end-of-year CPIs as deflators (denoted SET-2).

The general unrestricted model (GUM) is formulated as an autoregressive distributed lag model with one lag for each of the potential variables [i.e. ADL(1,1)]. All of the data for the potential variables in the GUM are of zero integration. For variables that have a unit root, their first-differenced terms that are stationary are included in the GUM.

Only one proxy representing a variable is allowed to enter the GUM at a time. A total of 12 GUMs are formulated for each of the four lapse models. This is because the potential explanatory variables comprise two proxies each for the income and life expectancy variables, three proxies for the interest rate variable and one proxy each for the stock market return, unemployment, inflation, price, crude live-birth rate, crude death rate and total fertility rate variables.

9.1 Presentation of Test Results of the Liberal Strategy

This section presents the test results of the liberal strategy and section 9.2 presents the test results of the conservative strategy.

9.1.1 Simplification Results for SET-1

For SET-1, all of the stock and flow variables are deflated by the average annual CPIs. The GUM formulated is as shown on the following page (where "e" is the error term).

The LAPSE variable refers to four types of lapse rate. Three of the lapse rates are forfeiture rates computed using different methods and the other one is a surrender rate. For the three forfeiture rates, their original/non-differenced series are stationary. Therefore, their original/non-differenced series (i.e. MFR1, MFR2 and MFR3) are used for analysis. For the surrender rate, its original/non-differenced series (i.e. MSR) is non-stationary but its first-differenced series (i.e. DMSR) is stationary. Hence, its first-

$$
\begin{aligned}
&\text{LAPSE}_t \\
&= C_0 + b_0(\text{LAPSE}_{t-1}) + b_1(\text{Dmgdp}_t \text{ or Dmipc}_t) + b_2(\text{Dmgdp}_{t-1} \text{ or Dmipc}_{t-1}) \\
&\quad + b_3(\text{MSMR}_t) + b_4(\text{MSMR}_{t-1}) + b_5(\text{MRUR}_t) + b_6(\text{MRUR}_{t-1}) + b_7(\text{DMSDR}_t \text{ or} \\
&\quad \text{DMFDR}_t \text{ or DMTBR3M}_t) + b_8(\text{DMSDR}_{t-1} \text{ or DMFDR}_{t-1} \text{ or DMTBR3M}_{t-1}) \\
&\quad + b_9(\text{MIA}_t) + b_{10}(\text{MIA}_{t-1}) + b_{11}(\text{mp}_t) + b_{12}(\text{mp}_{t-1}) + b_{13}(\text{MCBR}_t) + b_{14}(\text{MCBR}_{t-1}) \\
&\quad + b_{15}(\text{MCDR}_t) + b_{16}(\text{MCDR}_{t-1}) + b_{17}(\text{DMTFR}_t) + b_{18}(\text{DMTFR}_{t-1}) + b_{19}(\text{DMLEm}_t \\
&\quad \text{or DMLEf}_t) + b_{20}(\text{DMLEm}_{t-1} \text{ or DMLEf}_{t-1}) + e_t
\end{aligned}
$$

differenced term is used for analysis. The inflation rate in SET-1 is the average inflation rate (MIA).

The (simplified) congruent models derived from the simplification of the GUMs (denoted Model), the simplified models obtained from the union models of the congruent models (labelled as L1, L2, etc.) and the final specific models (denoted FSM) are summarised in a series of tables. The structure of each table is organised in the same way as used for reporting the results of the demand for life insurance in Malaysia in the previous chapter. The same structure of the table is maintained throughout this chapter for reporting the results of lapsation of life insurance in Malaysia.

Lapse Model Using MFR1. As a result of the simplification, the GUMs converge into four different congruent models. The detailed simplification results for one of the GUMs are presented in the appendix (refer to Table 9.1) and the summary results of the four congruent models are displayed in Table 9.2. Among the 15 variables that appear in the four models, the constant term, MFR1_1, MSMR_1, mp, MCDR_1 and DMTFR have been retained consistently across all of the models. Two union models are formulated with the 13 variables and one of the two income variables (i.e. either Dmgdp_1 or Dmipc_1) enters the models to be subject to a further simplification. Dmgdp_1 and Dmipc_1 enter the union models separately because they are highly correlated with each other (r=0.9995), as gross domestic product (GDP) is used as the basis to compute income per capita (mipc). The simplified models are L1 and L2. They are identical and the same as Model-4. However, by crude observation, Model-1 and Model-2 seem to be superior to L1 or L2 (or Model-4) based upon their adjusted-R^2 and σ values. Therefore, consideration is also given to Model-1 and Model-2 to be used as the base model(s) in order to obtain the final specific model(s). It is noted that Model-4 is a subset of Model-1 and Model-2. This implies that the latter two models (i.e. Model-1 and Model-2) are more variance dominant than the former model (i.e Model-4). Further, an encompassing test is performed in order to select a non-dominated model between Model-1 and Model-2. The results show that Model-1 and Model-2 are mutually non-dominating (refer to Table 9.3). Therefore, both Model-1 and Model-2 are regarded as the final specific models (i.e. FSM-I and FSM-II).

Lapse Model Using MFR2. The simplification process has resulted in five different congruent models as exhibited in Table 9.4. A total of 19 variables are retained in the five models. Among them, the constant term, MSMR_1, MIA, MIA_1, mp and MCDR_1 are the variables that have been retained consistently in all of the models. For the purpose of a further simplification, two union models are formulated with the 17 variables and one of the two income variables (i.e. either Dmgdp_1 or Dmipc_1) enters the models at a time. The simplified models are L3 and L4, which are identical. By crude observation, Model-1 and Model-2 appear to be superior to L3 (or L4) in terms of their adjusted-R^2 and σ values. In order to select a non-dominated model among Model-1, Model-2 and L3 (or L4) to be the base model(s) for deriving the final specific model(s), encompassing tests are conducted on the following three pairs of models: (Model-1 and Model-2), (Model-1 and L3) and (Model-2 and L3). The first encompassing test results show that Model-1 and Model-2 are mutually non-dominating (refer to Table 9.5). Meanwhile, the second and third encompassing test results show that Model-1 and Model-2 are more dominant than L3 (refer to Tables 9.6 and 9.7). Thus, Model-1 and Model-2 are used as the base models to derive the final specific model(s). Model-1 and Model-2 are re-parameterised as the parameter values of –mp and mp_1 are approximately of equal magnitude. The two variables are dropped and Dmp is introduced instead in order to capture the short-run dynamics of price change. The two re-parameterised models [i.e. Re-specified Model-1 (or R-M1 in short) and Re-specified Model-2 (or R-M2 in short)] are subject to an encompassing test. The test results show that the former is a non-dominating model (refer to Table 9.8) and it is regarded as the final specific model (i.e. FSM-III).

Lapse Model Using MFR3. The simplification of the 12 GUMs has derived six different congruent models. The summary results of the models are shown in Table 9.9. A total of 20 variables appear in the six models. The constant term, MSMR_1, MIA, MIA_1, mp and MCDR_1 have been retained consistently in all of the models. They are the same six variables that have been retained throughout all of the congruent models using MFR2 (refer to Table 9.4). Two union models are formulated with the 18 variables and one of the two income variables (i.e. either Dmgdp_1 or Dmipc_1) enters the models at a time to be subject to a further simplification. The simplified models are L5 and L6. However, Model-1 and Model-2 seem to be superior to L5 and L6 based on the adjusted-R^2 and σ values. In order to select a non-dominated model, an encompassing test is conducted on each pair of the models among L5, L6, Model-1 and Model-2. The encompassing test results reveal the following: L5 and L6 are mutually non-dominating (refer to Table 9.10) while Model-1 is a more dominant model than Model-2 (refer to Table 9.11) or L5 (refer to Table 9.12) or L6 (refer to Table 9.13).

Hence, Model-1 is used as the base model to derive the final specific model. Model-1 is re-parameterised so that the variable Dmp is introduced to replace mp and mp_1 in order to capture the short-run dynamics of price change because the parameter value of –mp is approximately equal to the value of mp_1 (as in the above discussion). The re-parameterised model is the final specific model (i.e. FSM-IV).

Lapse Model Using DMSR. For the lapse model that uses the surrender rate, each of the 12 GUMs is simplified into a congruent model by itself. Their summary results are displayed in Table 9.14. A total of 25 variables are retained in the 12 models. Only MIA_1 has been retained consistently in all of the models. Two union models are formulated with the 21 variables along with either set of the income variables defined by GDP (i.e. Dmgdp and Dmgdp_1) or income per capita (i.e. Dmipc and Dmipc_1) enters the models at a time to be subject to a further simplification. The simplified models are L7 and L8. As there are not enough observations to perform the heteroscedasticity test for L7 and L8, attention has focused on Model-1 and Model-2 (being the next superior models in terms of the adjusted-R^2 and σ values) to be the base models for deriving the final specific models. As Model-1 and Model-2 are mutually non-dominating (refer to Table 9.15), both of them are regarded as the final specific models (i.e. FSM-V and FSM-VI).

9.1.2 Simplification Results for SET-2

For SET-2, the stock and flow variables are deflated respectively by the end-of-year and average annual CPIs. The GUM formulated is as shown below (where "e" is the error term):

$$
\begin{aligned}
&\text{LAPSE}_t \\
&= C_0 + b_0\,(\text{LAPSE}_{t-1}) + b_1\,(\text{Dmgdp}_t \text{ or Dmipc}_t) + b_2\,(\text{Dmgdp}_{t-1} \text{ or Dmipc}_{t-1}) \\
&\quad + b_3\,(\text{MSMR}_t) + b_4\,(\text{MSMR}_{t-1}) + b_5\,(\text{MRUR}_t) + b_6\,(\text{MRUR}_{t-1}) + b_7\,(\text{DMSDR}_t \\
&\quad \text{or DMFDR}_t \text{ or DMTBR3M}_t) + b_8\,(\text{DMSDR}_{t-1} \text{ or DMFDR}_{t-1} \text{ or DMTBR3M}_{t-1}) \\
&\quad + b_9\,(\text{MIE}_t) + b_{10}\,(\text{MIE}_{t-1}) + b_{11}\,(\text{mpn}_t) + b_{12}\,(\text{mpn}_{t-1}) + b_{13}\,(\text{MCBR}_t) + b_{14}\,(\text{MCBR}_{t-1}) \\
&\quad + b_{15}\,(\text{MCDR}_t) + b_{16}\,(\text{MCDR}_{t-1}) + b_{17}\,(\text{DMTFR}_t) + b_{18}\,(\text{DMTFR}_{t-1}) + b_{19}\,(\text{DMLEm}_t \\
&\quad \text{or DMLEf}_t) + b_{20}\,(\text{DMLEm}_{t-1} \text{ or DMLEf}_{t-1}) + e_t
\end{aligned}
$$

The three forfeiture rates are unaffected by the introduction of the new deflator (i.e. the end-of-year CPIs) as the business forfeited and new business of life insurance are flow variables and have been deflated into constant dollar terms using the average annual CPIs. For identification purpose, an asterisk mark is added to their variable names in SET-2 in order to differentiate them from those in SET-1, i.e. MFR1*, MFR2* and MFR3* are used in SET-2. The inflation rate in SET-2 is the end-of-year inflation rate (MIE). Two variables are affected by the introduction of the new deflator: the surrender rate (denoted DMSRN) and price (denoted mpn) variables. The new variables have an "N" or "n" being added at the end of their original variable names.

Lapse Model Using MFR1*. Seven different congruent models are obtained as a result of the simplification. The summary results of the models are shown in Table 9.16. A total of 16 variables appear in the seven models. Only two variables, namely MSMR_1 and MCDR_1, have been retained consistently in all of the models. Two union models are formulated with the 14 variables and one of the two income variables (i.e. either Dmgdp or Dmipc) enters the models at a time to be subject to a further simplification because they are highly correlated (r=0.9995). Their simplified models, i.e. L9 and L10, are the same. It is the final specific model (i.e. FSM-VII).

Lapse Model Using MFR2*. For this lapse model, five different congruent models are obtained from the simplification as displayed in Table 9.17. A total of 14 variables are retained in the five models. Four of the variables have been retained consistently throughout the models: the constant term, MSMR_1, MIE_1 and MCDR_1. In order to perform a further simplification, a union model comprising all of the 14 variables that appear in the five models is formulated. The simplified model is L11 which is in fact Model-1. It is regarded as the final specific model (i.e. FSM-VIII).

Lapse Model Using MFR3*. The simplification process has resulted in six different congruent models. The summary results of the models are shown in Table 9.18. A total of 11 variables appear in the six models. The constant term, MIE_1 and MCDR_1 are the variables that have been retained consistently across all of the six models. For the purpose of performing a further simplification, a union model is formulated with the inclusion of all the 11 variables that appear in the six congruent models. The simplified model is L12 and it is the final specific model (i.e. FSM-IX).

Lapse Model Using DMSRN. When subject to simplification, each of the 12 GUMs has been simplified into a congruent model by itself as exhibited in Table 9.19. No variable has been retained consistently in all of the 12 models. For the purpose of a further simplification, two union models are formulated with the 19 variables, with either of the income variables defined by GDP (i.e. Dmgdp and Dmgdp_1) or income per capita (i.e. Dmipc and Dmipc_1) entering the models at a time. The simplified models are L13 and L14 which are Model-2 and Model-1 respectively. As the encompassing test is unable to determine which is a more dominant model between L13 and L14 (refer to Table 9.20), the two models are regarded as the final specific models (i.e. FSM-X and FSM-XI).

9.2 Presentation of Test Results of the Conservative Strategy

This section presents the test results of the conservative strategy.

9.2.1 Simplification Results for SET-1

For SET-1, the average annual CPIs only are used as deflators.

Lapse Model Using MFR1. When subject to a more stringent simplification, the GUMs converge into four different congruent models as shown in Table 9.21. Only MFR1_1 and MSMR_1 have been retained consistently in all of the four models. A union model that includes all of the eight retained variables is formulated for a further simplification. The simplified model is L15. It is equivalent to Model-1 and is the final specific model (i.e. FSM-XII).

Lapse Model Using MFR2. The simplification process has resulted in three different congruent models. Their summary results are displayed in Table 9.22. Four variables have been retained consistently in all of the models: the constant term, MIA, mp and MCDR_1. A union model that consists of all the eight retained variables is formulated to be subject to a further simplification. The simplified model is L16 which is the same as Model-1. It is the final specific model (i.e. FSM-XIII).

Lapse Model Using MFR3. The simplifications produce four different congruent models. Their summary results are shown in Table 9.23. A total of nine variables appear in the four models. The same four variables (i.e. the constant term, MIA, mp and MCDR_1) retained across all of the congruent models in the lapse model using MFR2 also have been retained consistently throughout all of the congruent models in this lapse model. For the purpose of a further simplification, a union model is formulated with the inclusion of all the retained variables. The simplified model (i.e. L17) is the final specific model (i.e. FSM-XIV).

Lapse Model Using DMSR. For this lapse model, eight different congruent models are obtained from the simplification as exhibited in Table 9.24. A total of 14 variables are retained in the eight models. No variable has been retained consistently throughout the eight models. In order to perform a further simplification, two union models are formulated with the 10 variables, with either of the income variables defined by GDP (i.e. Dmgdp and Dmgdp_1) or income per capita (i.e. Dmipc and Dmipc_1) entering the models at a time. The simplified models are L18 and L19. However, a careful inspection of Table 9.24 shows Model-1 is more dominant than L19 and Model-2 is more dominant than L18 because L19 and L18 are subsets of Model-1 and Model-2 respectively. Therefore, consideration is given to Model-1 and Model-2 to be used as the base model(s) in order to derive the final specific model(s). An encompassing test performed to select a non-dominated model between Model-1 and Model-2 indicates that they are mutually non-dominating (refer to Table 9.25). Therefore, Model-1 and Model-2 are regarded as the final specific models (i.e. FSM-XV and FSM-XVI respectively).

9.2.2 Simplification Results for SET-2

For SET-2, the end-of-year and average annual CPIs are used as deflators.

Lapse Model Using MFR1*. The GUMs converge into four different congruent models as a result of the simplification. The summary results are shown in Table 9.26. A union model with the inclusion of all the variables that have been retained in the four models is subject to a further simplification. The union model converges into Model-1 (or L20) and it is the final specific model (i.e. FSM-XVII).

Lapse Model Using MFR2*. Seven different congruent models are obtained from the simplification. The summary results of the models are displayed in Table 9.27. A total of 13 variables are retained in the seven models. Two union models are formulated with the 11 variables, with one of the two income variables (i.e. either Dmgdp or Dmipc) entering the models at a time for the purpose of a further simplification. The simplified models are L21 and L22 and they are in fact the same model. Therefore, it is regarded as the final specific model (i.e. FSM-XVIII).

Lapse Model Using MFR3*. The simplification process has resulted in seven different congruent models as shown in Table 9.28. A union model comprising all of the 11 retained variables is formulated for a further simplification. The simplified model is L23 and it is also the final specific model (i.e. FSM-XIX).

Lapse Model Using DMSRN. As a result of the simplification, five different congruent models are obtained from the simplification as displayed in Table 9.29. A total of nine variables are retained in the five models. In order to perform a further simplification, two union models are formulated with the seven variables, and one of the two income variables (i.e. either Dmgdp or Dmipc) entering the models at a time. The two simplified models are L24 and L25. The encompassing test results show that L25 is more dominant than L24 (refer to Table 9.30). However, by crude observation at the adjusted-R^2 and σ values, Model-1 appears to be superior to L25 and the encompassing test results confirm that Model-1 is more dominant than L25 (refer to Table 9.31). Therefore, Model-1 is regarded as the final specific model (i.e. FSM-XIX).

9.3 Presentation of Test Results for Cointegration and Error Correction Model (ECM)

The cointegration test is performed on the lapse models using the surrender rate. The dependent variable (i.e. the surrender rate) is non-stationary and has a unit root so that we can examine whether it is integrated with the explanatory variables that also have a unit root such as the GDP, income per capita, fixed deposit rate, total fertility rate and life expectancy at birth for females which are retained in the final specific models of FSM-X, FSM-XI and FSM-XX. The cointegration test is performed only for the regression models SET-2 because the stock and flow variables have been deflated appropriately.

Lapse Model Using Surrender Rate with GDP as Income Variable. At the initial stage, the preliminary ordinary least squares (OLS) regression model is estimated as such:

$$MSRN_t = \alpha_0 + \alpha_1(mgdp_t) + \alpha_2(MFDR_t) + \alpha_3(MTFR_t) + \alpha_4(MLEf_t) + Resid1_t$$

where Resid1 is the error term. The results of the preliminary regression model reveal that the estimated parameters of the constant term and the interest rate variable are statistically not different from zero (i.e. $\alpha_0=\alpha_2=0$) (refer to Table 9.32). Thus, the regression model is re-estimated by removing the two insignificant variables:

$$MSRN_t = \alpha_5(mgdp_t) + \alpha_6(MTFR_t) + \alpha_7(MLEf_t) + Resid2_t$$

where Resid2 is the error term. In the re-estimated regression model, the income, total fertility rate and life expectancy variables are now significant but the regression model has the problem of residual autocorrelation (i.e. p=0.0004) (refer to Table 9.33). Hence, the cointegration test and ECM are not conducted.

Lapse Model Using Surrender Rate with Income per Capita as Income Variable. The estimation of the long-run regression model for this lapse model also faces the similar problems experienced by the corresponding lapse model with GDP as the income variable. The preliminary regression model is as below:

$$MSRN_t = \alpha_8 + \alpha_9(mipc_t) + \alpha_{10}(MFDR_t) + \alpha_{11}(MTFR_t) + \alpha_{12}(MLEf_t) + Resid3_t$$

where Resid3 is the error term. The results show that the estimated parameters of the constant term and the interest rate variable are not significant (refer to Table 9.34). However, when the model is re-estimated by dropping the insignificant variables:

$$MSRN_t = \alpha_{13}(mipc_t) + \alpha_{14}(MTFR_t) + \alpha_{15}(MLEf_t) + Resid4_t$$

where Resid4 is the error term, it has the mis-specification of residual autocorrelation (i.e. p=0.0008) (refer to Table 9.35). Therefore, further efforts are not pursued to perform the cointegration test and ECM.

9.4 Discussion of Results

9.4.1 Comparing the Results between SET-1 and SET-2 for Different Modelling Strategies

Tables 9.36 and 9.37 re-compile the final specific models of different deflation approaches for the liberal and conservative modelling strategies respectively. The results from the two tables show that if the stock and flow variables are not deflated appropriately, the findings are affected as the final specific models obtained are different under SET-1 and SET-2.

Table 9.36 reveals that the retained variables in the lapse models using different forfeiture rates (i.e. MFR1, MFR2 and MFR3) differ between SET-1 and SET-2. SET-1 tends to have more retained variables than SET-2. For SET-1, the lapse models using MFR1 (i.e. FSM-I and FSM-II), MFR2 (i.e. FSM-III) and MFR3 (i.e. FSM-IV) have 14 variables retained in each of their models. For SET-2, the lapse model using MFR1* (i.e. FSM-VII) only has seven variables retained in its model. Meanwhile, only 10 variables are retained in each of the lapse models using MFR2* (i.e. FSM-VIII) and MFR3* (i.e. FSM-IX).

The lapse models using MFR1 differ slightly between SET-1 (i.e. FSM-I and FSM-II) and SET-2 (i.e. FSM-VII). Of the seven variables retained in FSM-VII (of SET-2), six of them are among those of the 14 variables retained in FSM-I and FSM-II (of SET-1). No interest rate variables have been retained in SET-1 but the average discount rate on three-month treasury bills has been retained in SET-2. For the lapse models using MFR2 and MFR3, their final specific models differ more widely between SET-1 and SET-2. There are only five common variables in both SET-1 and SET-2 for each of the lapse models. Even though the variables such as the average discount rate on three-month treasury bills, crude live-birth rate and life expectancy at birth are retained in the final specific models of SET-1 (i.e. FSM-III and FSM-IV) and SET-2 (i.e. FSM-VIII and FSM-IX), there are differences in terms of either the original or lagged variable that is retained for the first two variables and in terms of whether the male or female life expectancy variable that is retained for the last variable. The anticipated change in the average discount rate on three-month treasury bills, the crude live-birth rate in the previous period and the life expectancy at birth for males variables are retained in the final specific models of SET-2 (i.e. FSM-VIII and FSM-IX) but the change in the average discount rate on three-month treasury bills in the previous period, the anticipated crude live-birth rate and the life expectancy at birth for females variables are retained in the final specific models of SET-1 (i.e. FSM-III and FSM-IV).

Comparing the three lapse models using the forfeiture rate, the variables retained in the lapse models using MFR2 and MFR3 are almost identical. For SET-1, exactly the same set of the 14 variables is retained in FSM-III and FSM-IV for the lapse models using MFR2 and MFR3 respectively. For SET-2, nearly the similar set of variables (i.e. nine common variables out of the 10 retained variables) is retained in FSM-VIII and FSM-IX with respect to the lapse models using MFR2 and MFR3. However, the variables retained in the lapse models using MFR2 and MFR3 are quite different from those retained in the lapse models using MFR1. This is not surprising because both MFR2 and MFR3 are computed using the revised formulae that have been refined so that the denominator takes into account three years of new life insurance business as the life policies that exposed to the risk of forfeiture that is in line with the definition stated in Section 156 of the Insurance Act 1996 of Malaysia. In contrast, the formula adopted by the central bank of Malaysia for reporting the forfeiture rates (i.e. MFR1) fails to reflect this feature as noted in section 4.2.

On the other hand, for the lapse models using the surrender rate, the retained variables in SET-1 and SET-2 differ considerably. SET-2 (i.e. 13 variables each in FSM-X and FSM-XI) tends to have more retained variables than SET-1 (i.e. 10 variables each in FSM-V and FSM-VI). However, FSM-V (of SET-1) and FSM-XI (of SET-2) have only a slight different between them as they have nine common variables. The inflation rate in the previous period retained in FSM-V is not retained in FSM-XI.

For Table 9.37, when the conservative strategy is used for simplification, obviously a much smaller number of variables is retained in the final specific models in both SET-1 and SET-2 as compared with those when the liberal strategy is adopted for simplification. It is also observed that (as before) the lapse models using MFR2 resemble closely the lapse models using MFR3 for SET-1 (i.e. FSM-XIII and FSM-XIV) and SET-2 (i.e. FSM-XVIII and FSM-XIX) due to the similarity in the formulae used to compute the forfeiture rates. On the other hand, for the lapse models using the surrender rate, SET-2 (i.e. FSM-XX) has far fewer retained variables than SET-1 (i.e. FSM-XV and FSM-XVI). In FSM-XX (of SET-2), only four variables are retained (being half the number of the variables retained in SET-1) and this model is a subset of FSM-XVI (of SET-1), i.e. FSM-XX$\subset$FSM-XVI.

Among the retained variables in the final specific models, for the lapse models using the forfeiture rate, the constant term, the stock market return in the previous period, the crude death rate in the previous period and the inflation rate in the previous period are the four variables that have been retained consistently in all of the models under the liberal strategy (refer to Table 9.36). However, only the first three variables have been retained consistently in all of the models under the conservative strategy (refer to Table 9.37) indicating that these three variables are of paramount importance in their relationship with the forfeiture rate of life insurance. Meanwhile, for the lapse models using the surrender rate, the surrender rate in the previous period, both the anticipated and past stock market returns, the anticipated inflation rate and both the anticipated and past changes in the life expectancy at birth for females are the six variables that have been retained consistently in all of the models under the liberal strategy (refer to Table 9.36). However, only three of them, namely the surrender rate in the previous period, the stock market return in the previous period and the anticipated change in the life expectancy at birth for females have been retained consistently in all of the models under the conservative strategy (refer to Table 9.37). This implies that these three variables have an important relationship with the surrender rate of life insurance. Given the above, if we do not differentiate the lapse rate between the forfeiture rate and the surrender rate, the stock market return in the previous period appears to be the only variable that has been retained throughout all of the lapse models (in SET-1 and SET2 under both the liberal and conservative strategies) (refer to Tables 9.36 and 9.37). This suggests that the stock market return in the previous period has a crucial relationship with the propensity to lapse a life policy.

9.4.2 Comparing the Results between the Liberal Strategy and Conservative Strategy of SET-1

Table 9.38 exhibits the results of SET-1 that uses the average annual CPIs as deflators for the two modelling strategies. For the lapse models using MFR1, a substantially fewer number of variables is retained in the final specific model under the conservative strategy (i.e. five variables in FSM-XII) than in the final specific models under the liberal strategy (i.e. 14 variables each in FSM-I and FSM-II) so that FSM-XII is a subset of FSM-I and FSM-II. For the lapse models using MFR2 and MFR3, even though the final specific models of the liberal strategy (i.e. FSM-III and FSM-IV) retain the same set of the 14 variables, the respective final specific models under the conservative strategy differ slightly with seven and six variables being retained in their models. On the other hand, for the lapse models using the surrender rate, the difference in the number of variables retained in the final specific models under the conservative and liberal modelling strategies is small, (i.e. eight and 10 variables respectively) in which it is noted that FSM-XV (of the conservative strategy) is a subset of FSM-VI (of the liberal strategy). Among the retained variables, the stock market return in the previous period is the only variable that has been retained consistently in all of the lapse models (using the forfeiture and surrender rates).

9.4.3 Comparing the Results between the Liberal Strategy and Conservative Strategy of SET-2

Table 9.39 displays the results of SET-2 that uses both the end-of-year and average annual CPIs as deflators for the liberal and conservative modelling strategies. We provide a comprehensive discussion on this table because it reports the results of the analysis in which the stock and flow variables are deflated appropriately into constant dollar terms.

The discussion in this sub-section is divided into three parts: (a) the lapse models using the forfeiture and surrender rates, (b) the various factors that affect the propensity to lapse a life policy and (c) cointegration and error correction model (ECM).

9.4.3.1 Lapse Models Using the Forfeiture and Surrender Rates

Lapse Models Using MFR1. The first lapse models use the formula (i.e. MFR1) (refer to Eq4.1) adopted by the central bank of Malaysia to calculate the forfeiture rate. The final specific model under the conservative strategy (i.e. five variables in FSM-XVII) has a slightly lesser number of variables as compared with the final specific model under the liberal strategy (i.e. seven variables in FSM-VII). When the conservative strategy is applied for simplification, the interest rate and inflation variables are forced out of the model, while for the price variable, its lagged variable is retained instead of its original variable.

As MFR1 does not fully reflect the lapse experience of Malaysia because the exposed to risk only captures one year of new life insurance business as the life policies that exposed to the risk of forfeiture whereas according to Section 156 of the Insurance Act 1996 of Malaysia, a policy is considered forfeited when it is lapsed within the first three years of its inception. Therefore, two improved formulae in which the exposed to risk captures three years of new life insurance business as the life policies that exposed to the risk of forfeiture are developed to overcome the shortcomings of MFR1: MFR2 and MFR3 of which the former is more straightforward to implement.

Lapse Models Using MFR2. In the second lapse models, the improved but simple formula (i.e. MFR2) (refer to Eq4.3) is utilised for analysis. A total of 10 variables are retained in the final specific model under the liberal strategy (i.e. FSM-VIII) but only seven variables are retained in the final specific model under the conservative strategy (i.e. FSM-XVIII). When subject to a more stringent simplification, the anticipated inflation rate and both the anticipated and past changes in the life expectancy at birth for males are dropped from the model, while for the price variable, the anticipated price is retained instead of the price in the previous period.

Lapse Models Using MFR3. In the third lapse models, the more complicated formula (i.e. MFR3) (refer to Section 4.2.3) is adopted for analysis. The final specific models of the liberal and conservative strategies of these lapse models are very similar to those of the lapse models using MFR2. A total of 10 variables are retained in the final specific model of the liberal strategy (i.e. FSM-IX) but only eight variables are retained in the final specific model of the conservative strategy (i.e. FSM-XIX).

Comparing the Lapse Models Using MFR1, MFR2 and MFR3. Comparing the lapse models using the three different computations of forfeiture rate, we note that the final specific models of the lapse models using MFR1 have smaller values of adjusted-R^2 and bigger values of σ than the lapse models using MFR2 and MFR3. This implies that the lapse models using MFR2 and MFR3 have a better fit than the lapse models using MFR1. The lapse models using MFR2 and MFR3 are able to explain a bigger proportion of the variance in forfeiture rate with a lower regression standard error than the lapse models using MFR1. Under the liberal strategy, FSM-VIII and FSM-IX of the lapse models using MFR2 and MFR3 respectively have slightly higher adjusted-R^2 values (i.e. about 90% each) and much lower σ values (i.e. 0.95 and 1.07 respectively) than FSM-VII of the lapse model using MFR1 (i.e. adjusted-R^2=89%; σ=2.82). Likewise, under the conservative strategy, FSM-XVIII and FSM-XIX of the lapse models using MFR2 and MFR3 respectively have considerably higher adjusted-R^2 values (i.e. 86.8% and 89.4% respectively) and much lower σ values (i.e. 1.09 and 1.11 respectively) than FSM-XVII of the lapse model using MFR1 (i.e. adjusted-R^2=85.8%; σ=3.20).

Comparing the Lapse Models Using MFR2 and MFR3. A comparison between the lapse models using MFR2 and MFR3 under the liberal strategy reveals that FSM-VIII and FSM-IX retain almost the same group of variables. Each of the models retains 10 variables in which nine of them are common to both models. The difference is that the model using MFR2 retains the anticipated change in the life expectancy at birth for males whereas the model using MFR3 retains the forfeiture rate in the previous period. Likewise, the lapse models using MFR2 and MFR3 under the conservative strategy show that FSM-XVIII and FSM-XIX retain almost an identical set of variables. The former retains seven variables. The latter retains the same seven variables retained in FSM-XVIII and one more variable in addition (that is the forfeiture rate in the previous period). When subject to a more stringent simplification, the stock market return in the previous period, the anticipated change in the average discount rate on three-month treasury bills, the inflation rate in the previous period, the crude live-birth rate in the previous period and the crude death rate in the previous period seem to have an important relationship with the life insurance forfeiture rate.

Further, when examining the goodness of fit between the lapse models using MFR2 and MFR3, the lapse models using MFR3 appear to have higher adjusted-R^2 but also higher σ values than the lapse models using MFR2. Although FSM-VIII and FSM-IX (being the lapse models using MFR2 and MFR3 respectively of the liberal strategy) have roughly the same values of the adjusted-R^2 (i.e. about 90% each) but the former model is more efficiently estimated because FSM-VIII (i.e. 0.95) has a lower σ value (being the regression standard error) than FSM-IX (i.e.1.07). Meanwhile, for FSM-XVIII and FSM-XIX (being the lapse models using MFR2 and MFR3 respectively under the conservative strategy), even though the latter (i.e. 89.4%) has a higher adjusted-R^2 value than the former (i.e. 86.8%) but it (i.e. 1.11) also has a higher σ value than the latter (i.e. 1.09). In light of the above trade off between the adjusted-R^2 and σ values for the lapse models using MFR2 and MFR3, the lapse models using MFR2 appear to be superior to the lapse models using MFR3 taking into account the fact that MFR2 is based on a much simpler computation method for estimating the forfeiture rate than MFR3.

Lapse Models Using Surrender Rate. In these lapse models, the surrender rate (i.e. MSRN) (refer to Eq4.2) is used for analysis. The final specific model under the conservative strategy (i.e. FSM-XX) retains a substantially smaller number of variables than the final specific model under the liberal strategy (i.e. FSM-X and FSM-XI) – i.e. four versus 13 variables. This suggests that only a few variables strictly have a vital relationship with the surrender rate of life insurance, namely the surrender rate in the previous period, the anticipated change in GDP, the stock market return in the previous period and the anticipated change in the life expectancy at birth for females.

Comparing the two final specific models under the liberal strategy, FSM-XI with income per capita as the income variable is more efficiently estimated than FSM-X with GDP as the income variable. FSM-XI (i.e. adjusted-R^2=81.9%; σ=0.131) explains a slightly greater proportion of the variance in surrender rate with a slightly greater accuracy than FSM-X (i.e. adjusted-R^2=81.4%; σ=0.133).

9.4.3.2 Various Factors Affecting the Propensity to Lapse a Life Policy

The discussion in this sub-section focuses mainly on the lapse models using MFR2, MFR3 and MSRN. An examination across the various lapse models in Table 9.39 shows that the group of variables that relates significantly to the forfeiture and surrender rates of life insurance is not the same. Strictly speaking, the stock market return in the previous period, the anticipated change in the average discount rate on three-month treasury bills, the inflation rate in the previous period, the crude live-birth rate in the previous period and the crude death rate in the previous period are found to have an important relationship with the forfeiture rate of life insurance. On the other hand, the surrender rate in the previous period, the anticipated change in GDP, the stock market return in the previous period and the anticipated change in the life expectancy at birth for females appear to have an important association with the surrender rate of life insurance. Given the above, the stock market return in the previous period has emerged to be the only variable that has a paramount importance in its relationship with the propensity to lapse a life policy in Malaysia.

Emergency Fund Hypothesis (EFH). Income levels do not appear to have a strong and important relationship with the forfeiture rate of life insurance. Even though the income variables have been retained in the lapse models using MFR2 under the conservative strategy in Model-4 (i.e. Dmipc – negative and significant) and Model-5 (i.e. Dmgdp – negative but insignificant), none is retained in the final specific model when subject to a further simplification (refer to Table 9.27). In contrast, income levels are found to relate significantly to the surrender rate of life insurance when the liberal strategy is used for modelling but the income variables are forced out of the model when the conservative strategy is used for modelling. The signs of the estimated parameters for the income variables are inconsistent. The anticipated change in GDP or income per capita has a negative sign whereas the change in GDP or income per capita in the previous period has a positive sign. The findings of this study are not in total agreement with the findings of Outreville (1990) and Russell (1997). The findings of Outreville (1990) are in support of EFH, i.e. income levels tend to affect inversely early lapssation but the findings of Russell (1997) reveal that the surrender activity (unexpectedly) is related directly to real income per capita.

The stock market return in the previous period is found to have a significant negative relationship with both the forfeiture and surrender rates of life insurance. (Further, the anticipated stock market return also is found to have a significant negative relationship with the surrender rate of life insurance when the liberal strategy is used for modelling.) The findings confirm the concept of dependent lapsing proposed by Katrakis (2000) that the lapse rates would surge when the stock market is experiencing unfavourable conditions. In the current study, the findings indicate that the performance of the stock market has a lagged influence on the propensity to lapse a life policy. When the performance of the stock market in the previous period has not been encouraging, the policyholders probably suffer a loss from their stock market investments that has resulted in their decision to lapse their life policies due to financial distress. The findings on stock market return provide strong evidence in favour of the EFH.

Unemployment does not have an important relationship with the forfeiture rate of life insurance. Although the unemployment variables have been retained in the lapse models using MFR2 under the conservative strategy in Model-4 (i.e. MRUR_1) and Model-5 (i.e. MRUR) and unexpectedly are found to relate negatively and significantly to the forfeiture rate of life insurance, they are not retained in the final specific model when subject to a further simplification (refer to Table 9.27). On the other hand, unemployment is found to have a significant relationship with the surrender rate of life insurance under the liberal strategy but the unemployment variables are dropped from the model under the conservative strategy. The estimated coefficients of the unemployment variables do not have a consistent sign. The anticipated registered unemployment rate is related negatively while the rate in the previous period is related positively to the surrender rate of life insurance. The findings of this study are not fully in line with the findings of Dar and Dodds (1989) and Outreville (1990) that unemployment positively affects surrender activity and early lapsation, and which provide strong support for the EFH. The inconsistent findings might be due to the use of an unsuitable proxy in which the registered unemployment rate has been used in place of the more commonly defined unemployment rate in this study.

Based on the above findings, the propensity to forfeit or surrender a life policy appears to be affected by the emergency fund effect with respect to the performance of the stock market in the previous period. Factors such as income levels and unemployment appear not to have an important relationship with the forfeiture rate of life insurance. However, whilst both the income levels and unemployment are found to have a significant relationship with the surrender rate of life insurance, no conclusion can be drawn in connection with their effects on the EFH.

Interest Rate Hypothesis (IRH). Three types of interest rate, namely the savings deposit rate, the 12-month fixed deposit rate and the average discount rate on three-month treasury bills, are subject to test for their interest rate effects on the forfeiture and surrender rates of life insurance.

Only the average discount rate on three-month treasury bills emerges to have a significant relationship with the forfeiture rate of life insurance. The other interest rate variables, such as the savings and fixed deposits rates, have not been retained in any of the congruent models in the lapse models using MFR2 and MFR3. However, the estimated parameters of the anticipated change in the average discount rate on three-month treasury bills unexpectedly have a negative sign. The findings of this study contradict those of Outreville (1990) that do not discover a significant relationship between the short-term interest rate on three-month treasury bills and early lapsation.

For the lapse models using the surrender rate, the fixed deposit rate is the sole interest rate variable that is retained in the final specific models under the liberal strategy (but not under the conservative strategy). Although the savings deposit rate has been retained in two of the congruent models (i.e. Model-3 and Model-4) in the lapse models under the liberal strategy, when the union models (that include the savings and fixed deposits rates alongside other variables that have been retained in the 12 congruent models) are formulated to be subject to a further simplification, only the fixed deposit rate is retained in the simplified models (i.e. L13 and L14) (refer to Table 9.19). The savings deposit rate is not retained indicating that the fixed deposit rate has a more dominant interest rate effect than the savings deposit rate. Thus, the fixed deposit rate is found to have a significant positive relationship with the surrender rate of life insurance. The findings provide support for the IRH. However, the findings on the fixed deposit rate are new as researchers in the past have not used the fixed deposit rate as the proxy for the interest rate variable. Meanwhile, the average discount rate on three-month treasury bills is not retained in any of the congruent models in the lapse models using the surrender rate. This suggests that the average discount rate on three-month treasury bills does not have an important relationship with the surrender rate of life insurance. This is in line with the findings of Outreville (1990).

Based on the above findings, the average discount rate on three-month treasury bills and the fixed deposits rate are identified to be important interest rates that are related significantly to the forfeiture and surrender rates of life insurance respectively. However, only the latter has the expected positive interest rate effect on life insurance surrender rate.

Preservation of Purchasing Power. In this study, the inflation rate is found to have an important relationship with the propensity to forfeit or surrender a life policy. These findings do not confirm the findings of Dar and Dodds (1989), Outreville (1990) and Russell (1997) (for a company-specific data set) that discover no significant relationship between the lapsation of life insurance and inflation.

For the forfeiture rate of life insurance, both the anticipated and past inflation rates are retained in the final specific models under the liberal strategy (i.e. FSM-VIII and FSM-IX) but only the inflation rate in the previous period is retained in the final specific models under the conservative strategy (i.e. FSM-XVIII and FSM-XIX). The signs of the estimated parameters are inconsistent for the anticipated and past inflation rates. The anticipated inflation rate (as hypothesised) is related positively but the inflation rate in the previous period (unexpectedly) is related negatively to the forfeiture rate. Therefore, a conclusive remark cannot be drawn on the relationship between the forfeiture rate of life insurance and inflation. On the other hand, for the surrender rate, only the anticipated inflation rate is retained in the final specific models under the liberal strategy (i.e. FSM-X and FSM-XI) but the inflation variable is forced out of the model when subject to the conservative strategy for simplification. However, the anticipated inflation rate is found to have an unexpected significant negative relationship with the surrender rate. The findings suggest that an inflationary environment does not seem to have a dampening effect (i.e. high inflation rate causes the cash values accumulated under the policies to deteriorate in value) on the propensity to surrender a life policy. This may possibly be due to the fact that the main purpose of the policyholders in purchasing life insurance is for protection but not for investment so that when the inflation rate is rising they continue to hold on and do not tend to lapse their life policies as the cost of subsequent replacement with a new policy would be expected to be higher.

The price of life insurance is related negatively and significantly to the forfeiture rate. The anticipated price of insurance is retained under the conservative strategy but the price of insurance in the previous period is retained under the liberal strategy. When it is more costly to obtain insurance protection, the propensity of the early cancellation of life policies would tend to be lower. On the other hand, for the surrender rate of life insurance, only the anticipated price of insurance is retained under the liberal strategy but no price variable is retained under the conservative strategy. However, the anticipated price of insurance unexpectedly has a positive sign indicating the contrary to the proposition that the surrender rate would tend to be lower when insurance protection become more costly. The findings on the price variable in relation to the forfeiture rate are in line with the findings of Outreville (1990) but not those in relation to the surrender rate.

Based on the above findings, although the inflation rate has a significant relationship with the propensity to forfeit or surrender a life policy, the inflation rate tends to be related negatively to the forfeiture and surrender rates of life insurance in Malaysia. Meanwhile, the price of insurance also is found to be associated significantly with life insurance forfeiture and surrender rates. When the costs of obtaining insurance protection become more expensive, the forfeiture rate tends to be lower. However, it is an unexpected finding that when the cost of insurance is rising, the surrender rate tends to be higher.

Demographic Characteristics of the Population. For the demographic variables, the crude live-birth rate is found to have a significant positive (lagged) relationship with the forfeiture rate of life insurance. This finding suggests that the high birth rate might be due to unanticipated births that have caused the policyholders being caught in a position where they need money urgently and therefore decide not to pay the premiums of their newly effected policies. On the other hand, the crude live-birth rate appears not to be an important factor affecting the surrender rate of life insurance.

The crude death rate is also found to have a significant positive (lagged) relationship with the life insurance forfeiture rate. This unexpected finding suggests that the forfeiture rate tends to be high when the probability of death is high. There is a possibility that the crude death rate does not serve as a good proxy for the probability of death as it is strongly affected by the proportion of the population at older ages in a country. It is recognised that the age-adjusted death rate would be a better proxy as it adjusts for the changing proportion of people at each age in the population but these data are not available in the published reports of Malaysia such as the Demographic Yearbook, the Vital Statistics and the Yearbook of Statistics. On the other hand, the crude death rate is not an important factor affecting the life insurance surrender rate.

The total fertility rate does not have a significant relationship with the forfeiture rate. However, it is related positively and significantly to the surrender rate. The findings could possibly be explained because life policies may be surrendered for their cash values in order to serve a specific purpose that arises when the family size grows larger. If this is true, this will provide further evidence to support the EFH.

Life expectancy at birth is found to have an important relationship with the forfeiture (when the liberal strategy is used for modelling) and surrender rates of life insurance. Life expectancy at birth is found to have a positive relationship with life insurance forfeiture rate. The finding could be explained by the fact that, if people generally are living longer, it may be natural for them to delay their decision on the ownership of life insurance into a later stage in order to take advantage of other investment opportunities. Furthermore, when the life expectancy is longer, the insurance premium charged at each age category tends to be revised downwards to reflect the lower risk level assumed by the life insurers. The relationship of the surrender rate with life expectancy at birth is inconsistent as the signs switch between positive and negative, and therefore a convincing conclusion cannot be made in this respect. Further, it is interesting to note that life expectancy at birth for males is related significantly to the forfeiture rate, while life expectancy at birth for females to the surrender rate. As this stage, we are not sure what has caused the difference in the association between life expectancy at birth for the different genders and the different types of lapse rate (i.e. forfeiture rate and surrender rate). Further research is required to investigate this phenomenon in order to identify the cause.

Based on the above findings, the crude live-birth rate and crude death rate have a significant positive (lagged) relationship with the forfeiture rate of life insurance, the total fertility rate has a significant positive (lagged) relationship with the surrender rate of life insurance, whilst the life expectancy at birth has an important relationship with both the forfeiture and surrender rates of life insurance. Given the above, the findings on the demographic variables are new (and potentially important) because these variables have not been investigated in past studies. Further examination of these variables is needed in order to seek evidence to confirm their relationship with the propensity to lapse a life policy.

9.4.3.3 Cointegration and ECM

As mis-specifications are detected in the long-run regression model of the lapse models using the surrender rate, no further efforts have been undertaken to perform the cointegration test and ECM.

9.5 Concluding Comments

In summary, the major findings of the lapse study of Malaysia are as follows:

(a) The use of different deflation approaches affects the final specific models obtained under SET-1 and SET-2.

(b) The findings from the lapse models using the improved formulae (i.e. MFR2 and MFR3) are almost similar but they are quite different from the lapse models using the formula adopted by the central bank of Malaysia (i.e. MFR1) in reporting the forfeiture rates in the insurance annual reports. The former two categories of lapse model are superior to the latter category in terms of both the computation method of the forfeiture rate and the goodness of fit of the estimated model. However, the lapse models using MFR2 is superior to the lapse models using MFR3 because MFR2 is a much simpler computation method than MFR3 in calculating the forfeiture rate and the models estimated using MFR2 have a smaller σ value than the models estimated using MFR3.

(c) The propensity to forfeit or surrender a life policy is affected by the emergency fund effect with respect to the performance of the stock market in the previous period. The stock market return in the previous period is found to have an important relationship with both the forfeiture and surrender rates.

(d) The discount rate on treasury bills and the fixed deposit rate have an interest rate effect on life insurance forfeiture and surrender rates respectively. The latter has the expected positive effect on the surrender rate but the former does not generate the intended effect on the forfeiture rate.

(e) The inflation rate has a significant relationship with the forfeiture and surrender rates of life insurance. It is related negatively to the propensity to surrender a life policy but its relationship with the propensity to forfeit a life policy cannot be confirmed because of inconsistent findings.

(f) The price of insurance is found to be associated significantly with the forfeiture and surrender rates of life insurance. It is found to have a negative relationship with the forfeiture rate but unexpectedly it has a positive relationship with the surrender rate.

(g) For the demographic factors, both the crude live-birth rate and crude death rate in the previous period are found to be related positively and significantly to the forfeiture rate. On the other hand, the total fertility rate in the previous period is found to be associated positively and significantly with the surrender rate. However, the findings on the relationship between life expectancy at birth and the forfeiture and surrender rates are mixed and inconclusive.

APPENDIX CHAPTER 9

Table 9.1
Detailed Simplification Results of a GUM for the Lapse Model Using MFR1 Using PcGets (Liberal Strategy)

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(1) Testing the General Model (GUM) for Mis-specifications (or for Congruence)

The GUM is formulated as an ADL(1,1) model. The GUM is then subject to the mis-specification tests in order to check its main attributes of congruence. The results show that the GUM passes the initial mis-specification tests for Chow test, normality test and residual serial correlation test at the pre-specified significance level of 0.01. As there are not enough observations to perform the heteroscedasticity test, the test is not performed for the GUM. However, the heteroscedasticity test is applied to the specific model in order to examine whether the OLS estimators in the specific model have minimum variance. Based on the initial mis-specification test results for the GUM, the significance levels for the mis-specification tests are established for subsequent tests in the simplification process.

Modelling MFR1 by GETS, 1971 - 2000

	Coeff	StdError	t-value	t-prob
Constant	-50.12928	34.28551	-1.462	0.1819
MFR1_1	0.54151	0.28022	1.932	0.0894
Dmipc	-3.90243	8.40341	-0.464	0.6547
Dmipc_1	-7.00490	11.80698	-0.593	0.5694
MSMR	-0.02096	0.03869	-0.542	0.6027
MSMR_1	-0.08918	0.05071	-1.759	0.1167
MRUR	-19.91626	17.80890	-1.118	0.2959
MRUR_1	15.93313	16.28516	0.978	0.3565
DMSDR	0.22865	0.97748	0.234	0.8209
DMSDR_1	-0.00075	0.69938	-0.001	0.9992
MIA	-0.88741	1.14671	-0.774	0.4613
MIA_1	-1.01108	1.13096	-0.894	0.3974
mp	-39.80083	42.60723	-0.934	0.3776
mp_1	29.76573	41.72421	0.713	0.4959
MCBR	0.34442	1.19895	0.287	0.7812
MCBR_1	-0.20785	0.95864	-0.217	0.8338
MCDR	3.31673	10.46678	0.317	0.7594
MCDR_1	15.45865	10.20061	1.515	0.1681
DMTFR	14.75981	14.07802	1.048	0.3251
DMTFR_1	17.59055	17.22227	1.021	0.3370
DMLEf	2.90691	4.30572	0.675	0.5186
DMLEf_1	0.93919	3.15897	0.297	0.7738

RSS	112.46239	sigma	3.74937	R^2	0.94615	Radj^2	0.80478
LogLik	-19.82132	AIC	2.78809	HQ	3.11681	SC	3.81563
T	30	p	22	FpNull	0.00000	FpConst	0.00472

	value	prob	alpha
Chow(1998:1)	1.6160	0.2745	0.0100
normality test	0.8928	0.6399	0.0100
AR 1-4 test	0.1264	0.9651	0.0100

Significance levels (alpha) set for subsequent tests.

(2) Removal of Completely Irrelevant Variables Subject to Retaining Congruence – Pre-search / Pre-selection Simplifications

Once the congruence of the GUM is established, the GUM is subject to three stages of cumulative simplification, namely the lag-order pre-selection, top-down and bottom-up simplifications, in order to eliminate the highly irrelevant variables, either individually or in block.

(a) Lag-order Pre-selection Simplification

For time-series data, the first stage of simplification is the block test of lag length. PcGets conducts an F-test to check the significance of all the variables at lag one to examine whether a block of them can be removed from the GUM at the significance level of 0.9. The test result shows that all of the variables at lag one cannot be removed in a block.

```
Stage-0 (Step 1): F presearch testing (lag-order preselection)
  Check lag  1 : F-prob =0.0418, Tests failed =  1;  Invalid reduction.
```

(b) First Round of Top-down Simplification

At the second stage of simplification, groups of variables are tested in the order of their t^2-statistics, starting from the smallest upwards and a cumulative F-test checks the increasing block sizes until the null hypothesis is rejected (when no further deletion is possible). There are two rounds of top-down simplification. For the first round of simplification, the significance level is 0.9. The test results show that 12 variables are eliminated in the first round of top-down simplification. They are DMSDR_1, MCBR_1, DMSDR, MCBR, DMLEf_1, MCDR, Dmipc, MSMR, Dmipc_1, DMLEf, mp_1 and MIA.

```
Stage-0 (Step 2): F presearch testing (top-down)
  Remove  1 variable  with t-prob > 0.9992 : F-prob =0.9992, Tests failed =  0;
  Remove  2 variables with t-prob > 0.8338 : F-prob =0.9745, Tests failed =  0;
  Remove  3 variables with t-prob > 0.8209 : F-prob =0.9924, Tests failed =  0;
  Remove  4 variables with t-prob > 0.7812 : F-prob =0.9972, Tests failed =  0;
  Remove  5 variables with t-prob > 0.7738 : F-prob =0.9990, Tests failed =  0;
  Remove  6 variables with t-prob > 0.7594 : F-prob =0.9990, Tests failed =  0;
  Remove  7 variables with t-prob > 0.6547 : F-prob =0.9970, Tests failed =  0;
  Remove  8 variables with t-prob > 0.6027 : F-prob =0.9564, Tests failed =  0;
  Remove  9 variables with t-prob > 0.5694 : F-prob =0.9354, Tests failed =  0;
  Remove 10 variables with t-prob > 0.5186 : F-prob =0.9550, Tests failed =  0;
  Remove 11 variables with t-prob > 0.4959 : F-prob =0.9151, Tests failed =  0;
  Remove 12 variables with t-prob > 0.4613 : F-prob =0.9390, Tests failed =  0;
  Remove 13 variables with t-prob > 0.3974 : F-prob =0.8940, Tests failed =  1;   Invalid
reduction.
```

As a result, the simplified model is as shown below:

```
Stage-0: General model of MFR1, 1971 - 2000

               Coeff     StdError  t-value    t-prob
Constant    -49.21216    17.09737   -2.878    0.0093
MFR1_1        0.59370     0.10489    5.660    0.0000
MSMR_1       -0.04631     0.01491   -3.106    0.0056
MRUR         -7.52712     5.68099   -1.325    0.2001
MRUR_1        8.28250     5.47497    1.513    0.1460
MIA_1        -0.42641     0.27025   -1.578    0.1303
mp          -17.96756     4.51434   -3.980    0.0007
MCDR_1       22.23078     4.77032    4.660    0.0002
DMTFR        14.04517     5.61808    2.500    0.0212
DMTFR_1      11.77750     6.39710    1.841    0.0805

RSS       175.64371   sigma     2.96348   R^2      0.91589   Radj^2    0.87804
LogLik    -26.50890   AIC       2.43393   HQ       2.58335   SC        2.90099
T                30   p              10   FpNull   0.00000   FpGUM     0.93901
```

(c) Second Round of Top-down Simplification

For the second round of simplification, the significance level is 0.75. The test results show that three variables (i.e. MRUR, MRUR_1 and MIA) are removed in this round of top-down simplification. As the remaining seven variables are significant, no variables can be removed from the model.

```
Stage-0 (Step 3): F presearch testing (top-down)
  Remove  1 variable  with t-prob > 0.2001 : F-prob =0.9150, Tests failed =  0;
  Remove  2 variables with t-prob > 0.1460 : F-prob =0.9238, Tests failed =  0;
  Remove  3 variables with t-prob > 0.1303 : F-prob =0.9289, Tests failed =  0;
F presearch testing stopped: none remaining variable with t-prob > 0.1000.
```

(d) Bottom-up Simplification

At the third stage of simplification, the checks are carried out in the opposite direction, starting from the largest t^2-statistics downwards. A cumulative F-test checks the decreasing block sizes until the null hypothesis is not rejected at the significance level of 0.125. The test results show that all of the seven variables in the model are significant. Therefore, all of them are retained in the model.

```
Stage-0 (Step 4): F presearch testing  (bottom-up)
  Found    7 variables with t-prob < 0.1000.
  Include  7 variables with t-prob < 0.1303 : F-prob =0.9289, Tests failed =  0;  Valid
reduction found.

Stage-0 (Step 5): No additional restriction imposed by the bottom-up reduction.
```

As a result, the simplified model is as shown below:

```
Stage-1: General model of MFR1, 1971 - 2000

               Coeff      StdError  t-value    t-prob
Constant    -45.95033      9.48533   -4.844    0.0001
MFR1_1        0.64678      0.09063    7.137    0.0000
MSMR_1       -0.04034      0.01391   -2.900    0.0081
mp          -14.16806      3.33528   -4.248    0.0003
MCDR_1       18.99799      3.81397    4.981    0.0000
DMTFR        10.06743      4.43739    2.269    0.0330
DMTFR_1       5.96080      4.49534    1.326    0.1979

RSS       201.38816    sigma       2.95906    R^2        0.90356    Radj^2     0.87840
LogLik    -28.56055    AIC         2.37070    HQ         2.47530    SC         2.69765
T                30    p                 7    FpNull     0.00000    FpGUM      0.92886
```

(3) Removal of Less Obviously Irrelevant Variables Subject to Retaining Congruence – Simplifications via Multiple Search Paths

At this stage, all of the paths that commence with an insignificant t-deletion are explored. The significance level for the t-tests is 0.1. As part of the simplification process, a non-null set of final models is selected. The final models are the distinct minimal congruent models found along all of the search paths. If a unique model results, it is selected. However, when more than one congruent final model is found, an encompassing test is employed in order to make a choice between the models. The test results show that five possible paths have been explored resulting in three non-null sets of final models.

```
Stage-1: Multiple-path encompassing search

Path  1: Check variables with t-prob > 0.0010.
Remove MSMR_1, DMTFR, DMTFR_1, Tests failed =  0     Terminal specification found.

Path  2: Check variables with t-prob > 0.0100.
Remove DMTFR, DMTFR_1, Tests failed =  0     Terminal specification found.

Path  3: Check variables with t-prob > 0.0500.
Remove DMTFR_1, Tests failed =  0     Terminal specification found.

Path  4: Check variables with t-prob > 0.1000.
Remove DMTFR_1, Path converged to a previously found specification.

Path  5 of  5 started.
Remove DMTFR_1            : Path converged to a previously found specification.
```

Final-model-1

	Coeff	StdError	t-value	t-prob
Constant	-45.21108	11.07297	-4.083	0.0004
MFR1_1	0.60774	0.11285	5.385	0.0000
mp	-14.16731	3.73653	-3.792	0.0008
MCDR_1	18.73492	4.37642	4.281	0.0002

RSS	377.25842	sigma	3.80919	R^2	0.81934	Radj^2	0.79850
LogLik	-37.97600	AIC	2.79840	HQ	2.85817	SC	2.98523
T	30	p	4	FpNull	0.00000	FpGUM	0.50163

Final-model-2

	Coeff	StdError	t-value	t-prob
Constant	-38.84834	9.31732	-4.169	0.0003
MFR1_1	0.59459	0.09332	6.371	0.0000
MSMR_1	-0.04974	0.01375	-3.617	0.0013
mp	-11.18054	3.19608	-3.498	0.0018
MCDR_1	15.88166	3.70134	4.291	0.0002

RSS	247.68027	sigma	3.14757	R^2	0.88139	Radj^2	0.86242
LogLik	-31.66412	AIC	2.44427	HQ	2.51898	SC	2.67781
T	30	p	5	FpNull	0.00000	FpGUM	0.84600

Final-model-3

	Coeff	StdError	t-value	t-prob
Constant	-41.50286	9.01160	-4.605	0.0001
MFR1_1	0.62831	0.09095	6.908	0.0000
MSMR_1	-0.04681	0.01323	-3.539	0.0017
mp	-12.48255	3.13190	-3.986	0.0005
MCDR_1	17.12145	3.59721	4.760	0.0001
DMTFR	7.50030	4.05537	1.849	0.0767

RSS	216.78354	sigma	3.00544	R^2	0.89619	Radj^2	0.87456
LogLik	-29.66553	AIC	2.37770	HQ	2.46735	SC	2.65794
T	30	p	6	FpNull	0.00000	FpGUM	0.90914

(4) Testing for Encompassing between the Contending Models

Since there are three congruent final models, an encompassing test is employed in order to select a non-dominated model among the models. Each contending model is tested against their union, dropping those that are dominated by and do not dominate another contending models. The significance level adopted is 0.125. The results show that one model survives, i.e. Final-model-3. Thus, it becomes the specific model.

Union-model

	Coeff	StdError	t-value	t-prob
Constant	-41.50286	9.01160	-4.605	0.0001
MFR1_1	0.62831	0.09095	6.908	0.0000
MSMR_1	-0.04681	0.01323	-3.539	0.0017
mp	-12.48255	3.13190	-3.986	0.0005
MCDR_1	17.12145	3.59721	4.760	0.0001
DMTFR	7.50030	4.05537	1.849	0.0767

RSS	216.78354	sigma	3.00544	R^2	0.89619	Radj^2	0.87456
LogLik	-29.66553	AIC	2.37770	HQ	2.46735	SC	2.65794
T	30	p	6	FpNull	0.00000	FpGUM	0.90914

Encompassing tests

```
Model 1:  F test     8.8830 [0.0013] Removed.
Model 2:  F test     3.4206 [0.0767] Removed.
Model 3:  F test     ------ [0.0000]

All variables are significant: General -> Specific.
```

(5) Final Specific Model for the General Model (Model-4 in Table 9.2)

Once the specific model is obtained, the sub-sample reliability test is applied to the specific model in order to evaluate the overall significance of the retained variables. The significance level for the reliability test is 0.125.

```
Specific model of MFR1, 1971 - 2000

              Coeff    StdError  t-value    t-prob   Split1    Split2  reliable
Constant  -41.50286     9.01160   -4.605    0.0001   0.0001    0.0004    1.0000
MFR1_1      0.62831     0.09095    6.908    0.0000   0.0000    0.0000    1.0000
MSMR_1     -0.04681     0.01323   -3.539    0.0017   0.0013    0.0015    1.0000
mp        -12.48255     3.13190   -3.986    0.0005   0.0003    0.0006    1.0000
MCDR_1     17.12145     3.59721    4.760    0.0001   0.0000    0.0001    1.0000
DMTFR       7.50030     4.05537    1.849    0.0767   0.1202    0.0300    1.0000

RSS       216.78354   sigma      3.00544   R^2       0.89619   Radj^2    0.87456
LogLik    -29.66553   AIC        2.37770   HQ        2.46735   SC        2.65794
T                30   p                6   FpNull    0.00000   FpGUM     0.90914

                     value        prob
Chow(1998:1)         0.5422       0.5890
normality test       8.4027       0.0150
AR   1-4 test        1.7406       0.1807
hetero test          0.6768       0.7286
```

Table 9.2
Summary Results of Specific Models for the Lapse Model Using MFR1 (Liberal Strategy) for the Sample Period 1971-2000
(for Variables being Made Constant Using the Average Annual CPIs as Deflators)

No.	Model	1 FSM-I	2 FSM-II	3	4	L1 = L2 = Model-4		L2 = L1 = Model-4	
1	Constant	-56.98654 ***	-57.16501 ***	-32.05731 **	-41.50286 ***	Constant	-41.50286 ***	Constant	-41.50286 ***
		(0.7000)	(0.7000)	(0.7000)	(1.0000)		(1.0000)		(1.0000)
2	MFR1_1	0.48825 ***	0.48987 ***	0.55635 ***	0.62831 ***	MFR1_1	0.62831 ***	MFR1_1	0.62831 ***
		(1.0000)	(1.0000)	(1.0000)	(1.0000)		(1.0000)		(1.0000)
3	Dmgdp_1	-13.49049 **				Dmgdp_1			
		(1.0000)							
4	Dmipc_1		-13.37009 **					Dmipc_1	
			(1.0000)						
5	MSMR_1	-0.06006 ***	-0.06009 ***	-0.05653 ***	-0.04681 ***	MSMR_1	-0.04681 ***	MSMR_1	-0.04681 ***
		(1.0000)	(1.0000)	(1.0000)	(1.0000)		(1.0000)		(1.0000)
6	MRUR	-18.82032 **	-18.55898 **			MRUR		MRUR	
		(1.0000)	(1.0000)						
7	MRUR_1	13.71455 **	13.45376 **			MRUR_1		MRUR_1	
		(1.0000)	(1.0000)						
8	MIA	-0.89144 *	-0.89673 *	-0.89641 **		MIA		MIA	
		(0.7000)	(0.7000)	(1.0000)					
9	MIA_1	-1.17978 **	-1.16827 **			MIA_1		MIA_1	
		(1.0000)	(1.0000)						
10	mp	-50.87661 **	-51.02827 **	-44.17064 **	-12.48255 ***	mp	-12.48255 ***	mp	-12.48255 ***
		(1.0000)	(1.0000)	(1.0000)	(1.0000)		(1.0000)		(1.0000)
11	mp_1	38.52569 *	38.73934 *	31.37166 *		mp_1		mp_1	
		(0.7000)	(0.7000)	(1.0000)					
12	MCDR_1	22.68787 ***	22.60376 ***	15.99489 ***	17.12145 ***	MCDR_1	17.12145 ***	MCDR_1	17.12145 ***
		(1.0000)	(1.0000)	(1.0000)	(1.0000)		(1.0000)		(1.0000)
13	DMTFR	18.60790 ***	18.53447 ***	8.90032 **	7.50030 *	DMTFR	7.50030 *	DMTFR	7.50030 *
		(1.0000)	(1.0000)	(1.0000)	(1.0000)		(1.0000)		(1.0000)
14	DMTFR_1	13.98602 *	13.84015 *			DMTFR_1		DMTFR_1	
		(0.7000)	(0.7000)						
15	DMLEm_1	3.76076 *	3.75923 *			DMLEm_1		DMLEm_1	
		(1.0000)	(1.0000)						
	No. of GUM(s)	1	1	4	4				
	Adjusted-R^2	0.90143	0.90114	0.88804	0.87456		0.87456		0.87456
	Sigma	2.66417	2.66811	2.83945	3.00544		3.00544		3.00544
	Probability:								
	Chow (1998: 1)	0.4138	0.4293	0.4667	0.5890		0.5890		0.5890
	Normality Test	0.6954	0.6737	0.2465	0.0150		0.0150		0.0150
	AR 1-4 Test	0.5412	0.5532	0.7256	0.1807		0.1807		0.1807
	Hetero Test	0.5176	0.5369	0.7956	0.7286		0.7286		0.7286

Dependent variable: MFR1

Note: Two GUMs are removed because they do not pass the residual autocorrelation test. Therefore, only 10 GUMs have been estimated.

Note:
In the summary table, the regression coefficients, significance levels and reliability coefficients of the retained variables are reported. The significance levels are indicated by asterisk mark(s). Three asterisk marks indicate highly significant at 1% significance level, two asterisk marks indicate moderately significant at 5% significance level and one asterisk mark indicates marginally significant at 10% significance level. Meanwhile, "NS" is used to indicate that the retained variable is not significant. In each table, the regression coefficients are reported on top of the reliability coefficients and next to (and to the left of) the significance level indicators. The reliability coefficients are enclosed in parentheses.

Table 9.3

Full Results of Encompassing Test for Model-1 and Model-2 (Liberal Strategy)

```
Encompassing test statistics: 1971 to 2000

Model-1 is: MFR1 on
  Constant        MFR1_1          Dmgdp_1         MSMR_1          MRUR
  MRUR_1          MIA             MIA_1           mp              mp_1
  MCDR_1          DMTFR           DMTFR_1         DMLEm_1

Model-2 is: MFR1 on
  MFR1_1          Constant        Dmipc_1         MSMR_1          MRUR
  MRUR_1          MIA             MIA_1           mp              mp_1
  MCDR_1          DMTFR           DMTFR_1         DMLEm_1

Instruments used:
  Constant        MFR1_1          Dmgdp_1         MSMR_1          MRUR
  MRUR_1          MIA             MIA_1           mp              mp_1
  MCDR_1          DMTFR           DMTFR_1         DMLEm_1         Dmipc_1

sigma[Model-1] = 2.66417  sigma[Model-2 = 2.66811  sigma[Joint] = 2.74945

Test          Model-1 vs. Model-2                Model-2 vs. Model-1
Cox           N(0,1)    =   0.2130  [0.8313]     N(0,1)    =  -0.3681  [0.7128]
Ericsson IV   N(0,1)    =  -0.1557  [0.8762]     N(0,1)    =   0.2683  [0.7885]
Sargan        Chi^2(1)  = 0.024334  [0.8760]     Chi^2(1)  = 0.071560  [0.7891]
Joint Model   F(1,15)   = 0.022848  [0.8819]     F(1,15)   = 0.067389  [0.7987]
```

Table 9.4

Summary Results of Specific Models for the Lapse Model Using MFR2 (Liberal Strategy) for the Sample Period 1971-2000 (for Variables being **Made Constant** Using the Average Annual CPIs as Deflators)

No.	Model	1	2	3	4	5	L3 = L4		L4 = L3		Re-specified Model-1 FSM-III		Re-specified Model-2	
1	Constant	-35.52747 *** (1.0000)	-35.34053 *** (1.0000)	-20.54789 *** (0.5203)	-20.42140 *** (0.5254)	-28.75014 *** (1.0000)	Constant	-27.83836 *** (1.0000)	Constant	-27.83836 *** (1.0000)	Constant	-36.90024 *** (1.0000)	Constant	-36.80465 *** (1.0000)
2	Dmgdp_1		-6.44783 ** (1.0000)		-5.10340 * (1.0000)		Dmgdp_1						Dmgdp_1	-7.21791 *** (1.0000)
3	Dmipc_1	-6.55799 ** (1.0000)		-5.17058 ** (1.0000)					Dmipc_1		Dmipc_1	-7.28002 *** (1.0000)		
4	MSMR_1	-0.03914 *** (1.0000)	-0.03875 *** (1.0000)	-0.02346 *** (1.0000)	-0.02342 *** (1.0000)	-0.01670 ** (1.0000)	MSMR_1	-0.01706 *** (1.0000)	MSMR_1	-0.01706 *** (1.0000)	MSMR_1	-0.04180 *** (1.0000)	MSMR_1	-0.04158 *** (1.0000)
5	MRUR	-10.81019 *** (1.0000)	-10.71380 *** (1.0000)	-6.56226 ** (0.7000)	-6.57306 ** (0.7000)		MRUR		MRUR		MRUR	-11.88673 *** (1.0000)	MRUR	-11.86670 *** (1.0000)
6	MRUR_1	6.41612 *** (0.7000)	6.37285 *** (0.7000)	5.66922 ** (0.7000)	5.70393 ** (0.7000)		MRUR_1		MRUR_1		MRUR_1	6.73021 *** (1.0000)	MRUR_1	6.70856 *** (1.0000)
7	DMTBR3M_1	0.55527 ** (0.7000)	0.54885 ** (0.7000)				DMTBR3M_1		DMTBR3M_1		DMTBR3M_1	0.58489 *** (0.7000)	DMTBR3M_1	0.58020 *** (0.7000)
8	MIA	-0.71262 *** (1.0000)	-0.70706 *** (1.0000)	-0.67838 *** (1.0000)	-0.67484 *** (1.0000)	-0.29180 *** (0.7000)	MIA	-0.31744 *** (0.7000)	MIA	-0.31744 *** (0.7000)	MIA	-0.75633 *** (1.0000)	MIA	-0.75352 *** (1.0000)
9	MIA_1	-0.82997 *** (1.0000)	-0.82263 *** (1.0000)	-0.67347 *** (1.0000)	-0.67166 *** (1.0000)	-0.23470 ** (1.0000)	MIA_1	-0.31447 *** (1.0000)	MIA_1	-0.31447 *** (1.0000)	MIA_1	-0.87363 *** (1.0000)	MIA_1	-0.86907 *** (1.0000)
10	mp	-23.91938 *** (1.0000)	-23.78974 *** (1.0000)	-21.62991 *** (1.0000)	-21.55734 *** (1.0000)	-6.11819 *** (1.0000)	mp	-5.93728 *** (1.0000)	mp	-5.93728 *** (1.0000)				
11	mp_1	22.66637 ** (1.0000)	22.44849 ** (1.0000)	15.67767 * (1.0000)	15.55737 * (1.0000)		mp_1		mp_1					
12	MCBR	0.66580 *** (1.0000)	0.66433 *** (1.0000)			0.44737 ** (1.0000)	MCBR	0.35089 * (1.0000)	MCBR	0.35089 * (1.0000)	MCBR	0.72818 *** (1.0000)	MCBR	0.73153 *** (1.0000)
13	MCDR_1	7.02699 *** (1.0000)	7.06963 *** (1.0000)	9.89504 *** (1.0000)	9.91850 *** (1.0000)	8.63227 *** (1.0000)	MCDR_1	8.91055 *** (1.0000)	MCDR_1	8.91055 *** (1.0000)	MCDR_1	6.37966 *** (1.0000)	MCDR_1	6.37734 *** (1.0000)
14	DMTFR			6.99463 *** (0.7000)	6.97363 *** (0.7000)		DMTFR		DMTFR					
15	DMTFR_1	4.95261 * (0.7000)	4.87736 * (0.7000)	5.97067 * (0.4785)	5.96425 * (0.4777)		DMTFR_1		DMTFR_1		DMTFR_1	4.99032 ** (0.4000)	DMTFR_1	4.91149 * (0.4000)
16	DMLEm			1.31860 ** (0.4198)	1.30381 ** (0.4130)		DMLEm		DMLEm					
17	DMLEm_1			2.75973 *** (0.7000)	2.73661 *** (0.7000)		DMLEm_1	1.38418 ** (1.0000)	DMLEm_1	1.38418 ** (1.0000)				
18	DMLEf	2.18170 *** (1.0000)	2.12820 *** (1.0000)				DMLEf		DMLEf		DMLEf	2.32010 *** (1.0000)	DMLEf	2.27139 *** (1.0000)
19	DMLEf_1	1.79142 *** (1.0000)	1.76403 *** (1.0000)				DMLEf_1		DMLEf_1		DMLEf_1	1.85714 *** (1.0000)	DMLEf_1	1.83216 *** (1.0000)
20											Dmp	-25.35544 *** (1.0000)	Dmp	-25.32310 *** (1.0000)
	No. of GUM(s)	1	1	3	3	4								
	Adjusted-R^2	0.88905	0.88679	0.88029	0.87908	0.81081		0.84221		0.84221		0.89328		0.89075
	Sigma	0.99901	1.00913	1.03768	1.04291	1.30451		1.19137		1.19137		0.97976		0.99131
	Probability:													
	Chow (1998: 1)	0.7475	0.7355	0.0710	0.0710	0.3955		0.3125		0.3125		0.7505		0.7394
	Normality Test	0.1761	0.1916	0.2131	0.2255	0.7434		0.3024		0.3024		0.0927		0.0966
	AR 1-4 Test	0.2576	0.2519	0.7793	0.7873	0.1193		0.0831		0.0831		0.2380		0.2346
	Hetero Test	0.6199	0.6164	0.4517	0.4496	0.2686		0.8526		0.8526		0.6355		0.6343

Dependent variable: MFR2

Table 9.5

Summary Results of Encompassing Test for Model-1 and Model-2 (Liberal Strategy)

Encompassing test statistics: 1971 to 2000

sigma[Model-1] = 0.99901 sigma[Model-2] = 1.00913 sigma[Joint] = 0.981754

Test	Model-1 vs. Model-2				Model-2 vs. Model-1			
Cox	N(0,1)	=	1.688	[0.0914]	N(0,1)	=	-1.910	[0.0562]
Ericsson IV	N(0,1)	=	-1.205	[0.2281]	N(0,1)	=	1.336	[0.1815]
Sargan	Chi^2(1)	=	1.4795	[0.2239]	Chi^2(1)	=	1.7494	[0.1860]
Joint Model	F(1,14)	=	1.5320	[0.2362]	F(1,14)	=	1.8484	[0.1955]

Table 9.6

Summary Results of Encompassing Test for Model-1 and L3/L4 (Liberal Strategy)

Encompassing test statistics: 1971 to 2000

sigma[Model-1] = 0.99901 sigma[L3] = 1.19137 sigma[Joint] = 0.99033

Test	Model-1 vs. L3				L3 vs. Model-1			
Cox	N(0,1)	=	-1.871	[0.0613]	N(0,1)	=	-10.39	[0.0000]**
Ericsson IV	N(0,1)	=	1.264	[0.2061]	N(0,1)	=	6.112	[0.0000]**
Sargan	Chi^2(1)	=	1.2422	[0.2650]	Chi^2(8)	=	12.326	[0.1372]
Joint Model	F(1,14)	=	1.2641	[0.2798]	F(8,14)	=	2.2298	[0.0905]

Table 9.7

Summary Results of Encompassing Test for Model-2 and L3/L4 (Liberal Strategy)

Encompassing test statistics: 1971 to 2000

sigma[Model-2] = 1.00913 sigma[L3] = 1.19137 sigma[Joint] = 1.00174

Test	Model-2 vs. L3				L3 vs. Model-2			
Cox	N(0,1)	=	-1.841	[0.0657]	N(0,1)	=	-10.13	[0.0000]**
Ericsson IV	N(0,1)	=	1.244	[0.2135]	N(0,1)	=	6.011	[0.0000]**
Sargan	Chi^2(1)	=	1.2045	[0.2724]	Chi^2(8)	=	12.102	[0.1467]
Joint Model	F(1,14)	=	1.2224	[0.2875]	F(8,14)	=	2.1397	[0.1019]

Table 9.8

Summary Results of Encompassing Test for R-M1 and R-M2 (Liberal Strategy)

Encompassing test statistics: 1971 to 2000

sigma[R-M1] = 0.97976 sigma[R-M2] = 0.991311 sigma[Joint] = 0.9559

Test	R-M1 vs. R-M2				R-M2 vs. R-M1			
Cox	N(0,1)	=	1.765	[0.0776]	N(0,1)	=	-2.001	[0.0454]*
Ericsson IV	N(0,1)	=	-1.303	[0.1924]	N(0,1)	=	1.443	[0.1489]
Sargan	Chi^2(1)	=	1.7217	[0.1895]	Chi^2(1)	=	2.0525	[0.1520]
Joint Model	F(1,15)	=	1.8087	[0.1986]	F(1,15)	=	2.2074	[0.1581]

Table 9.9

Summary Results of Specific Models for the Lapse Model Using MFR3 (Liberal Strategy) for the Sample Period 1971-2000 (for Variables being Made Constant Using the Average Annual CPIs as Deflators)

No.	Model	1	2	3	4	5	6	L5		L6		Re-specified Model-I FSM-IV	
1	Constant	-37.40704 *** (1.0000)	-37.17824 *** (1.0000)	-20.80904 ** (0.4977)	-20.66722 ** (0.5054)	-17.95676 *** (0.7000)	-30.41110 *** (1.0000)	Constant	-31.21877 *** (0.7000)	Constant	-31.32723 *** (0.7000)	Constant	-38.84229 *** (1.0000)
2	MFR3_1					0.29868 ** (1.0000)		MFR3_1		MFR3_1			
3	Dmgdp_1		-7.06418 ** (1.0000)		-5.62777 ** (1.0000)			Dmgdp_1	-5.20844 ** (0.7000)				
4	Dmipc_1	-7.20173 ** (1.0000)		-5.70502 ** (1.0000)						Dmipc_1	-5.30644 ** (0.7000)	Dmipc_1	-7.95661 *** (1.0000)
5	MSMR_1	-0.04510 *** (1.0000)	-0.04467 *** (1.0000)	-0.02712 *** (1.0000)	-0.02708 *** (1.0000)	-0.02120 *** (1.0000)	-0.02469 *** (1.0000)	MSMR_1	-0.03839 *** (1.0000)	MSMR_1	-0.03865 *** (1.0000)	MSMR_1	-0.04789 *** (1.0000)
6	MRUR	-12.16959 *** (1.0000)	-12.04889 *** (1.0000)	-6.99724 ** (0.7000)	-7.00680 ** (0.7000)			MRUR	-6.50232 ** (0.5302)	MRUR	-6.53523 ** (0.5382)	MRUR	-13.29512 *** (1.0000)
7	MRUR_1	7.76705 *** (0.7000)	7.71184 *** (1.0000)	6.37588 ** (0.7000)	6.41265 ** (0.7000)			MRUR_1	3.35003 * (0.5430)	MRUR_1	3.34124 * (0.5457)	MRUR_1	8.09543 *** (1.0000)
8	DMTBR3M_1	0.58193 ** (0.7000)	0.57423 ** (0.7000)					DMTBR3M_1		DMTBR3M_1		DMTBR3M_1	0.61289 *** (0.7000)
9	MIA	-0.78716 *** (1.0000)	-0.78093 *** (1.0000)	-0.75955 *** (1.0000)	-0.75564 *** (1.0000)	-0.59343 *** (1.0000)	-0.37641 *** (1.0000)	MIA	-0.80142 *** (1.0000)	MIA	-0.80689 *** (1.0000)	MIA	-0.83286 *** (1.0000)
10	MIA_1	-0.95776 *** (1.0000)	-0.94883 *** (1.0000)	-0.77293 *** (1.0000)	-0.77077 *** (1.0000)	-0.22767 ** (1.0000)	-0.34014 *** (1.0000)	MIA_1	-0.67791 *** (1.0000)	MIA_1	-0.68182 *** (1.0000)	MIA_1	-1.00341 *** (1.0000)
11	mp	-25.30775 *** (1.0000)	-25.15869 *** (1.0000)	-22.66357 ** (1.0000)	-22.58256 ** (1.0000)	-20.51159 *** (1.0000)	-5.80035 *** (0.7000)	mp	-21.43470 *** (1.0000)	mp	-21.52649 *** (1.0000)		
12	mp_1	23.99772 ** (1.0000)	23.74470 ** (1.0000)	16.49046 * (1.0000)	16.35624 * (1.0000)	14.15825 * (1.0000)		mp_1	20.49601 ** (1.0000)	mp_1	20.68008 ** (1.0000)		
13	MCBR	0.73173 *** (1.0000)	0.72956 *** (1.0000)				0.46915 ** (1.0000)	MCBR	0.58928 *** (0.7000)	MCBR	0.58993 *** (0.7000)	MCBR	0.79696 *** (1.0000)
14	MCDR_1	7.28035 *** (0.7000)	7.32792 *** (0.7000)	10.23296 *** (1.0000)	10.25845 *** (1.0000)	8.82410 *** (1.0000)	8.84374 *** (1.0000)	MCDR_1	6.32324 *** (0.7000)	MCDR_1	6.27044 *** (0.7000)	MCDR_1	6.60356 *** (1.0000)
15	DMTFR			7.22713 ** (0.7000)	7.20261 ** (0.7000)	2.99115 * (0.7000)		DMTFR		DMTFR			
16	DMTFR_1	5.33158 * (0.7000)	5.24171 * (0.7000)	5.88827 * (0.4009)	5.87952 * (0.4000)			DMTFR_1		DMTFR_1		DMTFR_1	5.37100 ** (0.4000)
17	DMLEm			1.64129 ** (0.4685)	1.62494 ** (0.4622)			DMLEm		DMLEm			
18	DMLEm_1			3.19356 *** (1.0000)	3.16755 *** (1.0000)	1.24880 * (0.7000)		DMLEm_1	2.30857 *** (0.7000)	DMLEm_1	2.33428 *** (0.7000)		
19	DMLEf	2.61430 *** (1.0000)	2.55410 *** (1.0000)				1.14017 * (1.0000)	DMLEf	1.12746 ** (0.7000)	DMLEf	1.15502 ** (0.7000)	DMLEf	2.75900 *** (1.0000)
20	DMLEf_1	2.04765 *** (1.0000)	2.01579 *** (1.0000)				0.82065 * (1.0000)	DMLEf_1		DMLEf_1		DMLEf_1	2.11636 *** (1.0000)
21												Dmp	-26.80917 *** (1.0000)
	No. of GUM(s)	1	1	3	2	1	4						
	Adjusted-R^2	0.89718	0.89486	0.89183	0.89067	0.88075	0.83387		0.89502		0.89642		0.90135
	Sigma	1.10002	1.11240	1.12829	1.13435	1.18465	1.39828		1.11151		1.10411		1.07748
	Probability:												
	Chow (1998: 1)	0.7654	0.7522	0.0600	0.0603	0.3008	0.3367		0.0740		0.0722		0.7766
	Normality Test	0.1900	0.2028	0.1998	0.2119	0.0280	0.4675		0.0800		0.0724		0.1074
	AR 1-4 Test	0.1230	0.1179	0.7112	0.7212	0.8809	0.2337		0.2150		0.2067		0.1094
	Hetero Test	0.5342	0.5302	0.3746	0.3730	0.5503	0.7985		0.9293		0.9312		0.5370

Dependent variable: MFR3

Table 9.10
Summary Results of Encompassing Test for L5 and L6 (Liberal Strategy)

```
Encompassing test statistics: 1971 to 2000

sigma[L5] = 1.11151   sigma[L6] = 1.10411   sigma[Joint] = 1.08485

Test          L5 vs. L6                               L6 vs. L5
Cox           N(0,1)     =   -1.794  [0.0728]         N(0,1)     =    1.628  [0.1036]
Ericsson IV   N(0,1)     =    1.341  [0.1798]         N(0,1)     =   -1.233  [0.2175]
Sargan        Chi^2(1)   =   1.7583  [0.1848]         Chi^2(1)   =   1.5534  [0.2126]
Joint Model   F(1,16)    =   1.8458  [0.1931]         F(1,16)    =   1.6091  [0.2228]
```

Table 9.11
Summary Results of Encompassing Test for Model-1 and Model-2 (Liberal Strategy)

```
Encompassing test statistics: 1971 to 2000

sigma[Model-1] = 1.10002   sigma[Model-2] = 1.1124   sigma[Joint] = 1.06563

Test          Model-1 vs. Model-2                     Model-2 vs. Model-1
Cox           N(0,1)     =    1.889  [0.0589]         N(0,1)     =   -2.123  [0.0337]*
Ericsson IV   N(0,1)     =   -1.350  [0.1769]         N(0,1)     =    1.484  [0.1378]
Sargan        Chi^2(1)   =   1.8617  [0.1724]         Chi^2(1)   =   2.1526  [0.1423]
Joint Model   F(1,14)    =   1.9838  [0.1808]         F(1,14)    =   2.3457  [0.1479]
```

Table 9.12
Summary Results of Encompassing Test for Model-1 and L5 (Liberal Strategy)

```
Encompassing test statistics: 1971 to 2000

sigma[Model-1] = 1.10002   sigma[L5] = 1.11151   sigma[Joint] = 1.02215

Test          Model-1 vs. L5                          L5 vs. Model-1
Cox           N(0,1)     =   -2.399  [0.0164]*        N(0,1)     =   -3.338  [0.0008]**
Ericsson IV   N(0,1)     =    1.488  [0.1369]         N(0,1)     =    2.062  [0.0392]*
Sargan        Chi^2(2)   =   3.7753  [0.1514]         Chi^2(4)   =   6.0062  [0.1987]
Joint Model   F(2,13)    =   2.1862  [0.1519]         F(4,13)    =   1.7755  [0.1939]
```

Table 9.13
Summary Results of Encompassing Test for Model-1 and L6 (Liberal Strategy)

```
Encompassing test statistics: 1971 to 2000

sigma[Model-1] = 1.10002   sigma[L6] = 1.10411   sigma[Joint] = 1.06544

Test          Model-1 vs. L6                          L6 vs. Model-2
Cox           N(0,1)     =   -2.529  [0.0114]*        N(0,1)     =   -3.270  [0.0011]**
Ericsson IV   N(0,1)     =    1.557  [0.1195]         N(0,1)     =    2.025  [0.0428]*
Sargan        Chi^2(1)   =   1.8665  [0.1719]         Chi^2(3)   =   3.9637  [0.2654]
Joint Model   F(1,14)    =   1.9896  [0.1802]         F(3,14)    =   1.4189  [0.2790]
```

Table 9.14

Summary Results of Specific Models for the Lapse Model Using DMSR (Liberal Strategy) for the Sample Period 1972-2001 (for Variables being Made Constant Using the Average Annual CPIs as Deflators)

No.	Model	1 FSM-V	2 FSM-VI	3	4	5	6	7	8	9	10	11	12	L7		L8	
1	Constant							-3.56175 *** (1.0000)						Constant		Constant	
2	DMSR_1	0.37616 *** (1.0000)	0.40052 *** (1.0000)	0.36987 *** (1.0000)	0.39132 *** (1.0000)	0.36136 ** (1.0000)	0.35203 ** (1.0000)							DMSR_1	0.50123 *** (1.0000)	DMSR_1	0.50210 *** (1.0000)
3	Dmgdp			-0.82026 *** (0.5266)	-0.98378 *** (0.7000)		-1.04893 *** (0.5275)		-1.25223 *** (0.7000)		-1.29245 *** (0.7000)		-1.21794 *** (0.7000)	Dmgdp	-1.30218 *** (1.0000)		
4	Dmgdp_1			0.77720 *** (1.0000)	0.89941 *** (1.0000)		0.77436 ** (1.0000)				0.75771 * (1.0000)			Dmgdp_1	1.65752 *** (1.0000)		
5	Dmipc	-0.83070 *** (0.5462)	-0.98355 *** (0.7000)			-1.04840 *** (0.5394)		-1.32708 *** (1.0000)		-1.28371 *** (0.7000)		-1.23351 *** (0.7000)				Dmipc	-1.28943 *** (1.0000)
6	Dmipc_1	0.76452 *** (1.0000)	0.89699 *** (1.0000)			0.77987 ** (1.0000)				0.73475 * (1.0000)						Dmipc_1	1.59123 *** (1.0000)
7	MSMR	-0.00166 ** (0.7000)	-0.00148 * (0.7000)	-0.00167 ** (0.7000)	-0.00146 * (0.7000)	-0.00203 * (0.7000)	-0.00200 * (0.7000)			-0.00216 * (0.7000)	-0.00219 * (0.7000)			MSMR	-0.00475 *** (1.0000)	MSMR	-0.00463 *** (1.0000)
8	MSMR_1	-0.00400 *** (1.0000)	-0.00473 *** (1.0000)	-0.00403 *** (1.0000)	-0.00475 *** (1.0000)	-0.00371 *** (1.0000)	-0.00373 *** (1.0000)							MSMR_1	-0.00177 ** (0.7000)	MSMR_1	-0.00178 ** (0.7000)
9	MRUR								0.64529 ** (1.0000)	1.08180 *** (1.0000)	1.09783 *** (1.0000)	0.71330 ** (1.0000)	0.70692 ** (1.0000)	MRUR	1.09243 *** (1.0000)	MRUR	1.03796 *** (1.0000)
10	MRUR_1							-0.57937 *** (1.0000)	-0.76965 *** (1.0000)	-0.93263 *** (1.0000)	-0.94573 *** (1.0000)	-0.69189 ** (1.0000)	-0.68882 ** (1.0000)	MRUR_1	-0.99448 *** (1.0000)	MRUR_1	-0.95225 *** (1.0000)
11	DMSDR		0.05806 ** (1.0000)		0.05723 ** (1.0000)									DMSDR		DMSDR	
12	DMFDR	0.10995 ** (1.0000)		0.10923 ** (1.0000)										DMFDR		DMFDR	
13	DMFDR_1							-0.15157 ** (1.0000)	-0.15617 ** (1.0000)					DMFDR_1	-0.14962 ** (1.0000)	DMFDR_1	-0.14432 ** (1.0000)
14	MIA	-0.06296 *** (0.7000)	-0.05795 *** (0.7000)	-0.06310 *** (0.7000)	-0.05840 *** (0.7000)			-0.06919 *** (1.0000)	-0.07850 *** (1.0000)					MIA		MIA	
15	MIA_1	0.06584 *** (0.7000)	0.06494 *** (1.0000)	0.06577 *** (0.7000)	0.06479 *** (1.0000)	0.05898 *** (0.5288)	0.05831 *** (0.5252)	0.08609 *** (1.0000)	0.10660 *** (1.0000)	0.09903 *** (0.7000)	0.10001 *** (0.7000)	0.07367 *** (0.7000)	0.07353 *** (0.7000)	MIA_1	0.15981 *** (1.0000)	MIA_1	0.15550 *** (1.0000)
16	mp					2.30772 ** (0.4058)	2.32510 ** (0.4050)			3.96021 *** (0.4781)	3.97926 *** (0.4934)	3.07243 *** (0.5372)	3.04329 *** (0.5358)	mp	3.20617 *** (1.0000)	mp	3.15706 *** (1.0000)
17	mp_1					-2.02914 ** (0.4138)	-2.04799 ** (0.4134)			-3.85243 *** (0.4846)	-3.87327 *** (0.4993)	-2.96702 *** (0.5185)	-2.93739 *** (0.5161)	mp_1	-2.70209 *** (1.0000)	mp_1	-2.64838 *** (1.0000)
18	MCBR							-0.26288 *** (1.0000)	-0.28294 *** (1.0000)	-0.15362 ** (0.7000)	-0.15835 ** (0.7000)	-0.11555 * (0.4000)	-0.11702 * (0.4000)	MCBR	-0.17126 *** (1.0000)	MCBR	-0.16270 *** (1.0000)
19	MCBR_1							0.23468 *** (1.0000)	0.21321 ** (1.0000)	0.13131 ** (1.0000)	0.13648 ** (1.0000)	0.09893 * (0.7000)	0.10153 * (0.7000)	MCBR_1	0.18859 *** (1.0000)	MCBR_1	0.18019 *** (1.0000)
20	MCDR					-0.17768 * (0.4276)	-0.17532 * (0.4337)							MCDR	-0.48867 * (1.0000)	MCDR	-0.48547 * (1.0000)
21	MCDR_1							0.96486 *** (1.0000)	0.40252 ** (1.0000)					MCDR_1		MCDR_1	
22	DMTFR							1.50753 ** (1.0000)	1.62382 ** (0.7000)					DMTFR		DMTFR	
23	DMLEm							0.43217 *** (1.0000)	0.48380 *** (1.0000)	0.62791 *** (1.0000)	0.63284 *** (1.0000)	0.56565 *** (0.7000)	0.56196 *** (0.7000)	DMLEm	0.39075 *** (0.7000)	DMLEm	0.38353 *** (0.7000)
24	DMLEf	0.38695 *** (1.0000)	0.40336 *** (1.0000)	0.39323 *** (1.0000)	0.41193 *** (1.0000)	0.37302 *** (1.0000)	0.38131 *** (1.0000)							DMLEf		DMLEf	
25	DMLEf_1	-0.13620 * (0.4000)	-0.15514 ** (0.7000)	-0.13224 * (0.4000)	-0.14859 * (0.7000)	-0.17246 * (1.0000)	-0.16471 * (0.4000)							DMLEf_1	-0.36310 *** (1.0000)	DMLEf_1	-0.35886 *** (1.0000)
	No. of GUM(s)	1	1	1	1	1	1	1	1	1	1	1	1				
	Adjusted-R^2	0.78887	0.78506	0.78278	0.77879	0.71664	0.70892	0.67590	0.63939	0.59310	0.58924	0.50922	0.50406		0.83017		0.83561
	Sigma	0.15046	0.15182	0.15262	0.15401	0.17431	0.17667	0.18642	0.19664	0.20888	0.20987	0.22940	0.23061		0.13495		0.13277
	Probability:																
	Chow (1999: 1)	0.8539	0.6830	0.8485	0.6815	0.9362	0.9319	0.8148	0.5442	0.6261	0.6184	0.7395	0.7373		0.5628		0.5605
	Normality Test	0.0876	0.0220	0.0746	0.0184	0.0288	0.0211	0.1237	0.1390	0.9968	0.9962	0.6294	0.5605		0.2444		0.1811
	AR 1-4 Test	0.8091	0.8955	0.7760	0.8709	0.4228	0.4221	0.0210	0.6771	0.7767	0.7703	0.2207	0.2105		0.1897		0.2333
	Hetero Test	0.9529	0.9857	0.9612	0.9888	0.8850	0.9150	0.2986	0.2153	0.3694	0.3610	0.1639	0.1521		n.a.		n.a.

Dependent variable: DMSR

Table 9.15
Summary Results of Encompassing Test for Model-1 and Model-2 (Liberal Strategy)

```
Encompassing test statistics: 1972 to 2001

sigma[Model-1] = 0.150465   sigma[Model-2] = 0.151816   sigma[Joint] =
0.150806

Test          Model-1 vs. Model-2              Model-2 vs. Model-1
Cox           N(0,1)    =   -1.486 [0.1373]    N(0,1)    =   -1.821 [0.0686]
Ericsson IV   N(0,1)    =    1.136 [0.2559]    N(0,1)    =    1.375 [0.1690]
Sargan        Chi^2(1)  =  0.91366 [0.3391]    Chi^2(1)  =   1.2520 [0.2632]
Joint Model   F(1,19)   =  0.90952 [0.3522]    F(1,19)   =   1.2688 [0.2740]
```

Table 9.16
Summary Results of Specific Models for the Lapse Model Using MFR1* (Liberal Strategy) for the Sample Period 1971-2000
(for Variables being Made Constant Using a Combination of Average and End-of-Year CPIs as Deflators)

No.	Model	1	2	3	4	5	6	7	L9=L10 FSM-VII		L10=L9 FSM-VII	
1	Constant	-47.83822 *** (1.0000)	-56.28471 *** (1.0000)	-47.19204 *** (1.0000)	-47.45616 *** (1.0000)	-43.66806 *** (1.0000)	-66.09146 *** (1.0000)		Constant	-50.24602 *** (1.0000)	Constant	-50.24602 *** (1.0000)
2	MFR1_1	0.67379 *** (1.0000)	0.45396 *** (1.0000)	0.51724 *** (1.0000)	0.51627 *** (1.0000)	0.57568 *** (1.0000)		0.76913 *** (1.0000)	MFR1_1	0.44959 *** (1.0000)	MFR1_1	0.44959 *** (1.0000)
3	Dmgdp			-9.16080 ** (1.0000)					Dmgdp			
4	Dmipc				-9.11320 ** (1.0000)						Dmipc	
5	MSMR							-0.04020 ** (1.0000)	MSMR		MSMR	
6	MSMR_1	-0.04592 *** (1.0000)	-0.07121 *** (1.0000)	-0.05128 *** (1.0000)	-0.05144 *** (1.0000)	-0.04166 *** (1.0000)	-0.08044 *** (1.0000)	-0.06641 *** (1.0000)	MSMR_1	-0.07141 *** (1.0000)	MSMR_1	-0.07141 *** (1.0000)
7	DMTBR3M		-1.14640 ** (1.0000)				-1.45929 ** (1.0000)		DMTBR3M	-0.96636 * (1.0000)	DMTBR3M	-0.96636 * (1.0000)
8	MIE		0.44715 * (0.7000)						MIE		MIE	
9	MIE_1		-0.53275 ** (1.0000)	-0.42830 ** (1.0000)	-0.42913 * (1.0000)		-1.13046 *** (1.0000)		MIE_1	-0.44537 ** (1.0000)	MIE_1	-0.44537 ** (1.0000)
10	mpn	-15.28788 *** (1.0000)							mpn	-14.21393 *** (1.0000)	mpn	-14.21393 *** (1.0000)
11	mpn_1		-14.41819 *** (1.0000)	-12.47982 *** (0.7000)	-12.48871 *** (0.7000)	-10.92746 *** (1.0000)	-12.96299 *** (0.7000)		mpn_1		mpn_1	
12	MCDR_1	19.97033 *** (1.0000)	22.10307 *** (1.0000)	19.17611 *** (1.0000)	19.19025 *** (1.0000)	16.86723 *** (1.0000)	25.36384 *** (1.0000)	1.12997 ** (1.0000)	MCDR_1	20.87539 *** (1.0000)	MCDR_1	20.87539 *** (1.0000)
13	DMTFR	12.44200 ** (1.0000)							DMTFR		DMTFR	
14	DMTFR_1	7.61519 * (1.0000)							DMTFR_1		DMTFR_1	
15	DMLEm						3.31785 * (1.0000)		DMLEm		DMLEm	
16	DMLEm_1						4.86818 *** (1.0000)		DMLEm_1		DMLEm_1	
	No. of GUM(s)	2	1	1	1	4	1	2				
	Adjusted-R^2	0.88746	0.88489	0.88227	0.88198	0.85782	0.85075	0.82077		0.88944		0.88944
	Sigma	2.84669	2.87903	2.91168	2.91523	3.19973	3.27829	3.59248		2.82152		2.82152
	Probability:											
	Chow (1998: 1)	0.5556	0.0416	0.3608	0.3673	0.4090	0.0888	0.2117		0.0379		0.0379
	Normality Test	0.0608	0.2256	0.1221	0.1297	0.0411	0.8234	0.0615		0.5015		0.5015
	AR 1-4 Test	0.5711	0.4217	0.1820	0.1623	0.4731	0.4452	0.4235		0.5274		0.5274
	Hetero Test	0.8584	0.9145	0.8076	0.8249	0.4550	0.9075	0.6169		0.7046		0.7046

Dependent variable: MFR1*

Table 9.17
Summary Results of Specific Models for the Lapse Model Using MFR2* (Liberal Strategy) for the Sample Period 1971-2000
(for Variables being Made Constant Using a Combination of Average and End-of-Year CPIs as Deflators)

No.	Model	1	2	3	4	5	L11 = Model-1 FSM-VIII	
1	Constant	-31.36588 *** (1.0000)	-22.88266 *** (1.0000)	-34.98899 *** (1.0000)	-18.74843 *** (1.0000)	-20.04842 *** (1.0000)	Constant	-31.36588 *** (1.0000)
2	MFR2_1		0.41114 *** (1.0000)		0.40024 *** (1.0000)	0.42674 *** (1.0000)	MFR2_1	
3	MSMR_1	-0.03276 *** (1.0000)	-0.01928 *** (1.0000)	-0.03010 *** (1.0000)	-0.02385 *** (1.0000)	-0.01533 ** (1.0000)	MSMR_1	-0.03276 *** (1.0000)
4	DMTBR3M	-0.65416 *** (1.0000)		-0.68516 *** (1.0000)			DMTBR3M	-0.65416 *** (1.0000)
5	MIE	0.19252 ** (1.0000)		0.26016 ** (1.0000)			MIE	0.19252 ** (1.0000)
6	MIE_1	-0.51939 *** (1.0000)	-0.31689 *** (1.0000)	-0.44133 *** (1.0000)	-0.29609 *** (0.7000)	-0.23009 ** (0.7000)	MIE_1	-0.51939 *** (1.0000)
7	mpn		-7.11924 *** (1.0000)		-5.76129 *** (1.0000)		mpn	
8	mpn_1	-6.27699 *** (1.0000)		-7.57908 *** (1.0000)		-5.32098 *** (1.0000)	mpn_1	-6.27699 *** (1.0000)
9	MCBR_1	0.52440 *** (1.0000)		0.59321 *** (1.0000)			MCBR_1	0.52440 *** (1.0000)
10	MCDR_1	8.66671 *** (1.0000)	9.87744 *** (1.0000)	9.75809 *** (1.0000)	8.23266 *** (1.0000)	8.18673 ** (1.0000)	MCDR_1	8.66671 *** (1.0000)
11	DMTFR		4.13174 ** (1.0000)				DMTFR	
12	DMTFR_1		3.83036 ** (0.7000)				DMTFR_1	
13	DMLEm	0.95767 * (0.7000)					DMLEm	0.95767 * (0.7000)
14	DMLEm_1	1.19073 ** (1.0000)	1.07684 * (0.7000)				DMLEm_1	1.19073 ** (1.0000)
	No. of GUM(s)	2	4	2	2	2		
	Adjusted-R^2	0.89955	0.87134	0.86738	0.82898	0.81658		0.89955
	Sigma	0.95057	1.07580	1.09219	1.24030	1.28447		0.95057
	Probability:							
	Chow (1998: 1)	0.1533	0.7254	0.2787	0.5013	0.4025		0.1533
	Normality Test	0.6268	0.0602	0.7572	0.1490	0.0408		0.6268
	AR 1-4 Test	0.6016	0.9104	0.2507	0.3865	0.3033		0.6016
	Hetero Test	0.2712	0.9988	0.2433	0.9514	0.8118		0.2712

Dependent variable: MFR2*

Table 9.18
Summary Results of Specific Models for the Lapse Model Using MFR3* (Liberal Strategy) for the Sample Period 1971-2000
(for Variables being Made Constant Using a Combination of Average and End-of-Year CPIs as Deflators)

No.	Model	1	2	3	4	5	6	L12 FSM-IX	
1	Constant	-37.85401 *** (1.0000)	-23.24678 *** (1.0000)	-21.68935 *** (1.0000)	-20.39203 *** (1.0000)	-36.20772 *** (1.0000)	-25.05209 *** (1.0000)	Constant	-32.92903 *** (1.0000)
2	MFR3_1		0.42782 *** (1.0000)	0.36264 *** (1.0000)	0.44847 *** (1.0000)		0.50431 *** (1.0000)	MFR3_1	0.21252 * (1.0000)
3	MSMR_1	-0.03368 *** (1.0000)	-0.01899 *** (1.0000)	-0.02784 *** (1.0000)	-0.02625 *** (1.0000)	-0.02094 *** (1.0000)		MSMR_1	-0.03013 *** (1.0000)
4	DMTBR3M	-0.72690 *** (1.0000)	-0.39368 * (1.0000)			-0.59926 ** (1.0000)		DMTBR3M	-0.61381 *** (1.0000)
5	MIE	0.25974 ** (1.0000)						MIE	0.22016 ** (1.0000)
6	MIE_1	-0.58600 *** (1.0000)	-0.25785 *** (0.7000)	-0.43265 *** (1.0000)	-0.32016 *** (0.7000)	-0.36840 *** (1.0000)	-0.18942 * (0.5444)	MIE_1	-0.46746 *** (1.0000)
7	mpn			-6.10748 *** (1.0000)	-6.11122 *** (1.0000)			mpn	
8	mpn_1	-7.79551 *** (1.0000)	-5.98215 *** (0.7000)			-7.16021 *** (0.7000)	-6.96592 *** (1.0000)	mpn_1	-7.14065 *** (1.0000)
9	MCBR_1	0.55732 *** (1.0000)				0.57958 *** (1.0000)		MCBR_1	0.43812 ** (1.0000)
10	MCDR_1	10.84350 *** (1.0000)	9.30960 *** (1.0000)	9.21218 *** (1.0000)	8.78366 *** (1.0000)	10.05018 *** (1.0000)	10.04806 *** (1.0000)	MCDR_1	9.76167 *** (1.0000)
11	DMLEm_1	1.33319 ** (1.0000)		1.20970 * (0.7000)				DMLEm_1	0.98426 * (1.0000)
	No. of GUM(s)	2	1	4	2	1	2		
	Adjusted-R^2	0.88880	0.85197	0.86186	0.84819	0.83472	0.80139		0.90306
	Sigma	1.14400	1.31990	1.27505	1.33665	1.39471	1.52889		1.06814
	Probability:								
	Chow (1998: 1)	0.3358	0.0422	0.5573	0.5398	0.2280	0.3823		0.2068
	Normality Test	0.8691	0.0455	0.0344	0.1569	0.8563	0.1688		0.2900
	AR 1-4 Test	0.0393	0.2452	0.4214	0.3010	0.0715	0.0622		0.2602
	Hetero Test	0.2274	0.6330	0.9240	0.8232	0.0693	0.2784		0.7242

Dependent variable: MFR3*

Table 9.19

Summary Results of Specific Models for the Lapse Model Using DMSRN (Liberal Strategy) for the Sample Period 1972-2001 (for Variables being Made Constant Using a Combination of Average and End-of-Year CPIs as Deflators)

No.	Model	1	2	3	4	5	6	7	8	9	10	11	12	L13 = Model-2 FSM-X	L14 = Model-1 FSM-XI
1	DMSRN_1	0.48971 *** (1.0000)	0.48268 *** (1.0000)	0.68825 *** (1.0000)	0.68331 *** (1.0000)	0.44656 *** (1.0000)	0.43716 *** (1.0000)							DMSRN_1 0.48268 *** (1.0000)	DMSRN_1 0.48971 *** (1.0000)
2	Dmgdp		-0.73698 *** (0.4038)	-0.57531 ** (0.7000)			-0.86493 *** (0.7000)		-1.10062 *** (1.0000)		-0.72529 ** (0.7000)	-1.26514 *** (1.0000)		Dmgdp -0.73698 *** (0.4038)	
3	Dmgdp_1		0.66579 ** (1.0000)	1.01317 *** (1.0000)			0.83456 *** (1.0000)							Dmgdp_1 0.66579 ** (1.0000)	
4	Dmipc	-0.73699 *** (0.4137)			-0.59473 ** (0.7000)	-0.86856 *** (0.7000)		-1.16246 *** (0.7000)		-0.81453 ** (1.0000)			-1.14301 *** (1.0000)		Dmipc -0.73699 *** (0.4137)
5	Dmipc_1	0.66202 ** (1.0000)			0.97052 *** (1.0000)	0.83619 *** (1.0000)									Dmipc_1 0.66202 ** (1.0000)
6	MSMR	-0.00314 *** (1.0000)	-0.00316 *** (1.0000)	-0.00288 ** (1.0000)	-0.00268 ** (1.0000)	-0.00151 * (0.7000)	-0.00150 * (0.7000)							MSMR -0.00316 *** (1.0000)	MSMR -0.00314 *** (1.0000)
7	MSMR_1	-0.00461 *** (1.0000)	-0.00462 *** (1.0000)	-0.00675 *** (1.0000)	-0.00662 *** (1.0000)	-0.00269 ** (1.0000)	-0.00272 ** (1.0000)							MSMR_1 -0.00462 *** (1.0000)	MSMR_1 -0.00461 *** (1.0000)
8	MRUR	-0.72709 *** (0.7000)	-0.72967 *** (0.7000)	-0.75197 *** (0.5474)	-0.72634 *** (0.4981)			-0.14970 ** (0.2077)						MRUR -0.72967 *** (0.7000)	MRUR -0.72709 *** (0.7000)
9	MRUR_1	0.66961 *** (0.7000)	0.67175 *** (0.7000)	0.75645 *** (0.7000)	0.73259 *** (0.7000)									MRUR_1 0.67175 *** (0.7000)	MRUR_1 0.66961 *** (0.7000)
10	DMSDR			0.08717 *** (1.0000)	0.08541 *** (1.0000)									DMSDR	DMSDR
11	DMFDR	0.14069 *** (1.0000)	0.13947 *** (1.0000)											DMFDR 0.13947 *** (1.0000)	DMFDR 0.14069 *** (1.0000)
12	MIE	-0.03670 *** (0.7000)	-0.03698 ** (0.7000)			-0.03715 ** (0.7000)	-0.03730 ** (1.0000)	-0.06594 *** (1.0000)	-0.06315 *** (1.0000)	-0.05082 *** (1.0000)	-0.04730 *** (0.7000)	-0.06473 *** (0.7000)	-0.06437 *** (0.7000)	MIE -0.03698 ** (0.7000)	MIE -0.03670 *** (0.7000)
13	MIE_1					0.04207 *** (1.0000)	0.04146 *** (1.0000)							MIE_1	MIE_1
14	mpn	0.07384 *** (0.7000)	0.07426 *** (0.4000)											mpn 0.07426 *** (0.4000)	mpn 0.07384 *** (0.7000)
15	MCBR							-0.21002 *** (1.0000)	-0.13268 * (1.0000)			-0.15042 * (1.0000)		MCBR	MCBR
16	MCBR_1							0.13230 ** (1.0000)	0.13766 * (1.0000)			0.15747 * (1.0000)	0.00493 * (0.2490)	MCBR_1	MCBR_1
17	MCDR_1							0.49624 *** (1.0000)						MCDR_1	MCDR_1
18	DMTFR							1.51272 *** (1.0000)	1.11650 ** (0.7000)			1.17170 * (0.7000)		DMTFR	DMTFR
19	DMTFR_1	0.91201 *** (1.0000)	0.92363 *** (1.0000)	1.17177 *** (1.0000)	1.10825 *** (1.0000)			0.36343 NS (0.1034)						DMTFR_1 0.92363 *** (1.0000)	DMTFR_1 0.91201 *** (1.0000)
20	DMLEm							0.56574 *** (1.0000)	0.51730 *** (1.0000)	0.48387 *** (1.0000)	0.47702 *** (1.0000)	0.51185 *** (1.0000)	0.46540 *** (1.0000)	DMLEm	DMLEm
21	DMLEm_1							0.28034 *** (1.0000)	0.21895 ** (0.7000)	0.26105 *** (0.7000)	0.27237 *** (0.7000)			DMLEm_1	DMLEm_1
22	DMLEf	0.44338 *** (1.0000)	0.44964 *** (1.0000)	0.49628 *** (1.0000)	0.48965 *** (1.0000)	0.32132 *** (1.0000)	0.32913 *** (1.0000)							DMLEf 0.44964 *** (1.0000)	DMLEf 0.44338 *** (1.0000)
23	DMLEf_1	-0.11573 * (0.7000)	-0.11167 * (0.7000)	-0.15799 ** (1.0000)	-0.15164 ** (1.0000)	-0.16820 * (0.7000)	-0.16114 * (0.7000)							DMLEf_1 -0.11167 * (0.7000)	DMLEf_1 -0.11573 * (0.7000)
	No. of GUM(s)	1	1	1	1	1	1	1	1	1	1	1	1		
	Adjusted-R^2	0.81877	0.81370	0.78215	0.77941	0.71471	0.70746	0.67322	0.51629	0.46838	0.45332	0.42624	0.38137	0.81370	0.81877
	Sigma	0.13133	0.13316	0.14399	0.14490	0.16478	0.16686	0.17635	0.21456	0.22494	0.22810	0.23368	0.24265	0.13316	0.13133
	Probability:														
	Chow (1987: 1)	0.3613	0.3366	0.9651	0.9603	0.4528	0.4480	0.2139	0.2787	0.0781	0.0945	0.5133	0.3404	0.3366	0.3613
	Chow (1999: 1)	0.8838	0.8867	0.7238	0.6968	0.8251	0.8202	0.2786	0.7889	0.8282	0.8590	0.9160	0.7682	0.8867	0.8838
	Normality Test	0.5700	0.5903	0.5947	0.6146	0.3624	0.3073	0.0264	0.7245	0.6696	0.6867	0.2657	0.4859	0.5903	0.5700
	AR 1-4 Test	0.6550	0.6611	0.8661	0.8161	0.4453	0.4182	0.5606	0.0690	0.0434	0.0452	0.3968	0.4164	0.6611	0.6550
	ARCH 1-4 Test	0.8107	0.8356	0.8677	0.8419	0.8427	0.8429	0.9447	0.7367	0.4325	0.4038	0.5986	0.6242	0.8356	0.8107
	Hetero Test	0.3228	0.3221	0.6074	0.6218	0.6304	0.6814	0.2004	0.2886	0.6678	0.6930	0.1735	0.1967	0.3221	0.3228

Dependent variable: DMSRN

Table 9.20
Summary Results of Encompassing Test for L13 and L14 (Liberal Strategy)

```
Encompassing test statistics: 1972 to 2001

sigma[L13] = 0.133159  sigma[L14] = 0.131331   sigma[Joint] = 0.121268

Test          L13 vs. L14                        L14 vs. L13
Cox           N(0,1)    =   -2.374 [0.0176]*     N(0,1)    =    2.131 [0.0331]*
Ericsson IV   N(0,1)    =    1.762 [0.0781]      N(0,1)    =   -1.625 [0.1041]
Sargan        Chi^2(2) =   4.5592 [0.1023]      Chi^2(2) =   4.2106 [0.1218]
Joint Model   F(2,15)   =   2.7486 [0.0962]      F(2,15)   =   2.4692 [0.1183]
```

Table 9.21
Summary Results of Specific Models for the Lapse Model Using MFR1 (Conservative Strategy)
for the Sample Period 1971-2000 (for Variables being Made Constant Using the Average Annual CPIs as Deflators)

No.	Model	1	2	3	4	L15 = Model-1 FSM-XII	
1	Constant	-38.84834 *** (1.0000)				Constant	-38.84834 *** (1.0000)
2	MFR1_1	0.59459 *** (1.0000)	0.58535 *** (1.0000)	0.71673 *** (1.0000)	0.98139 *** (1.0000)	MFR1_1	0.59459 *** (1.0000)
3	MSMR			-0.04700 *** (0.7000)		MSMR	
4	MSMR_1	-0.04974 *** (1.0000)	-0.07364 *** (1.0000)	-0.07179 *** (1.0000)	-0.05310 *** (1.0000)	MSMR_1	-0.04974 *** (1.0000)
5	MIA		-1.17620 ** (1.0000)	-0.13896 NS (0.0000)		MIA	
6	mp	-11.18054 *** (1.0000)	-54.80326 *** (1.0000)			mp	-11.18054 *** (1.0000)
7	mp_1		49.96254 *** (1.0000)	2.27717 ** (1.0000)		mp_1	
8	MCDR_1	15.88166 *** (1.0000)	4.75389 *** (1.0000)			MCDR_1	15.88166 *** (1.0000)
	No. of GUM(s)	7	1	1	1		
	Adjusted-R^2	0.86242	0.83291	0.82617	0.73738		0.86242
	Sigma	3.14757	3.46872	3.53797	4.34868		3.14757
	Probability:						
	Chow (1998: 1)	0.4634	0.2595	0.3136	0.5476		0.4634
	Normality Test	0.0892	0.2441	0.0102	0.4109		0.0892
	AR 1-4 Test	0.6391	0.5044	0.4981	0.1551		0.6391
	Hetero Test	0.3150	0.5981	0.3348	0.2911		0.3150

Dependent variable: MFR1

Note: Two GUMs are removed because they do not pass the residual autocorrelation test. Therefore, only 10 GUMs have been estimated.

Table 9.22

Summary Results of Specific Models for the Lapse Model Using MFR2 (Conservative Strategy) for the Sample Period 1971-2000 (for Variables being Made Constant Using the Average Annual CPIs as Deflators)

No.	Model	1	2	3	L16 = Model-1 FSM-XIII	
1	Constant	-25.14570 *** (1.0000)	-28.75014 *** (1.0000)	-26.02610 *** (1.0000)	Constant	-25.14570 *** (1.0000)
2	MSMR_1	-0.01629 ** (1.0000)	-0.01670 ** (1.0000)		MSMR_1	-0.01629 ** (1.0000)
3	MIA	-0.35134 *** (0.7000)	-0.29180 *** (0.7000)	-0.45601 *** (1.0000)	MIA	-0.35134 *** (0.7000)
4	MIA_1	-0.33045 *** (1.0000)	-0.23470 ** (1.0000)		MIA_1	-0.33045 *** (1.0000)
5	mp	-6.60950 *** (1.0000)	-6.11819 *** (1.0000)	-7.38806 *** (1.0000)	mp	-6.60950 *** (1.0000)
6	MCBR		0.44737 ** (1.0000)		MCBR	
7	MCDR_1	10.77741 *** (1.0000)	8.63227 *** (1.0000)	11.26240 *** (1.0000)	MCDR_1	10.77741 *** (1.0000)
8	DMLEm_1	1.67711 ** (1.0000)			DMLEm_1	1.67711 ** (1.0000)
	No. of GUM(s)	6	4	2		
	Adjusted-R^2	0.81962	0.81081	0.71334		0.81962
	Sigma	1.27377	1.30451	1.60578		1.27377
	Probability:					
	Chow (1998: 1)	0.2042	0.3955	0.1703		0.2042
	Normality Test	0.1658	0.7434	0.3287		0.1658
	AR 1-4 Test	0.0736	0.1193	0.0939		0.0736
	Hetero Test	0.5958	0.2686	0.1331		0.5958

Dependent variable: MFR2

Table 9.23

Summary Results of Specific Models for the Lapse Model Using MFR3 (Conservative Strategy) for the Sample Period 1971-2000 (for Variables being Made Constant Using the Average Annual CPIs as Deflators)

No.	Model	1	2	3	4	L17 FSM-XIV	
1	Constant	-28.34571 *** (1.0000)	-22.70882 *** (1.0000)	-32.43503 *** (1.0000)	-29.18936 *** (1.0000)	Constant	-20.28107 *** (1.0000)
2	MFR1_3		0.46035 *** (1.0000)			MFR1_3	0.48088 *** (1.0000)
3	MSMR_1	-0.01823 ** (1.0000)		-0.01863 ** (1.0000)		MSMR_1	-0.01334 ** (0.3000)
4	MIA	-0.39740 *** (0.7000)	-0.31363 *** (0.7000)	-0.32842 *** (0.7000)	-0.51994 *** (1.0000)	MIA	-0.27486 *** (0.6194)
5	MIA_1	-0.39807 *** (1.0000)		-0.28188 *** (1.0000)		MIA_1	
6	mp	-7.01073 *** (1.0000)	-6.82760 *** (1.0000)	-6.49485 *** (0.7000)	-7.86113 *** (1.0000)	mp	-5.89101 *** (1.0000)
7	MCBR			0.50528 ** (0.7000)		MCBR	
8	MCDR_1	11.84382 *** (1.0000)	9.56936 *** (1.0000)	9.44608 *** (1.0000)	12.33471 *** (1.0000)	MCDR_1	8.50646 *** (1.0000)
9	DMLEm_1	2.03334 *** (1.0000)				DMLEm_1	
	No. of GUM(s)	4	2	4	2		
	Adjusted-R^2	0.83125	0.81843	0.81380	0.71472		0.84284
	Sigma	1.40928	1.46183	1.48033	1.83235		1.36002
	Probability:						
	Chow (1998: 1)	0.2217	0.2330	0.4363	0.1978		0.2822
	Normality Test	0.3914	0.2008	0.8328	0.2901		0.0802
	AR 1-4 Test	0.0463	0.1411	0.0825	0.1020		0.3495
	Hetero Test	0.4610	0.2264	0.0647	0.1032		0.2947

Dependent variable: MFR3

Table 9.24
Summary Results of Specific Models for the Lapse Model Using DMSR (Conservative Strategy) for the Sample Period 1972-2001
(for Variables being Made Constant Using the Average Annual CPIs as Deflators)

No.	Model	1 FSM-XV	2 FSM-XVI	3	4	5	6	7	8	L18		L19	
1	DMSR_1	0.30738 ** (1.0000)	0.30684 ** (1.0000)	0.29955 ** (0.4000)			0.38334 *** (0.7000)	0.34006 ** (0.7000)		DMSR_1	0.19379 NS (0.0000)	DMSR_1	0.18541 NS (0.0000)
2	Dmgdp		-1.03743 *** (0.5622)		-0.80939 *** (0.7000)					Dmgdp	-0.79433 *** (0.6057)		
3	Dmgdp_1		0.66553 ** (1.0000)							Dmgdp_1			
4	Dmipc	-1.04575 *** (0.5508)		-0.74451 *** (0.5784)		-0.82727 ** (1.0000)						Dmipc	-0.84618 *** (0.6212)
5	Dmipc_1	0.64004 ** (1.0000)										Dmipc_1	
6	MSMR_1	-0.00469 *** (1.0000)	-0.00469 *** (1.0000)	-0.00317 *** (1.0000)	-0.00333 *** (1.0000)			-0.00376 *** (1.0000)		MSMR_1	-0.00320 *** (1.0000)	MSMR_1	-0.00330 *** (1.0000)
7	MRUR_1					-0.10839 ** (0.7000)				MRUR_1		MRUR_1	
8	DMSDR	0.06442 ** (1.0000)	0.06313 ** (1.0000)							DMSDR		DMSDR	
9	DMFDR			0.12080 ** (1.0000)						DMFDR		DMFDR	
10	MIA	-0.06518 *** (0.7000)	-0.06438 *** (1.0000)	-0.06670 *** (0.7000)	-0.06376 *** (0.6229)	-0.05429 *** (0.6043)				MIA	-0.05469 *** (0.5746)	MIA	-0.05750 *** (0.5859)
11	MIA_1	0.05200 *** (0.7000)	0.05287 *** (0.7000)	0.04788 *** (0.7000)	0.04810 *** (0.6188)	0.06165 *** (0.7000)	0.04534 *** (0.4898)		0.04654 ** (0.4159)	MIA_1	0.04226 *** (0.5535)	MIA_1	0.04104 *** (0.5475)
12	mp_1						-0.07905 *** (0.4523)		-0.06685 ** (0.4096)	mp_1		mp_1	
13	DMLEm					0.44291 *** (1.0000)				DMLEm		DMLEm	
14	DMLEf	0.48405 *** (1.0000)	0.48806 *** (1.0000)	0.42144 *** (1.0000)	0.42829 *** (1.0000)		0.23949 *** (1.0000)	0.32315 *** (1.0000)		DMLEf	0.41966 *** (1.0000)	DMLEf	0.42450 *** (1.0000)
	No. of GUM(s)	1	1	1	1	1	1	1	5				
	Adjusted-R^2	0.74571	0.74281	0.71166	0.62632	0.47450	0.45150	0.44715	0.17945		0.64972		0.65379
	Sigma	0.16513	0.16607	0.17584	0.20017	0.23738	0.24252	0.24348	0.29663		0.19380		0.19268
	Probability:												
	Chow (1999: 1)	0.6416	0.6481	0.9303	0.8588	0.8432	0.9554	0.8183	0.8783		0.8551		0.8371
	Normality Test	0.5422	0.4749	0.6226	0.9141	0.4807	0.6683	0.3139	0.9968		0.8602		0.8769
	AR 1-4 Test	0.9852	0.9739	0.9683	0.8665	0.0718	0.8358	0.4709	0.3065		0.9955		0.9957
	Hetero Test	0.8583	0.8626	0.8997	0.9304	0.5482	0.9464	0.7838	0.8814		0.6512		0.6553

Dependent variable: DMSR

Table 9.25

Summary Results of Encompassing Test for Model-1 and Model-2 (Conservative Strategy)

```
Encompassing test statistics: 1972 to 2001

sigma[Model-1] = 0.165128   sigma[Model-2] = 0.166068   sigma[Joint] =
0.170929

Test          Model-1 vs. Model-2              Model-2 vs. Model-1
Cox           N(0,1)    =   0.6074 [0.5436]    N(0,1)    =  -0.8488 [0.3960]
Ericsson IV   N(0,1)    =  -0.5226 [0.6012]    N(0,1)    =   0.7221 [0.4702]
Sargan        Chi^2(2)  =  0.57016 [0.7520]    Chi^2(2)  =  0.81189 [0.6663]
Joint Model   F(2,20)   =  0.26606 [0.7691]    F(2,20)   =  0.38318 [0.6866]
```

Table 9.26

Summary Results of Specific Models for the Lapse Model Using MFR1* (Conservative Strategy) for the Sample Period 1971-2000 (for Variables being Made Constant Using a Combination of Average and End-of-Year CPIs as Deflators)

No.	Model	1	2	3	4	L20 = Model-1 FSM-XVII	
1	Constant	-43.66806 *** (1.0000)		-71.57845 *** (1.0000)		Constant	-43.66806 *** (1.0000)
2	MFR1_1	0.57568 *** (1.0000)	0.76913 *** (1.0000)		0.98139 *** (1.0000)	MFR1_1	0.57568 *** (1.0000)
3	MSMR		-0.04020 ** (1.0000)			MSMR	
4	MSMR_1	-0.04166 *** (1.0000)	-0.06641 *** (1.0000)	-0.05935 *** (1.0000)	-0.05310 *** (1.0000)	MSMR_1	-0.04166 *** (1.0000)
5	MIE_1			-1.05463 *** (1.0000)		MIE_1	
6	mpn_1	-10.92746 *** (1.0000)		-15.20919 *** (0.6069)		mpn_1	-10.92746 *** (1.0000)
7	MCDR_1	16.86723 *** (1.0000)	1.12997 ** (1.0000)	27.87599 *** (1.0000)		MCDR_1	16.86723 *** (1.0000)
8	DMLEm_1			4.60471 ** (1.0000)		DMLEm_1	
	No. of GUM(s)	3	6	1	2		
	Adjusted-R^2	0.85782	0.82077	0.79658	0.73738		0.85782
	Sigma	3.19973	3.59248	3.82727	4.34868		3.19973
	Probability:						
	Chow (1998: 1)	0.4090	0.2117	0.5266	0.5476		0.4090
	Normality Test	0.0411	0.0615	0.3802	0.4109		0.0411
	AR 1-4 Test	0.4731	0.4235	0.0267	0.1551		0.4731
	Hetero Test	0.4550	0.6169	0.4360	0.2911		0.4550

Dependent variable: MFR1*

Table 9.27

Summary Results of Specific Models for the Lapse Model Using MFR2* (Conservative Strategy) for the Sample Period 1971-2000

(for Variables being Made Constant Using a Combination of Average and End-of-Year CPIs as Deflators)

No.	Model	1	2	3	4	5	6	7	L21 = L22 FSM-XVIII		L22 = L21 FSM-XVIII	
1	Constant	-32.01875 *** (1.0000)	-18.74843 *** (1.0000)	-20.04842 *** (1.0000)	-32.39424 *** (1.0000)	-31.94801 *** (1.0000)	-24.15793 *** (1.0000)	-25.79448 *** (1.0000)	Constant	-30.69920 *** (1.0000)	Constant	-30.69920 *** (1.0000)
2	MFR2_1		0.40024 *** (1.0000)	0.42674 *** (1.0000)	0.57473 *** (1.0000)	0.53048 *** (1.0000)			MFR2_1		MFR2_1	
3	Dmgdp					-3.39985 NS (0.0000)			Dmgdp			
4	Dmipc				-3.33631 * (0.1950)						Dmipc	
5	MSMR_1	-0.01874 *** (0.7000)	-0.02385 *** (1.0000)	-0.01533 ** (1.0000)	-0.01736 ** (1.0000)	-0.02201 *** (1.0000)	-0.02834 *** (1.0000)	-0.01842 ** (1.0000)	MSMR_1	-0.02914 *** (1.0000)	MSMR_1	-0.02914 *** (1.0000)
6	MRUR					-3.67017 *** (0.6287)			MRUR		MRUR	
7	MRUR_1				-3.61476 *** (1.0000)				MRUR_1		MRUR_1	
8	DMTBR3M	-0.53355 ** (1.0000)							DMTBR3M	-0.57006 *** (1.0000)	DMTBR3M	-0.57006 *** (1.0000)
9	MIE_1	-0.32041 *** (1.0000)	-0.29609 *** (0.6311)	-0.23009 ** (0.5953)	-0.08982 NS (0.1576)	-0.20016 * (0.6000)	-0.47104 *** (1.0000)	-0.40275 *** (1.0000)	MIE_1	-0.39102 *** (1.0000)	MIE_1	-0.39102 *** (1.0000)
10	mpn		-5.76129 *** (1.0000)				-7.01709 *** (1.0000)		mpn	-7.38478 *** (1.0000)	mpn	-7.38478 *** (1.0000)
11	mpn_1	-6.66466 *** (0.6277)		-5.32098 *** (0.7000)				-6.43714 *** (0.6199)	mpn_1		mpn_1	
12	MCBR_1	0.50116 *** (1.0000)			0.38943 ** (0.1342)	0.42127 ** (0.1946)			MCBR_1	0.50693 *** (1.0000)	MCBR_1	0.50693 *** (1.0000)
13	MCDR_1	9.20579 *** (1.0000)	8.23266 *** (1.0000)	8.18673 *** (1.0000)	5.68496 *** (1.0000)	5.53314 *** (1.0000)	10.77005 *** (1.0000)	10.75461 *** (1.0000)	MCDR_1	9.33419 *** (1.0000)	MCDR_1	9.33419 *** (1.0000)
	No. of GUM(s)	2	2	2	1	1	2	2				
	Adjusted-R^2	0.83163	0.82898	0.81658	0.80497	0.78477	0.75280	0.72750		0.86763		0.86763
	Sigma	1.23066	1.24030	1.28447	1.32449	1.39141	1.49118	1.56562		1.09117		1.09117
	Probability:											
	Chow (1998: 1)	0.1746	0.5013	0.4025	0.6958	0.7786	0.4858	0.3854		0.1713		0.1713
	Normality Test	0.6022	0.1490	0.0408	0.0138	0.0123	0.2881	0.1391		0.8196		0.8196
	AR 1-4 Test	0.1128	0.3865	0.3033	0.8334	0.1372	0.1405	0.1096		0.2848		0.2848
	Hetero Test	0.1726	0.7925	0.8118	0.3545	0.2260	0.3472	0.2354		0.2693		0.2693

Dependent variable: MFR2*

Table 9.28
Summary Results of Specific Models for the Lapse Model Using MFR3* (Conservative Strategy) for the Sample Period 1971-2000
(for Variables being Made Constant Using a Combination of Average and End-of-Year CPIs as Deflators)

No.	Model	1	2	3	4	5	6	7	L23 FSM-XIX	
1	Constant	-20.39203 *** (1.0000)	-21.92530 *** (1.0000)	-36.20772 *** (1.0000)	-21.03578 *** (1.0000)			-8.47823 *** (0.7000)	Constant	-28.26644 *** (1.0000)
2	MFR3_1	0.44847 *** (1.0000)	0.46891 *** (1.0000)		0.62424 *** (1.0000)	0.66998 *** (1.0000)	0.93896 *** (1.0000)		MFR3_1	0.28133 ** (1.0000)
3	MSMR_1	-0.02625 *** (1.0000)	-0.01722 ** (1.0000)	-0.02094 *** (0.7000)		-0.01999 ** (1.0000)		-0.03273 *** (1.0000)	MSMR_1	-0.02898 *** (1.0000)
4	DMTBR3M			-0.59926 ** (1.0000)					DMTBR3M	-0.50497 ** (1.0000)
5	MIE_1	-0.32016 *** (0.6400)	-0.25256 ** (0.6102)	-0.36840 *** (1.0000)				-0.41123 *** (1.0000)	MIE_1	-0.33510 *** (1.0000)
6	mpn	-6.11122 *** (1.0000)							mpn	-6.95151 *** (1.0000)
7	mpn_1		-5.69376 *** (0.7000)	-7.16021 *** (0.5678)	-6.02232 *** (1.0000)				mpn_1	
8	MCBR					0.05447 NS (0.0000)			MCBR	
9	MCBR_1			0.57958 *** (1.0000)					MCBR_1	0.40623 * (0.7000)
10	MCDR					-3.97934 NS (0.1589)			MCDR	
11	MCDR_1	8.78366 *** (1.0000)	8.80596 *** (1.0000)	10.05018 *** (1.0000)	8.34497 *** (1.0000)	4.15963 NS (0.2539)		3.56528 *** (1.0000)	MCDR_1	8.80462 *** (1.0000)
	No. of GUM(s)	4	1	2	2	1	1	1		
	Adjusted-R^2	0.84819	0.83855	0.83472	0.78205	0.72716	0.62923	0.59150		0.89448
	Sigma	1.33665	1.37845	1.39471	1.60159	1.79193	2.08891	2.19264		1.11436
	Probability:									
	Chow (1998: 1)	0.5398	0.4350	0.2280	0.4691	0.4857	0.6995	0.6054		0.1277
	Normality Test	0.1569	0.0458	0.8563	0.0700	0.0102	0.0555	0.0207		0.7220
	AR 1-4 Test	0.3010	0.2232	0.0715	0.0872	0.2848	0.0993	0.0283		0.5091
	Hetero Test	0.8232	0.5486	0.0693	0.0654	0.1887	0.1047	0.1379		0.3761

Dependent variable: MFR3*

Table 9.29
Summary Results of Specific Models for the Lapse Model Using DMSRN (Conservative Strategy) for the Sample Period 1972-2001
(for Variables being Made Constant Using a Combination of Average and End-of-Year CPIs as Deflators)

No.	Model	1 FSM-XX	2	3	4	5	L24		L25	
1	DMSRN_1	0.32776 *** (0.6241)	0.29255 ** (0.3293)				DMSRN_1		DMSRN_1	
2	Dmgdp	-0.59970 ** (0.6178)	-0.75342 *** (0.6399)		-0.72529 ** (0.7000)		Dmgdp	-0.53340 * (0.3000)		
3	Dmipc			-0.81453 ** (0.7000)					Dmipc	-0.75909 ** (0.7000)
4	MSMR_1	-0.00403 *** (1.0000)				-0.00440 *** (1.0000)	MSMR_1	-0.00460 *** (1.0000)	MSMR_1	-0.00374 *** (1.0000)
5	MIE		-0.04916 *** (0.5598)	-0.05082 *** (0.7000)	-0.04730 *** (0.7000)		MIE		MIE	-0.02089 ** (0.1618)
6	MIE_1		0.03187 *** (0.4809)				MIE_1		MIE_1	
7	DMLEm			0.48387 *** (1.0000)	0.47702 *** (1.0000)		DMLEm		DMLEm	
8	DMLEm_1			0.26105 *** (0.5920)	0.27237 *** (0.6057)		DMLEm_1		DMLEm_1	
9	DMLEf	0.36179 *** (1.0000)	0.31191 *** (1.0000)			0.32924 *** (1.0000)	DMLEf	0.34997 *** (1.0000)	DMLEf	0.39676 *** (1.0000)
	No. of GUM(s)	2	1	3	2	3				
	Adjusted-R^2	0.59122	0.57231	0.46838	0.45332	0.43359		0.48657		0.54781
	Sigma	0.19724	0.20175	0.22494	0.22810	0.23218		0.22105		0.20745
	Probability:									
	Chow (1999: 1)	0.6610	0.9759	0.8282	0.8590	0.7337		0.6275		0.7074
	Normality Test	0.5654	0.5216	0.6696	0.6867	0.4250		0.9334		0.5490
	AR 1-4 Test	0.9800	0.9336	0.0434	0.0452	0.8488		0.9584		0.7596
	Hetero Test	0.6724	0.7282	0.6678	0.6930	0.6100		0.5246		0.9117

Dependent variable: DMSRN

Note: One GUM is removed because there is nothing to model. Therefore, only 11 GUMs have been estimated.

Table 9.30

Summary Results of Encompassing Test for L24 and L25 (Conservative Strategy)

Encompassing test statistics: 1972 to 2001

sigma[L24] = 0.221054 sigma[L25] = 0.207452 sigma[Joint] = 0.199726

Test	L24 vs. L25				L25 vs. L24			
Cox	N(0,1)	=	-12.01	[0.0000]**	N(0,1)	=	1.718	[0.0858]
Ericsson IV	N(0,1)	=	10.50	[0.0000]**	N(0,1)	=	-1.619	[0.1055]
Sargan	Chi^2(2)	=	6.5914	[0.0370]*	Chi^2(1)	=	2.8275	[0.0927]
Joint Model	F(2,25)	=	4.0371	[0.0302]*	F(1,25)	=	3.0505	[0.0930]

Table 9.31

Summary Results of Encompassing Test for Model-1 and L25 (Conservative Strategy)

Encompassing test statistics: 1972 to 2001

sigma[Model-1] = 0.197243 sigma[L25] = 0.207452 sigma[Joint] = 0.186495

Test	Model-1 vs. L25				L25 vs. Model-1			
Cox	N(0,1)	=	-4.455	[0.0000]**	N(0,1)	=	-8.300	[0.0000]**
Ericsson IV	N(0,1)	=	3.855	[0.0001]**	N(0,1)	=	6.888	[0.0000]**
Sargan	Chi^2(2)	=	4.5444	[0.1031]	Chi^2(2)	=	6.6042	[0.0368]*
Joint Model	F(2,24)	=	2.5416	[0.0997]	F(2,24)	=	4.0859	[0.0297]*

Table 9.32

Preliminary Regression Model for the Lapse Model Using Surrender Rate with GDP as Income Variable

Modelling MSRN by OLS, 1970 - 2001

	Coeff	StdError	t-value	t-prob
Constant	-15.87517	11.03474	-1.439	0.1617
mgdp	-0.93726	0.35951	-2.607	0.0147
MFDR	-0.14186	0.09091	-1.560	0.1303
MTFR	1.31636	0.58697	2.243	0.0333
MLEf	0.33105	0.14557	2.274	0.0311

sigma	0.448606	RSS	5.4336875
R^2	0.329493	F(4,27) =	3.317 [0.025]*
log-likelihood	-17.0361	DW	0.64
no. of observations	32	no. of parameters	5
mean(MSRN)	1.80076	var(MSRN)	0.253245

	value	prob
Chow(1998:1)	2.0000	0.1409
Normality test	0.9450	0.6234
AR 1-4 test	4.8531	0.0055
hetero test	0.8999	0.5370

Table 9.33
Re-estimated Regression Model for the Lapse Model Using Surrender Rate with GDP as Income Variable

Modelling MSRN by OLS, 1970 - 2001

	Coeff	StdError	t-value	t-prob
mgdp	-0.54839	0.26120	-2.100	0.0446
MTFR	0.38219	0.12450	3.070	0.0046
MLEf	0.09024	0.04021	2.244	0.0326

sigma	0.460434	RSS	6.14798698
log-likelihood	-19.0123	DW	0.458
no. of observations	32	no. of parameters	3
mean(MSRN)	1.80076	var(MSRN)	0.253245

	value	prob
Chow(1998:1)	2.4331	0.0876
normality test	0.0205	0.9898
AR 1-4 test	7.4137	0.0004
hetero test	1.2358	0.3264

Table 9.34
Preliminary Regression Model for the Lapse Model Using Surrender Rate with Income per Capita as Income Variable

Modelling MSRN by OLS, 1970 - 2001

	Coeff	StdError	t-value	t-prob
Constant	-14.12866	11.32791	-1.247	0.2230
mipc	-0.91464	0.42358	-2.159	0.0399
MFDR	-0.10697	0.09048	-1.182	0.2474
MTFR	1.40459	0.63173	2.223	0.0347
MLEf	0.26147	0.14134	1.850	0.0753

sigma	0.463478	RSS	5.799922
R^2	0.2843	F(4,27) =	2.681 [0.053]
log-likelihood	-18.0798	DW	0.618
no. of observations	32	no. of parameters	5
mean(MSRN)	1.80076	var(MSRN)	0.253245

	value	prob
Chow(1998:1)	1.6005	0.2154
normality test	0.8850	0.6424
AR 1-4 test	4.9335	0.0051
hetero test	0.9496	0.5024

Table 9.35
Re-estimated Regression Model for the Lapse Model Using Surrender Rate with Income per Capita as Income Variable

Modelling MSRN by OLS, 1970 - 2001

	Coeff	StdError	t-value	t-prob
mipc	-0.58982	0.31300	-1.884	0.0696
MTFR	0.51900	0.15462	3.357	0.0022
MLEf	0.06693	0.03252	2.058	0.0487

sigma	0.466456	RSS	6.3098587
log-likelihood	-19.4281	DW	0.477
no. of observations	32	no. of parameters	3
mean(MSRN)	1.80076	var(MSRN)	0.253245

	value	prob
Chow(1998:1)	1.9629	0.1443
normality test	0.0742	0.9636
AR 1-4 test	6.8025	0.0008
hetero test	1.1867	0.3494

Table 9.36

Summary Results of Final Specific Models (FSMs) for Life Insurance Lapse Models for Variables being Made Constant Using Different Deflation Approaches

Using Liberal Strategy (LS) as the Modelling Strategy

Lapse Model Using	Forfeiture Rate 1			Forfeiture Rate 2		Forfeiture Rate 3		Surrender Rate			
	FSM-I (LS)	FSM-II (LS)	FSM-VII (LS)	FSM-III (LS)	FSM-VIII (LS)	FSM-IV (LS)	FSM-IX (LS)	FSM-V (LS)	FSM-VI (LS)	FSM-X (LS)	FSM-XI (LS)
Constant	-56.98654 ***	-57.16501 ***	-50.24602 ***	-36.90024 ***	-31.36588 ***	-38.84229 ***	-32.92903 ***				
	(0.7000)	(0.7000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)				
MFR1_1 / MFR3_1 / DMSR_1 / DMSRN_1	0.48825 ***	0.48987 ***	0.44959 ***				0.21252 *	0.37616 ***	0.40052 ***	0.48268 ***	0.48971 ***
	(1.0000)	(1.0000)	(1.0000)				(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)
Dmgdp										-0.73698 ***	
										(0.4038)	
Dmgdp_1	-13.49049 **									0.66579 **	
	(1.0000)									(1.0000)	
Dmipc								-0.83070 ***	-0.98355 ***		-0.73699 ***
								(0.5462)	(0.7000)		(0.4137)
Dmipc_1		-13.37009 **		-7.28002 ***		-7.95661 ***		0.76452 ***	0.89699 ***		0.66202 **
		(1.0000)		(1.0000)		(1.0000)		(1.0000)	(1.0000)		(1.0000)
MSMR								-0.00166 **	-0.00148 *	-0.00316 ***	-0.00314 ***
								(0.7000)	(0.7000)	(1.0000)	(1.0000)
MSMR_1	-0.06006 ***	-0.06009 ***	-0.07141 ***	-0.04180 ***	-0.03276 ***	-0.04789 ***	-0.03013 ***	-0.00400 ***	-0.00473 ***	-0.00462 ***	-0.00461 ***
	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)
MRUR	-18.82032 **	-18.55898 **		-11.88673 ***		-13.29512 ***				-0.72967 ***	-0.72709 ***
	(1.0000)	(1.0000)		(1.0000)		(1.0000)				(0.7000)	(0.7000)
MRUR_1	13.71455 **	13.45376 **		6.73021 ***		8.09543 ***				0.67175 ***	0.66961 ***
	(1.0000)	(1.0000)		(1.0000)		(1.0000)				(0.7000)	(0.7000)
DMSDR									0.05806 **		
									(1.0000)		
DMFDR								0.10995 **		0.13947 ***	0.14069 ***
								(1.0000)		(1.0000)	(1.0000)
DMTBR3M			-0.96636 *		-0.65416 ***		-0.61381 ***				
			(1.0000)		(1.0000)		(1.0000)				
DMTBR3M_1				0.58489 ***		0.61289 ***					
				(0.7000)		(0.7000)					
MIA / MIE	-0.89144 *	-0.89673 *		-0.75633 ***	0.19252 **	-0.83286 ***	0.22016 **	-0.06296 ***	-0.05795 ***	-0.03698 **	-0.03670 ***
	(0.7000)	(0.7000)		(1.0000)	(1.0000)	(1.0000)	(1.0000)	(0.7000)	(0.7000)	(0.7000)	(0.7000)
MIA_1 / MIE_1	-1.17978 **	-1.16827 **	-0.44537 **	-0.87363 ***	-0.51939 ***	-1.00341 ***	-0.46746 ***	0.06584 ***	0.06494 ***		
	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(0.7000)	(1.0000)		
mp / mpn	-50.87661 **	-51.02827 **	-14.21393 ***							0.07426 ***	0.07384 ***
	(1.0000)	(1.0000)	(1.0000)							(0.4000)	(0.7000)
mp_1 / mpn_1	38.52569 *	38.73934 *			-6.27699 ***		-7.14065 ***				
	(0.7000)	(0.7000)			(1.0000)		(1.0000)				
Dmp				-25.35544 ***		-26.80917 ***					
				(1.0000)		(1.0000)					
MCBR				0.72818 ***		0.79696 ***					
				(1.0000)		(1.0000)					
MCBR_1					0.52440 ***		0.43812 **				
					(1.0000)		(1.0000)				
MCDR_1	22.68787 ***	22.60376 ***	20.87539 ***	6.37966 ***	8.66671 ***	6.60356 ***	9.76167 ***				
	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)				
DMTFR	18.60790 ***	18.53447 ***									
	(1.0000)	(1.0000)									
DMTFR_1	13.98602 *	13.84015 *		4.99032 **		5.37100 **				0.92363 ***	0.91201 ***
	(0.7000)	(0.7000)		(0.4000)		(0.4000)				(1.0000)	(1.0000)
DMLEm					0.95767 *						
					(0.7000)						
DMLEm_1	3.76076 *	3.75923 *			1.19073 **		0.98426 *				
	(1.0000)	(1.0000)			(1.0000)		(1.0000)				
DMLEf				2.32010 ***		2.75900 ***		0.38695 ***	0.40336 ***	0.44964 ***	0.44338 ***
				(1.0000)		(1.0000)		(1.0000)	(1.0000)	(1.0000)	(1.0000)
DMLEf_1				1.85714 ***		2.11636 ***		-0.13620 *	-0.15514 **	-0.11167 *	-0.11573 *
				(1.0000)		(1.0000)		(0.4000)	(0.7000)	(0.7000)	(0.7000)
Adjusted-R^2	0.90143	0.90114	0.88944	0.89328	0.89955	0.90135	0.90306	0.78887	0.78506	0.81370	0.81877
Sigma	2.66417	2.66811	2.82152	0.97976	0.95057	1.07748	1.06814	0.15046	0.15182	0.13316	0.13133
Probability:											
Chow (1998: 1)	0.4138	0.4293	0.0379	0.7505	0.1533	0.7766	0.2068	0.8539	0.6830	0.8867	0.8838
Normality Test	0.6954	0.6737	0.5015	0.0927	0.6268	0.1074	0.2900	0.0876	0.0220	0.5903	0.5700
AR 1-4 Test	0.5412	0.5532	0.5274	0.2380	0.6016	0.1094	0.2602	0.8091	0.8955	0.6611	0.6550
Hetero Test	0.5176	0.5369	0.7046	0.6355	0.2712	0.5370	0.7242	0.9529	0.9857	0.3221	0.3228
Dependent Variable:	MFR1	MFR1	MFR1*	MFR2	MFR2*	MFR3	MFR3*	DMSR	DMSR	DMSRN	DMSRN

Note: (1) The results for SET-1 have a plain background; the results for SET-2 have a shaded background.

(2) The sample period for the three lapse models using forfeiture rate is 1971-2000; the sample period for the lapse model using surrender rate is 1972-2001.

Table 9.37

Summary Results of Final Specific Models (FSMs) for Life Insurance Lapse Models for Variables being Made Constant Using Different Deflation Approaches Using Conservative Strategy (CS) as the Modelling Strategy

Lapse Model Using	Forfeiture Rate 1		Forfeiture Rate 2		Forfeiture Rate 3		Surrender Rate		
	FSM-XII (CS)	FSM-XVII (CS)	FSM-XIII (CS)	FSM-XVIII (CS)	FSM-XIV (CS)	FSM-XIX (CS)	FSM-XV (CS)	FSM-XVI (CS)	FSM-XX (CS)
Constant	-38.84834 *** (1.0000)	-43.66806 *** (1.0000)	-25.14570 *** (1.0000)	-30.69920 *** (1.0000)	-20.28107 *** (1.0000)	-28.26644 *** (1.0000)			
MFR1_1 / MFR3_1 / DMSR_1 / DMSRN_1	0.59459 *** (1.0000)	0.57568 *** (1.0000)			0.48088 *** (1.0000)	0.28133 ** (1.0000)	0.30738 ** (1.0000)	0.30684 ** (1.0000)	0.32776 *** (0.6241)
Dmgdp								-1.03743 *** (0.5622)	-0.59970 ** (0.6178)
Dmgdp_1								0.66553 ** (1.0000)	
Dmipc							-1.04575 *** (0.5508)		
Dmipc_1							0.64004 ** (1.0000)		
MSMR_1	-0.04974 *** (1.0000)	-0.04166 *** (1.0000)	-0.01629 ** (1.0000)	-0.02914 *** (1.0000)	-0.01334 ** (0.3000)	-0.02898 *** (1.0000)	-0.00469 *** (1.0000)	-0.00469 *** (1.0000)	-0.00403 *** (1.0000)
DMSDR							0.06442 ** (1.0000)	0.06313 ** (1.0000)	
DMTBR3M				-0.57006 *** (1.0000)		-0.50497 ** (1.0000)			
MIA			-0.35134 *** (0.7000)		-0.27486 *** (0.6194)		-0.06518 *** (0.7000)	-0.06438 *** (1.0000)	
MIA_1 / MIE_1			-0.33045 *** (1.0000)	-0.39102 *** (1.0000)		-0.33510 *** (1.0000)	0.05200 *** (0.7000)	0.05287 *** (0.7000)	
mp / mpn	-11.18054 *** (1.0000)		-6.60950 *** (1.0000)	-7.38478 *** (1.0000)	-5.89101 *** (1.0000)	-6.95151 *** (1.0000)			
mpn_1		-10.92746 *** (1.0000)							
MCBR_1				0.50693 *** (1.0000)		0.40623 * (0.7000)			
MCDR_1	15.88166 *** (1.0000)	16.86723 *** (1.0000)	10.77741 *** (1.0000)	9.33419 *** (1.0000)	8.50646 *** (1.0000)	8.80462 *** (1.0000)			
DMLEm_1			1.67711 ** (1.0000)						
DMLEf							0.48405 *** (1.0000)	0.48806 *** (1.0000)	0.36179 *** (1.0000)
Adjusted-R^2	0.86242	0.85782	0.81962	0.86763	0.84284	0.89448	0.74571	0.74281	0.59122
Sigma	3.14757	3.19973	1.27377	1.09117	1.36002	1.11436	0.16513	0.16607	0.19724
Probability:									
Chow (1998: 1)	0.4634	0.4090	0.2042	0.1713	0.2822	0.1277	0.6416	0.6481	0.6610
Normality Test	0.0892	0.0411	0.1658	0.8196	0.0802	0.7220	0.5422	0.4749	0.5654
AR 1-4 Test	0.6391	0.4731	0.0736	0.2848	0.3495	0.5091	0.9852	0.9739	0.9800
Hetero Test	0.3150	0.4550	0.5958	0.2693	0.2947	0.3761	0.8583	0.8626	0.6724
Dependent Variable:	MFR1	MFR1*	MFR2	MFR2*	MFR3	MFR3*	DMSR	DMSR	DMSRN

Note: (1) The results for SET-1 have a plain background; the results for SET-2 have a shaded background.

(2) The sample period for the three lapse models using forfeiture rate is 1971-2000; the sample period for the lapse model using surrender rate is 1972-2001.

Table 9.38

Summary Results of Final Specific Models (FSMs) for Life Insurance Lapse Models for Variables being Made Constant Using the Average Annual CPIs as Deflators Using Liberal Strategy (LS) and Conservative Strategy (CS) as the Modelling Strategies

Lapse Model Using	Forfeiture Rate 1			Forfeiture Rate 2		Forfeiture Rate 3		Surrender Rate			
	FSM-I (LS)	FSM-II (LS)	FSM-XII (CS)	FSM-III (LS)	FSM-XIII (CS)	FSM-IV (LS)	FSM-XIV (CS)	FSM-V (LS)	FSM-VI (LS)	FSM-XV (CS)	FSM-XVI (CS)
Constant	-56.98654 ***	-57.16501 ***	-38.84834 ***	-36.90024 ***	-25.14570 ***	-38.84229 ***	-20.28107 ***				
	(0.7000)	(0.7000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)				
MFR1_1 / MFR3_1 / DMSR_1	0.48825 ***	0.48987 ***	0.59459 ***				0.48088 ***	0.37616 ***	0.40052 ***	0.30738 **	0.30684 **
	(1.0000)	(1.0000)	(1.0000)				(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)
Dmgdp											-1.03743 ***
											(0.5622)
Dmgdp_1	-13.49049 **										0.66553 **
	(1.0000)										(1.0000)
Dmipc								-0.83070 ***	-0.98355 ***	-1.04575 ***	
								(0.5462)	(0.7000)	(0.5508)	
Dmipc_1		-13.37009 **		-7.28002 ***		-7.95661 ***		0.76452 ***	0.89699 ***	0.64004 **	
		(1.0000)		(1.0000)		(1.0000)		(1.0000)	(1.0000)	(1.0000)	
MSMR								-0.00166 **	-0.00148 *		
								(0.7000)	(0.7000)		
MSMR_1	-0.06006 ***	-0.06009 ***	-0.04974 ***	-0.04180 ***	-0.01629 **	-0.04789 ***	-0.01334 **	-0.00400 ***	-0.00473 ***	-0.00469 ***	-0.00469 ***
	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(0.3000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)
MRUR	-18.82032 **	-18.55898 **		-11.88673 ***		-13.29512 ***					
	(1.0000)	(1.0000)		(1.0000)		(1.0000)					
MRUR_1	13.71455 **	13.45376 **		6.73021 ***		8.09543 ***					
	(1.0000)	(1.0000)		(1.0000)		(1.0000)					
DMSDR									0.05806 **	0.06442 **	0.06313 **
									(1.0000)	(1.0000)	(1.0000)
DMFDR								0.10995 **			
								(1.0000)			
DMTBR3M_1				0.58489 ***		0.61289 ***					
				(0.7000)		(0.7000)					
MIA	-0.89144 *	-0.89673 *		-0.75633 ***	-0.35134 ***	-0.83286 ***	-0.27486 ***	-0.06296 ***	-0.05795 ***	-0.06518 ***	-0.06438 ***
	(0.7000)	(0.7000)		(1.0000)	(0.7000)	(1.0000)	(0.6194)	(0.7000)	(0.7000)	(0.7000)	(1.0000)
MIA_1	-1.17978 **	-1.16827 **		-0.87363 ***	-0.33045 ***	-1.00341 ***		0.06584 ***	0.06494 ***	0.05200 ***	0.05287 ***
	(1.0000)	(1.0000)		(1.0000)	(1.0000)	(1.0000)		(0.7000)	(1.0000)	(0.7000)	(0.7000)
mp	-50.87661 **	-51.02827 **	-11.18054 ***		-6.60950 ***		-5.89101 ***				
	(1.0000)	(1.0000)	(1.0000)		(1.0000)		(1.0000)				
mp_1	38.52569 *	38.73934 *									
	(0.7000)	(0.7000)									
Dmp				-25.35544 ***		-26.80917 ***					
				(1.0000)		(1.0000)					
MCBR				0.72818 ***		0.79696 ***					
				(1.0000)		(1.0000)					
MCDR_1	22.68787 ***	22.60376 ***	15.88166 ***	6.37966 ***	10.77741 ***	6.60356 ***	8.50646 ***				
	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)				
DMTFR	18.60790 ***	18.53447 ***									
	(1.0000)	(1.0000)									
DMTFR_1	13.98602 *	13.84015 *		4.99032 **		5.37100 **					
	(0.7000)	(0.7000)		(0.4000)		(0.4000)					
DMLEm_1	3.76076 *	3.75923 *			1.67711 **						
	(1.0000)	(1.0000)			(1.0000)						
DMLEf				2.32010 ***		2.75900 ***		0.38695 ***	0.40336 ***	0.48405 ***	0.48806 ***
				(1.0000)		(1.0000)		(1.0000)	(1.0000)	(1.0000)	(1.0000)
DMLEf_1				1.85714 ***		2.11636 ***		-0.13620 *	-0.15514 **		
				(1.0000)		(1.0000)		(0.4000)	(0.7000)		
Adjusted-R^2	0.90143	0.90114	0.86242	0.89328	0.81962	0.90135	0.84284	0.78887	0.78506	0.74571	0.74281
Sigma	2.66417	2.66811	3.14757	0.97976	1.27377	1.07748	1.36002	0.15046	0.15182	0.16513	0.16607
Probability:											
Chow (1998: 1)	0.4138	0.4293	0.4634	0.7505	0.2042	0.7766	0.2822	0.8539	0.6830	0.6416	0.6481
Normality Test	0.6954	0.6737	0.0892	0.0927	0.1658	0.1074	0.0802	0.0876	0.0220	0.5422	0.4749
AR 1-4 Test	0.5412	0.5532	0.6391	0.2380	0.0736	0.1094	0.3495	0.8091	0.8955	0.9852	0.9739
Hetero Test	0.5176	0.5369	0.3150	0.6355	0.5958	0.5370	0.2947	0.9529	0.9857	0.8583	0.8626
Dependent Variable:	MFR1	MFR1	MFR1	MFR2	MFR2	MFR3	MFR3	DMSR	DMSR	DMSR	DMSR

Note: (1) The results for liberal strategy have a plain background; the results for conservative strategy have a shaded background.

(2) The sample period for the three lapse models using forfeiture rate is 1971-2000; the sample period for the lapse model using surrender rate is 1972-2001.

Table 9.39

Summary Results of Final Specific Models (FSMs) for Life Insurance Lapse Models for Variables being Made Constant Using a Combination of Average and End-of-Year CPIs as Deflators Using Liberal Atrategy (LS) and Conservative Strategy (CS) as the Modelling Strategy

Lapse Model Using	Forfeiture Rate 1		Forfeiture Rate 2		Forfeiture Rate 3		Surrender Rate		
	FSM-VII (LS)	FSM-XVII (CS)	FSM-VIII (LS)	FSM-XVIII (CS)	FSM-IX (LS)	FSM-XIX (CS)	FSM-X (LS)	FSM-XI (LS)	FSM-XX (CS)
Constant	-50.24602 ***	-43.66806 ***	-31.36588 ***	-30.69920 ***	-32.92903 ***	-28.26644 ***			
	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)			
MFR1_1 / MFR3_1 / DMSRN_1	0.44959 ***	0.57568 ***			0.21252 *	0.28133 **	0.48268 ***	0.48971 ***	0.32776 ***
	(1.0000)	(1.0000)			(1.0000)	(1.0000)	(1.0000)	(1.0000)	(0.6241)
Dmgdp							-0.73698 ***		-0.59970 **
							(0.4038)		(0.6178)
Dmgdp_1							0.66579 **		
							(1.0000)		
Dmipc								-0.73699 ***	
								(0.4137)	
Dmipc_1								0.66202 **	
								(1.0000)	
MSMR							-0.00316 ***	-0.00314 ***	
							(1.0000)	(1.0000)	
MSMR_1	-0.07141 ***	-0.04166 ***	-0.03276 ***	-0.02914 ***	-0.03013 ***	-0.02898 ***	-0.00462 ***	-0.00461 ***	-0.00403 ***
	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)
MRUR							-0.72967 ***	-0.72709 ***	
							(0.7000)	(0.7000)	
MRUR_1							0.67175 ***	0.66961 ***	
							(0.7000)	(0.7000)	
DMFDR							0.13947 ***	0.14069 ***	
							(1.0000)	(1.0000)	
DMTBR3M	-0.96636 *		-0.65416 ***	-0.57006 ***	-0.61381 ***	-0.50497 **			
	(1.0000)		(1.0000)	(1.0000)	(1.0000)	(1.0000)			
MIE			0.19252 **		0.22016 **		-0.03698 **	-0.03670 ***	
			(1.0000)		(1.0000)		(0.7000)	(0.7000)	
MIE_1	-0.44537 **		-0.51939 ***	-0.39102 ***	-0.46746 ***	-0.33510 ***			
	(1.0000)		(1.0000)	(1.0000)	(1.0000)	(1.0000)			
mpn	-14.21393 ***			-7.38478 ***		-6.95151 ***	0.07426 ***	0.07384 ***	
	(1.0000)			(1.0000)		(1.0000)	(0.4000)	(0.7000)	
mpn_1		-10.92746 ***	-6.27699 ***		-7.14065 ***				
		(1.0000)	(1.0000)		(1.0000)				
MCBR_1			0.52440 ***	0.50693 ***	0.43812 **	0.40623 *			
			(1.0000)	(1.0000)	(1.0000)	(0.7000)			
MCDR_1	20.87539 ***	16.86723 ***	8.66671 ***	9.33419 ***	9.76167 ***	8.80462 ***			
	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)	(1.0000)			
DMTFR_1							0.92363 ***	0.91201 ***	
							(1.0000)	(1.0000)	
DMLEm			0.95767 *						
			(0.7000)						
DMLEm_1			1.19073 **		0.98426 *				
			(1.0000)		(1.0000)				
DMLEf							0.44964 ***	0.44338 ***	0.36179 ***
							(1.0000)	(1.0000)	(1.0000)
DMLEf_1							-0.11167 *	-0.11573 *	
							(0.7000)	(0.7000)	
Adjusted-R^2	0.88944	0.85782	0.89955	0.86763	0.90306	0.89448	0.81370	0.81877	0.59122
Sigma	2.82152	3.19973	0.95057	1.09117	1.06814	1.11436	0.13316	0.13133	0.19724
Probability:									
Chow (1998: 1)	0.0379	0.4090	0.1533	0.1713	0.2068	0.1277	0.8867	0.8838	0.6610
Normality Test	0.5015	0.0411	0.6268	0.8196	0.2900	0.7220	0.5903	0.5700	0.5654
AR 1-4 Test	0.5274	0.4731	0.6016	0.2848	0.2602	0.5091	0.6611	0.6550	0.9800
Hetero Test	0.7046	0.4550	0.2712	0.2693	0.7242	0.3761	0.3221	0.3228	0.6724
Dependent Variable:	MFR1*	MFR1*	MFR2*	MFR2*	MFR3*	MFR3*	DMSRN	DMSRN	DMSRN

Note: (1) The results for liberal strategy have a plain background; the results for conservative strategy have a shaded background.

(2) The sample period for the three lapse models using forfeiture rate is 1971-2000; the sample period for the lapse model using surrender rate is 1972-2001.

CHAPTER 10
EMPIRICAL FINDINGS – A COMPARATIVE STUDY BETWEEN MALAYSIA AND THE UNITED STATES

This chapter discusses the empirical findings of a comparative study between Malaysia and the United States (US) on the demand for and lapsation of life insurance using the two built-in pre-defined liberal and conservative modelling strategies available in PcGets. All of the regression models reported in this chapter use the average and end-of-year consumer price indices (CPIs) as deflators (as appropriate) to convert the flow and stock variables of market values into constant dollar terms with base year 1987. Because the relevant data are not available to compute the price of insurance for the US, the price variable is not considered in the comparative study. The demand variable in the comparative study (defined in terms of life insurance business in force) is different from that in Chapter 8 (which is defined in terms of new life insurance business). Life insurance business in force is used instead of new life insurance business to proxy life insurance demand for two reasons. Firstly, the choice is made so that an analysis is performed using data that have a longer series. The US data for life insurance business in force are available for 1970-2001 in which they have a longer series than the data for new life insurance business that are available only for 1980-2001. Secondly, life insurance business in force has been one of the definitions used by researchers in the past to represent the demand for life insurance so that the use of an alternative representation for life insurance demand would allow us to examine the demand for life insurance from a different perspective. The demand variable is defined by number and by amount (but not by premium because although the data are available in the Insurance Annual Reports of Malaysia but the relevant data for the US are not reported in the Life Insurers Fact Book). Specifically, life insurance demand refers to the number of policies in force per thousand of population and the amount of business in force per capita. The lapse rate in the comparative study refers to the surrender rate calculated using the formula in Eq4.2 (refer to Chapter 4).

The general unrestricted model (GUM) is formulated as an autoregressive distributed lag model with one lag for each of the potential variables [i.e. ADL(1,1)]. All of the data for the potential variables in the GUM are of zero integration. For variables that have a unit root, their first-differenced terms that are stationary are included in the GUM.

Only one proxy representing a variable is allowed to enter the GUM at a time. A total of eight GUMs are formulated for each of the two demand models (by number and by amount) and four GUMs for the lapse models (using the surrender rate). This is because the potential explanatory variables comprise two proxies each for the income, financial development and life expectancy variables and one proxy each for the stock market return, unemployment, interest rate, inflation, crude live-birth rate, crude death rate and total fertility rate variables.

10.1 Presentation of Test Results for the Malaysian Study

This section presents the test results for the Malaysian study and section 10.2 presents the test results for the US study. In both sections, the results on the demand models are presented first and then followed by the results on the lapse models. For each of the models, the results of the liberal strategy are presented first before the results of the conservative strategy.

10.1.1 Demand Model

The GUM for the demand models is formulated as shown below (where "e" is the error term):

$$
\begin{aligned}
&\text{DEMAND}_t \\
&= C_0 + b_0\,(\text{DEMAND}_{t-1}) + b_1\,(\text{Dmgdp}_t \text{ or } \text{Dmipc}_t) + b_2\,(\text{Dmgdp}_{t-1} \text{ or } \text{Dmipc}_{t-1}) \\
&\quad + b_3\,(\text{MSMR}_t) + b_4\,(\text{MSMR}_{t-1}) + b_5\,(\text{DMFD}_t \text{ or } \text{Dmm2}_t) + b_6\,(\text{DMFD}_{t-1} \text{ or } \text{Dmm2}_{t-1}) \\
&\quad + b_7\,(\text{DMTBR1Y}_t) + b_8\,(\text{DMTBR1Y}_{t-1}) + b_9\,(\text{MIE}_t) + b_{10}\,(\text{MIE}_{t-1}) + b_{11}\,(\text{MCBR}_t) \\
&\quad + b_{12}\,(\text{MCBR}_{t-1}) + b_{13}\,(\text{MCDR}_t) + b_{14}\,(\text{MCDR}_{t-1}) + b_{15}\,(\text{DMTFR}_t) + b_{16}\,(\text{DMTFR}_{t-1}) \\
&\quad + b_{17}\,(\text{DMLEm}_t \text{ or } \text{DMLEf}_t) + b_{18}\,(\text{DMLEm}_{t-1} \text{ or } \text{DMLEf}_{t-1}) + e_t
\end{aligned}
$$

The DEMAND variable is life insurance business in force defined in two different ways by number and by amount. Since the original/non-differenced series of life insurance business in force by number per thousand of population and by amount per capita are stationary, their original/non-differenced series (i.e. mnifptp and maifpc) are used for analysis. The inflation rate is the end-of-year inflation rate (MIE).

The (simplified) congruent models derived from the simplification of the GUMs (denoted Model), the simplified models obtained from the union models of the congruent models (labelled as M1, M2, etc. and US1, US2, etc. respectively for Malaysia and the US) and the final specific models (denoted FSM) are summarised in a series of tables. All of the tables (except for Tables 10.20 and 10.24) have the same structure and presentation as the tables used for reporting the results of the demand for and lapsation of life insurance in Malaysia in the previous two chapters. The same organisation for the table is maintained throughout this chapter for reporting the results for this comparative study.

Demand Model by Number. Seven different congruent models are obtained as a result of the simplification using the liberal strategy. The summary results of the congruent models are depicted in Table 10.1. Among the 18 variables appearing in the seven models, three of them have been retained consistently across all of the models: mnifptp_1, MIE and DMTFR_1. For the purpose of a further simplification, two union models are formulated with the 16 variables and one of the two income variables (i.e. either Dmgdp or Dmipc) enters the union models at a time. The simplified models are M1 and M2 which are in fact the same as Model-1 and Model-2 respectively. An encompassing test is performed on M1 (or Model-1) and M2 (or Model-2) in order to select a non-dominated model between them. The results show that M1 and M2 are mutually non-dominating (refer to Table 10.2). M1 and M2 are re-parameterised as the values of the coefficients for Dmm2n and –Dmm2n_1 are approximately the same. The two variables (of Dmm2n and Dmm2n_1) are removed and DDmm2n is introduced instead in order to capture the acceleration of financial development. The two re-parameterised models [i.e. Re-specified M1 (or R-M1 in short) and Re-specified M2 (or R-M2 in short)] are subject to an encompassing test. The test results again show that they are mutually non-dominating (refer to Table 10.3). Thus, they are regarded as the final specific models (i.e. FSM-A and FSM-B).

On the other hand, the simplification process using the conservative strategy has resulted in four different congruent models as exhibited in Table 10.4. A total of eight variables are retained in all of the congruent models. Among them, only MIE has been retained consistently in all of them. A union model comprising all of the eight variables is formulated to be subject to a further simplification. The simplified model is M3 which is identical with Model-1. It is regarded as the final specific model (i.e. FSM-C).

Demand Model by Amount. The simplification of the GUMs using the liberal strategy leads to three different congruent models. The summary results of the models are shown in Table 10.5. A total of 12 variables appear in the three models. For the purpose of a further simplification, a union model is formulated with the inclusion of all the 12 variables appearing in the congruent models. The simplified model is M4 which is indeed Model-1. It is regarded as the final specific model (i.e. FSM-D).

On the other hand, four different congruent models are obtained as a result of the simplification using the conservative strategy. The summary results of the models are displayed in Table 10.6. A total of 10 variables appear in the four congruent models with the constant term, maifpc_1 and MIE being retained consistently in all of the models. A union model that consists of all the 10 retained variables is formulated to be subject to a further simplification. The simplified model is M5 which is equivalent to Model-1. Therefore, it is the final specific model (i.e. FSM-E).

10.1.2 Lapse Model

The GUM for the lapse models is formulated as (where "e" is the error term):

$$
\begin{aligned}
&DMSRN_t \\
&= C_0 + b_0 (DMSRN_{t-1}) + b_1 (Dmgdp_t \text{ or } Dmipc_t) + b_2 (Dmgdp_{t-1} \text{ or } Dmipc_{t-1}) \\
&\quad + b_3 (MSMR_t) + b_4 (MSMR_{t-1}) + b_5 (MRUR_t) + b_6 (MRUR_{t-1}) + b_7 (DMTBR1Y_t) \\
&\quad + b_8 (DMTBR1Y_{t-1}) + b_9 (MIE_t) + b_{10} (MIE_{t-1}) + b_{11} (MCBR_t) + b_{12} (MCBR_{t-1}) \\
&\quad + b_{13} (MCDR_t) + b_{14} (MCDR_{t-1}) + b_{15} (DMTFR_t) + b_{16} (DMTFR_{t-1}) + b_{17} (DMLEm_t \\
&\quad \text{or } DMLEf_t) + b_{18} (DMLEm_{t-1} \text{ or } DMLEf_{t-1}) + e_t
\end{aligned}
$$

The LAPSE variable is the surrender rate. As the original/non-differenced series (i.e. MSRN) of the surrender rate is non-stationary but its first-differenced series (i.e. DMSRN) is stationary, its first-differenced term is used for analysis. The inflation rate is the end-of-year inflation rate (MIE).

Each of the four GUMs is simplified into a congruent model by itself when the liberal strategy is used for modelling. Their summary results are shown in Table 10.7. A total of 18 variables are retained in the four congruent models. Only MIE has been retained consistently in all of the models. Two union models are formulated with the 14 variables, together with either of the income variables defined by GDP (i.e. Dmgdp and Dmgdp_1) or income per capita (i.e. Dmipc and Dmipc_1) entering the models at a time to be subject to a further simplification. The simplified models are M6 and M7. However, it is noted that Model-1 and Model-2 are superior to M6 and M7 by crude observation based on their adjusted-R^2 and σ values. Therefore, attention is also given to Model-1 and Model-2 in the process of searching for the base model(s) in order to derive the final specific model(s). Initially, the encompassing tests are conducted on the following six pairs of models: (M6 and M7), (Model-1 and Model-2), (Model-1 and M6), (Model-1 and M7), (Model-2 and M6) and (Model-2 and M7). The encompassing test results show that M6 and M7 are mutually non-dominating (refer to Table 10.8) but the results are uncertain in identifying a non-dominated model between Model-1 and Model-2 (refer to Table 10.9). Further, the encompassing test results clearly show that Model-1 and Model-2 are more dominant models than M6 and M7 (refer to Tables 10.10–10.13). Thus, Model-1 and Model-2 are used as the base models to derive the final specific model(s). Model-1 and Model-2 are re-specified so that DDmipc and DDmgdp are used in place of (Dmipc and Dmipc_1) and (Dmgdp and Dmgdp_1) respectively in order to capture the acceleration of income. This is because the estimated coefficients for the two income variables have a different sign and are of approximately the same magnitude: –Dmipc=0.86856 and Dmipc_1=0.83619 in Model-1; –Dmgdp= 0.86493 and Dmgdp_1=0.83456 in Model-2. As the encompassing test is unable to identify a non-dominated model between the two re-specified models [i.e. Re-specified Model-1 (or R-Modell in short) and Re-specified Model-2 (or R-Model2 in short)] (refer to Table 10.14), they are regarded as the final specific models (i.e. FSM-F and FSM-G respectively).

On the other hand, when the conservative strategy is used for modelling, each of the four GUMs again is simplified into a congruent model by itself. Their summary results are exhibited in Table 10.15. A total of eight variables is retained in the four models. No variable has been retained consistently in all of the models. Two union models are formulated with the six variables along with either of the income variables (i.e. either Dmgdp or Dmipc) enters the models at a time for a further simplification. The simplified models are M8 and M9. However, through crude observation, Model-1 seems to be superior to M8 and M9 judging by their adjusted-R^2 and σ values. Therefore, consideration is also given to Model-1 in order to obtain the final specific model(s). In order to select a non-dominated model among M8, M9 and Model-1 to be the base model(s) for deriving the final specific model(s), an encompassing test is conducted between two of them at each time. The encompassing test results reveal that M9 is more dominant than M8 (refer to Table 10.16). Further, another encompassing test results indicate that Model-1 appears to be more dominant than M9 (refer to Table 10.17). Variance dominance is transitive; since M9 variance dominates M8 and Model-1 variance dominates M9, then Model-1 variance dominating M8 must hold; i.e. M9$\succ$M8 and Model-1$\succ$M9, then Model-1$\succ$M9$\succ$M8 must be true (where the symbol "$\succ$" indicates greater variance dominance). Therefore, Model-1 is regarded as the final specific model (i.e. FSM-H).

10.2 Presentation of Test Results for the US Study

This section presents the test results for the US study. It has the same format of presentation as section 10.1.

10.2.1 Demand Model

The GUM for the demand models is as shown below (where "e" is the error term):

$$
\begin{aligned}
&DEMAND_t \\
&= C_0 + b_0\,(DEMAND_{t-1}) + b_1\,(usgdp_t \text{ or } usipc_t) + b_2\,(usgdp_{t-1} \text{ or } usipc_{t-1}) + b_3\,(USSMR_t) \\
&\quad + b_4\,(USSMR_{t-1}) + b_5\,(USFD_t \text{ or } usm2_t) + b_6\,(USFD_{t-1} \text{ or } usm2_{t-1}) + b_7\,(DUSTBR1Y_t) \\
&\quad + b_8\,(DUSTBR1Y_{t-1}) + b_9\,(USIE_t) + b_{10}\,(USIE_{t-1}) + b_{11}\,(DUSCBR_t) + b_{12}\,(DUSCBR_{t-1}) \\
&\quad + b_{13}\,(DUSCDR_t) + b_{14}\,(DUSCDR_{t-1}) + b_{15}\,(USTFR_t) + b_{16}\,(USTFR_{t-1}) + b_{17}\,(DUSLEm_t \\
&\quad \text{or } DUSLEf_t) + b_{18}\,(DUSLEm_{t-1} \text{ or } DUSLEf_{t-1}) + e_t
\end{aligned}
$$

The DEMAND variable is life insurance business in force defined by number and by amount. The original/non-differenced series (i.e. usnifptp and usaifpc) of life insurance business in force by number per thousand of population and by amount per capita are non-stationary but their first-differenced series (i.e. Dusnifptp and Dusaifpc) are stationary, therefore their first-differenced terms are used for analysis. The inflation rate is the end-of-year inflation rate (USIE).

Demand Model by Number. The eight GUMs are simplified into seven different congruent models using the liberal strategy. The summary results of the models are shown in Table 10.18. A total of 22 variables appear in the seven congruent models. No specific variable has been retained consistently across all of the models. In order to simplify further, four union models comprising the 16 common variables together with a combination of the income [i.e. either (usgdp and usgdp_1) or usipc_1] and financial development [i.e. either (usm2 and usm2_1) or USFD_1] variables are formulated in the following manner: the 16 common variables together with (i) (usgdp and usgdp_1) and (usm2 and usm2_1), (ii) (usgdp and usgdp_1) and USFD_1, (iii) usipc_1 and (usm2 and usm2_1) and (iv) usipc_1 and USFD_1. The simplified models are US1, US2, US3 and US4 respectively. US2 is indeed Model-1 (i.e. US2=Model-1). US3 is a subset of US1 (i.e. US3⊂US1) while US3 and US4 are a subset of US2 (i.e. US3 and US4 ⊂ US2). Therefore, US1 and US2 are more dominant than US3 and US4. In order to select a non-dominated model between US1 and US2, an encompassing test is performed and the results reveal that US2 is more dominant than US1 (refer to Table 10.19). As a result, US2 is regarded as the final specific model (i.e. FSM-a).

On the other hand, when the conservative strategy is used for simplification, only one congruent model with the total fertility rate variable retained in the model is obtained (refer to Table 10.20 for the summary results of the model). It is regarded as the final specific model (i.e. FSM-b).

Demand Model by Amount. The simplification using the liberal strategy produces five different congruent models. The summary results are displayed in Table 10.21. A total of 14 variables appear in the five models. No variable has been retained consistently throughout all of the models. For the purpose of a further simplification, two union models are formulated with the inclusion of the 11 variables along with the income variables of either usgdp or (usipc and usipc_1) entering the models at a time. The simplified models are US5 and US6. The encompassing test performed on US5 and US6 shows that the latter is more dominant than the former (refer to Table 10.22). Thus, US6 is regarded as the final specific model (i.e. FSM-c).

On the other hand, four different congruent models are obtained from the simplification using the conservative strategy. The summary results of the models are exhibited in Table 10.23. A total of seven variables are retained in the four models. Two union models are formulated to be subject to a further simplification. The union models include one type of the two income variables [i.e. either usgdp or (usipc and usipc_1)] with the other four variables. The simplified models are US7 and US8 which are identical and the same as Model-1. Therefore, it is regarded as the final specific model (i.e. FSM-d).

10.2.2 Lapse Model

The GUM for the lapse models is as below (where "e" is the error term):

$$\begin{aligned} &DUSSR_t \\ &= C_0 + b_0 (DUSSR_{t-1}) + b_1 (usgdp_t \text{ or } usipc_t) + b_2 (usgdp_{t-1} \text{ or } usipc_{t-1}) \\ &\quad + b_3 (USSMR_t) + b_4 (USSMR_{t-1}) + b_5 (DUSUR_t) + b_6 (DUSUR_{t-1}) \\ &\quad + b_7 (DUSTBR1Y_t) + b_8 (DUSTBR1Y_{t-1}) + b_9 (USIE_t) + b_{10} (USIE_{t-1}) \\ &\quad + b_{11} (DUSCBR_t) + b_{12} (DUSCBR_{t-1}) + b_{13} (DUSCDR_t) + b_{14} (DUSCDR_{t-1}) \\ &\quad + b_{15} (USTFR_t) + b_{16} (USTFR_{t-1}) + b_{17} (DUSLEm_t \text{ or } DUSLEf_t) + b_{18} (DUSLEm_{t-1} \\ &\quad \text{or } DUSLEf_{t-1}) + e_t \end{aligned}$$

The LAPSE variable is the surrender rate. The original/non-differenced series (i.e. USSR) of the surrender rate is non-stationary but its first-differenced series (i.e. DUSSR) is stationary, hence its first-differenced term is used for analysis. The inflation rate is the end-of-year inflation rate (USIE).

When the four GUMs are subject to simplification using the liberal strategy, it has resulted in only one congruent model with the change in the Treasury one-year yield in the previous period being the single variable that is retained in the model. Hence, it is regarded as the final specific model (i.e. FSM-e). These results are summarised in Table 10.24.

On the other hand, when the GUMs are subject to simplification using the conservative strategy, it is not surprising that the more stringent simplification criteria have resulted in no variables being retained in any of the simplified models. Therefore, there is no final specific model when the conservative strategy is used for modelling.

10.3 Presentation of Test Results for Cointegration and Error Correction Model (ECM)

For the model where the dependent variable is non-stationary and has a unit root, further analysis is carried out to examine whether it is integrated with the explanatory variables that also have a unit root and which are retained in the final specific model. If cointegration is present, there is a long-term relationship among the variables. Their relationship can be expressed as an ECM, enabling the examination of the short-run properties of the long-run relationship among the variables.

For Malaysia, the cointegration analysis is performed for the lapse model. This is because the dependent variable (i.e. the surrender rate) has a unit root so that a cointegration test can be conducted to investigate whether the surrender rate and the explanatory variables that also have a unit root (which are retained in FSM-F, FSM-G and FSM-H) such as the GDP, income per capita and life expectancy at birth for females are cointegrated.

For the US, the analysis of cointegration is performed for the demand models by number and by amount and also the lapse model. The variables of interest in these models such as the number of life policies in force per thousand of population, the amount of life insurance in force per capita and the surrender rate respectively have a unit root. Hence, the cointegration test can be carried out to verify whether each of them is cointegrated with the explanatory variables that also have a unit root which are retained in their respective final specific models. For example, for the demand model by number, the cointegration test is conducted to examine whether the number of life policies in force per thousand of population and the explanatory variables that have a unit root retained in FSM-a such as the interest rate, crude live-birth rate, crude death rate and life expectancy at birth for males are cointegrated. For the demand model by amount, the cointegration test is performed to check whether the amount of life insurance in force per capita and the explanatory variables that have a unit root retained in FSM-c such as the interest rate, crude live-birth rate, crude death rate and life expectancy at birth for females are cointegrated. For the lapse model, the cointegration test is conducted for the surrender rate and the Treasury one-year yield (being the explanatory variable that has a unit root retained in FSM-e).

Lapse Model with Income per Capita as Income Variable for Malaysia. The preliminary regression model is formulated as

$$\boxed{MSRN_t = \alpha_0 + \alpha_1(mipc_t) + \alpha_2(MLEf_t) + Resid1_t}$$

where Resid1 is the error term. The results reveal that the estimated parameters of the income and life expectancy variables are statistically not different from zero (i.e. α_1=α_2=0) (refer to Table 10.25). Since both the explanatory variables are insignificant, further analysis is not undertaken.

Lapse Model with GDP as Income Variable for Malaysia. To begin with, the preliminary regression model is formulated as

$$\boxed{MSRN_t = \alpha_3 + \alpha_4(mgdp_t) + \alpha_5(MLEf_t) + Resid2_t}$$

where Resid2 is the error term. The results show that the estimated parameters of the life expectancy variable is insignificant (i.e. α_5=0) (refer to Table 10.26). Therefore, the regression model is re-estimated by removing the insignificant variable:

$$\boxed{MSRN_t = \alpha_6 + \alpha_7(mgdp_t) + Resid3_t}$$

where Resid3 is the error term. In the re-estimated regression model, although the significance of the constant term and the income variable has improved further but the model suffered from the problem of residual autocorrelation (p=0.0005) (refer to Table 10.27). Since the long-run regression model is not robust, efforts are not pursued to perform further analysis.

Demand Model by Number for the US. The following regression model is formed at the initial stage:

$$\boxed{usnifptp_t = \alpha_8 + \alpha_9(USTBR1Y_t) + \alpha_{10}(USCBR_t) + \alpha_{11}(USCDR_t) + \alpha_{12}(USLEm_t) + Resid4_t}$$

where Resid4 is the error term. From Table 10.28, the preliminary results show that all of the variables are highly significant except for the crude live-birth rate. USCBR is found to be not significant, i.e. α_{10}=0. Then, the regression model is re-estimated by excluding the insignificant variable:

$$\boxed{usnifptp_t = \alpha_{13} + \alpha_{14}(USTBR1Y_t) + \alpha_{15}(USCDR_t) + \alpha_{16}(USLEm_t) + Resid5_t}$$

where Resid5 is the error term. In the re-estimated regression model (refer to Table 10.29), all of the variables are significant. The model also passes all of the mis-specification tests (but it only marginally passes the residual autocorrelation test, i.e. p=0.0135 against the pre-specified significance level of 0.01).

The residuals of the re-estimated regression model (i.e. Resid5) are then subjected to unit root analysis. The Dickey-Fuller (DF) unit root test is applied to the residuals in order to examine the stationarity property of the residuals. The unit root test results indicate that the test statistic (i.e. –3.0646) is more negative than the critical value at 1% for the cointegration test (i.e. –2.5899) so that the unit root hypothesis is rejected (refer to Table 10.30). Therefore, the residuals are stationary. This implies that usnifptp, USTBR1Y, USCDR and USLEm are cointegrated, so that they have a long-term relationship. As the residuals of the re-estimated regression model are stationary, the re-estimated regression model is the cointegrating regression model for usnifptp, USTBR1Y, USCDR and USLEm. Since cointegration is present among these variables, a further step is taken to investigate their short-run dynamics through an ECM. Similar to the formation of the GUM in the main analysis, the ECM is formulated as an autoregressive distributed lag model with one lag for each of the potential variables [i.e. ADL(1,1)] as shown below:

$$\begin{aligned}\text{Dusnifptp}_t = \; & \varphi_1 + \lambda_1(\text{Resid5}_{t-1}) + \omega_0(\text{Dusnifptp}_{t-1}) + \omega_1(\text{DUSTBR1Y}_t) + \omega_2(\text{DUSTBR1Y}_{t-1}) \\ & + \omega_3(\text{DUSCDR}_t) + \omega_4(\text{DUSCDR}_{t-1}) + \omega_5(\text{DUSLEm}_t) + \omega_6(\text{DUSLEm}_{t-1}) + \varepsilon_{1t}\end{aligned}$$

where "ε_1" is the error term. From the ECM results presented in Table 10.31, it is noted that the estimated parameter of Resid5_{t-1} is positive (i.e. λ_1=0.47203). It fails to meet the requirement that $\lambda<0$. In an ECM, the stability condition (i.e. $\lambda<0$) must hold in order to ensure that the equilibrium errors are "corrected" so that the equilibrium is restored in the following period. When λ is positive, this violates the assumption as the equilibrium errors will be magnified and there is no sign that equilibrium will be restored. As the estimated parameter for λ does not fulfil the stability condition required for an ECM, the model is abandoned.

Demand Model by Amount for the US. Initially, the preliminary regression model is formulated as:

$$\text{usaifpc}_t = \alpha_{17} + \alpha_{18}(\text{USTBR1Y}_t) + \alpha_{19}(\text{USCBR}_t) + \alpha_{20}(\text{USCDR}_t) + \alpha_{21}(\text{USLEf}_t) + \text{Resid6}_t$$

where Resid6 is the error term. The results for the regression model are displayed in Table 10.32 All of the variables are significant and the model passes all of the mis-specification tests. The residuals of the regression model (i.e. Resid6) are saved. The DF unit root test is used to test whether the residuals are stationary or not (refer to Table 10.33). As the test statistic (i.e. –3.3646) is more negative than the critical value at 1% for the cointegration test (i.e. –2.5899), the unit root hypothesis is rejected indicating that the residuals are stationary. It can be concluded that cointegration is present among usaifpc, USTBR1Y, USCBR, USCDR and USLEf. Therefore, there is a long-term relationship among them and their short-run behaviours can be expressed as an ECM as:

$$\begin{aligned}\text{Dusaifpc}_t = \; & \varphi_2 + \lambda_2(\text{Resid6}_{t-1}) + \omega_7(\text{Dusaifpc}_{t-1}) + \omega_8(\text{DUSTBR1Y}_t) + \omega_9(\text{DUSTBR1Y}_{t-1}) \\ & + \omega_{10}(\text{DUSCBR}_t) + \omega_{11}(\text{DUSCBR}_{t-1}) + \omega_{12}(\text{DUSCDR}_t) + \omega_{13}(\text{DUSCDR}_{t-1}) \\ & + \omega_{14}(\text{DUSLEm}_t) + \omega_{15}(\text{DUSLEm}_{t-1}) + \varepsilon_{2t}\end{aligned}$$

where "ε_2" is the error term. The ECM estimation for this demand model (refer to Table 10.34) experiences the same problems as faced by the demand model by number (refer to Table 10.31). It fails to produce a sensible estimate for λ_2 (i.e. the stability condition of $\lambda<0$ is not met). As a consequence, the model is also abandoned.

Lapse Model for the US. The preliminary regression model is constructed as:

$$USSR_t = \alpha_{22} + \alpha_{23}(USTBR1Y_t) + Resid7_t$$

where Resid7 is the error term. The estimated model is not robust as its residuals are found to be serially correlated ($p<0.0001$) and the model only marginally passes the other two mis-specification tests, namely the heteroscedasticity test and normality test (refer to Table 10.35). Since the long-run regression model does not have a sound specification, no efforts are taken to conduct the cointegration test and the ECM estimation.

10.4 Discussion of Results

For the convenience of reference, all of the final specific models for the various models using the different modelling strategies for Malaysia and the US are compiled in Tables 10.36 (i.e. contains FSM-A to FSM-H) and 10.37 (i.e. contains FSM-a to FSM-e) respectively.

10.4.1 Demand Model by Number

Malaysia. Table 10.36 is referred. The liberal modelling strategy has identified nine factors to be related significantly to the number of policies in force per thousand of population in each of its two final specific models (i.e FSM-A and FSM-B). The demand level in the previous period, the anticipated change in income, the acceleration of financial development (using the simple measure, i.e. the broad definition of money or M2), the anticipated inflation rate, the crude live-birth rate in the previous period and the change in total fertility rate in the previous period have a positive relationship whereas the anticipated stock market return, the crude death rate in the previous period and the change in the life expectancy at birth for males in the previous period have a negative relationship with the number of policies in force per thousand of population.

We note that the two final specific models of the liberal strategy with a different income variable retained in their models (i.e. FSM-A and FSM-B with GDP and income per capita as the income variable respectively) are equally good in explaining the variance in the number of policies in force per thousand of population (i.e. their adjusted-R^2=0.99949 and σ=0.0178).

On the other hand, the conservative modelling strategy has identified a slightly smaller number of factors to be related significantly to the number of policies in force per thousand of population. Among the seven variables retained in the final specific model of the conservative strategy (i.e. FSM-C), five of them are subset variables that are retained in the final specific models of the liberal strategy (i.e. FSM-A and FSM-B). The findings indicate that when a more stringent strategy is used for modelling, the five variables which are the demand level in the previous period, the anticipated inflation rate, the crude live-birth rate in the previous period, the crude death rate in the previous period and the change in the life expectancy at birth for males in the previous period still emerge to have an important relationship with the number of policies in force per thousand of population. Meanwhile, the other two variables retained in the final specific model of the conservative strategy (i.e. FSM-C) are the anticipated and past changes in financial development.

US. Table 10.37 is referred. The liberal modelling strategy has discovered 14 important factors to be associated with the change in the number of policies in force per thousand of population (refer to FSM-a). The GDP in the previous period, the anticipated change in the Treasury one-year yield, both the anticipated and past changes in crude live-birth rate and the total fertility rate in the previous period have a positive relationship with the change in the number of policies in force per thousand of population. Meanwhile, the demand level in the previous period, the stock market return in the previous period, the financial development [using the complicated measure, i.e. the percentage calculated as the ratio of quasi-money (M2–M1) to broad money (M2)] in the previous period, the inflation rate in the previous period, both the anticipated and past changes in crude death rate, the anticipated total fertility rate and both the anticipated and past changes in the life expectancy at birth for males have a negative relationship with the change in the number of policies in force per thousand of population.

On the other hand, when the conservative strategy is used for modelling, the number of variables retained in the final specific model (i.e. FSM-b) is reduced drastically to merely one variable. Only the anticipated total fertility rate which is retained in the final specific model of the liberal strategy (i.e. FSM-a) is found to have a significant negative relationship with the change in the number of policies in force per thousand of population under the conservative strategy.

Malaysia vs US. Tables 10.36 and 10.37 are referred. Comparing the results between Malaysia and the US, broadly speaking, the variables such as the demand level in the previous period, income, stock market return, financial development, inflation, crude live-birth rate, crude death rate, total fertility rate and life expectancy at birth for males are found to have an important relationship with life insurance business in force by number in the two countries. However, the relationship between life insurance business in force by number and the following four variables, namely the demand level in the previous period, financial development, inflation rate and total fertility rate, for Malaysia and the US are not consistent. Further, the interest rate is found to have a significant relationship with life insurance business in force by number in the US only.

Malaysia: Demand Models Using Business in Force vs Demand Models Using New Business. Tables 10.36 and 8.36 are referred. A comparison between these two models shows that the demand level in the previous period, stock market return and total fertility rate have a significant relationship with both the demand for life insurance defined using business in force and new business. Although financial development, inflation and crude live-birth rate also are found to have an important association with life insurance demand for the two models, their findings are inconsistent. On the other hand, income, crude death rate and life expectancy at birth are found to have an important relationship with life insurance business in force only, whilst the savings deposit rate is found to be related significantly to new life insurance business only.

The discussions below highlight the findings on the various factors affecting life insurance business in force by number in Malaysia and the US in more detailed.

Consumers' Ability to Buy and the Size of the Potential Market. Income level does not seem to have a strong relationship with life insurance business in force by number. Even though disposable income tends to be associated directly with life insurance business in force by number in Malaysia and the US when the liberal strategy is used for simplification (refer to Tables 10.1 and 10.18), the income variables have been removed from the models eventually when the conservative strategy is used for simplification (refer to Tables 10.4 and 10.20).

The performance of the stock market also is found not to have a strong relationship with life insurance business in force by number in Malaysia and the US. This is because when subject to a more stringent simplification, none of the stock market return variables are retained in the congruent models of the conservative strategy (refer to Tables 10.4 and 10.20). Further, the estimated parameters of the stock market return variable do not have the expected positive sign suggesting that a booming stock market is not associated with a higher volume of life insurance business in force by number. Nevertheless, it is beyond the scope of this study to consider the hypothesis that the decline in the number of policies in force may be a result of an increase in the amount of life insurance that has been effected per policy.

Financial development appears to have an important association with life insurance business in force by number in Malaysia and the US but the findings for the two countries are mutually contradictory. A more developed financial market, especially in the banking sectors, in Malaysia is more frequently linked with a higher level of life insurance business in force by number. In contrast, a more sophisticated financial structure in the US tends to be related to a lower level of life insurance business in force by number.

It is interesting to note that financial development defined as the broad definition of money (i.e. Dmm2, its lag and differenced-term) which is a simple indicator to gauge the liquidity of private sector is retained in the final specific models of Malaysia (i.e. FSM-A, FSM-B and FSM-C). On the other hand, financial development defined as the percentage calculated as the ratio of quasi-money (M2–M1) to broad money (M2) which is a more complicated indicator to reflect the complexity of financial structure is retained in the final specific model of the US (i.e. FSM-a). For Malaysia, in fact the more complicated measure for financial development (i.e. DMFD and its lag) is not retained in any of the congruent models (refer to Tables 10.1 and 10.4). For the US, the simple measure for financial development (i.e. usm2 and its lag) is retained in US1 (refer to Table 10.18). However, US2, which contains the more complicated measure for financial development (i.e. USFD_1) along with other explanatory variables, is verified by the encompassing test to be a more dominant model than US1 (refer to Table 10.19). In other words, US2 has a combination of variables that is better than US1 in which the variables in US2 collectively can explain a larger proportion of the variance of the change in the number of policies in force per thousand of population with a smaller regression standard error (i.e. adjusted-R^2=0.42938 and σ=0.01434 in US2; adjusted-R^2=0.35292 and σ=0.01527 in US1).

The findings on financial development of this study are not in total agreement with the findings of Outreville (1996) who has investigated three different measurements for financial development in his study. His findings show that, only when financial development is defined as the percentage calculated as the ratio of quasi-money to broad money (which is the more complicated measure for financial development in this study), is it found to be related significantly to the growth of life insurance business in the 48 developing countries. However, when financial development is defined based on the other two definitions, i.e. the broad definition of money (which is the simple measure for financial development in this study) and the ratio of M2 to the nominal GDP, they are statistically insignificant. Contrary to the findings of Outreville (1996), the results from the regression models for Malaysia have proven otherwise that the broad definition of money is deemed to be an appropriate proxy for financial development for a developing country like Malaysia (because banking is the predominant sector in its financial market). On the other hand, both the simple and more complicated measures for financial development are found to be statistically significant in the US regression models. However, the more complicated measure for financial development appears to be a better variable (collectively with other explanatory variables) than the simple measure for financial development (jointly with other explanatory variables) in explaining the variance of the change in the number of policies in force per thousand of population.

Based on the above, the findings on income and stock market return are consistent for Malaysia and the US. However, they do not have a strong relationship with life insurance business in force by number. Having a higher income enhances the consumers' ability to acquire new policies and to retain their existing policies but a booming stock market does not seem to be associated with a higher level of life insurance business in force by number of policies. On the other hand, the findings on financial development are inconsistent for the two countries. A better developed financial market tends to be related to a higher level of life insurance business in force by number in Malaysia but the opposite holds for the US.

Consumers' Decisions on Savings and the Accumulation of Financial Assets. The interest rate examined in the comparative study is the discount rate on one-year treasury bills. The interest rate variable is not retained in the regression models of Malaysia indicating that the average discount rate on 12-month treasury bills is not a major factor in the decision process of the consumers/policyholders both in purchasing new policies and in preserving their old policies. On the other hand, the Treasury one-year yield is found to be related significantly to the growth of life insurance business in force by number in the US but the estimated coefficient does not have the expected negative sign. The unexpected finding suggests that a more attractive yield on the US Treasury does not seem to discourage the consumers from owning life insurance.

Consumers' Purchasing Power in Acquiring Financial Assets. The anticipated inflation rate is associated positively and significantly with life insurance business in force by number in Malaysia while the inflation rate in the previous period is associated negatively and significantly with life insurance business in force by number in the US. It is an unexpected result that an environment of rising inflation rate in Malaysia does not seem to hamper the desired of the consumers/policyholders from buying new policies and retaining their current policies. On the other hand, we have an expected result that inflation has a negative impact on the ownership of life insurance for the case of the US. When the US economy is experiencing a high inflation rate in the previous year, this tends to be linked with a decline in the number of life policies in force.

Demographic Characteristics of the Population. The findings reveal that the demographic factors seem to have a critical effect, especially a lagged influence, on life insurance business in force by number. All of the four demographic factors examined in this study, namely the crude live-birth rate, crude death rate, total fertility rate and life expectancy at birth, are found to have a significant relationship with life insurance business in force by number.

A higher crude live-birth rate tends to support a higher level of life insurance business in force by number. The explanation for this finding may be that the arrival of a new family member would have prompted the consumers/policyholders to acquire new policies and to maintain their present policies because life insurance is a security nest for the family for financial protection if the primary income earner of the family should die prematurely.

The findings on the crude death rate for both countries do not substantiate the proposition that it is hypothesised to be related positively to the demand for life insurance. The unexpected negative relationship indicates the converse of the common belief that the policyholders would tend to ensure the persistency of their life policies when the probability of death is high. One of the possible reasons may be that the crude death rate is not a good proxy for the average death rate because of its dependence on the underlying age structure of the population.

The findings on the total fertility rate for Malaysia and the US are inconsistent. The change in total fertility rate in the previous period tends to be related positively to life insurance business in force by number in Malaysia. When the family size is expected to grow bigger, the policyholders tend to continue to keep their life policies in force. Life insurance may be regarded as a desirable instrument in Malaysia in order to maintain the living standard of the dependants should they lose the support of the major wage earner in the family. On the other hand, the findings on the total fertility rate for the US are mixed. The anticipated total fertility rate is related negatively but the rate in the previous period is related positively to life insurance business in force by number in the US. Further, when the conservative strategy is used for modelling, the anticipated total fertility rate appears to be the single key factor that is related negatively and significantly to life insurance business in force by number in the US. Even so, the contribution of this demographic factor is small as it is only able to explain about 1.5% of the variance of the change in life insurance business in force by number in the US.

Life expectancy at birth for males (but not the females) is found to have a significant negative relationship with life insurance business in force in Malaysia and the US. The findings are in line with the expectation. This possibly could be explained by the fact that when people generally are living longer, it would be natural for them to postpone their decision on the ownership of life insurance to a later stage in order to take advantage of other investment opportunities. Furthermore, when life expectancy is longer, the insurance premium charged at each age category tends to be revised downwards to reflect the lower risk level assumed by life insurers.

The findings reveal that males have a stronger gender effect than females with respect to life expectancy at birth in its relationship with life insurance business in force by number. This may be due to the social structure of Malaysia where the males (such as a father) normally act as the head of a household and they shoulder the role as the main income earner in the family. In view of their heavy responsibility in taking care of their family, they tend to have a life policy providing insurance for them or possibly a number of life policies in force in order to protect their dependants from their premature death so that the chance is also higher that they may fail to keep their life policies in force during their (average longer) lifetime.

Based on the above, the findings on crude live-birth rate, crude death rate and life expectancy at birth for males are consistent for Malaysia and the US. A higher crude live-birth rate tends to support a higher level of life insurance business in force by number in the two countries. Meanwhile, the opposite holds for the relationship between life expectancy at birth and life insurance business in force by number of policies. However, the crude death rate is unexpectedly found to be associated negatively with the number of life policies in force. On the other hand, the findings on total fertility rate are mixed for the US but it tends to be related positively to life insurance business in force by number for Malaysia.

This Study vs Past Studies. No researchers have used the number of policies of life insurance business in force as the demand variable in the past. Therefore, a direct comparison with an equivalent past study is not available for this version of the demand model.

10.4.2 Demand Model by Amount

Malaysia. Table 10.36 is referred. Eight variables are retained in the final specific model of the liberal strategy (i.e. FSM-D) but only six variables are retained in the final specific model of the conservative strategy (i.e. FSM-E) in which the latter is a subset of the former (i.e. FSM-E$\subset$FSM-D). The total fertility rate variables (i.e. DMTFR and DMTFR_1) are forced out of the model when subject to a more stringent simplification. The demand level in the previous period, the change in the level of financial development in the previous period, the inflation rate in the previous period and both the anticipated and past changes in total fertility rate are related positively while the anticipated inflation rate and the anticipated crude death rate are related negatively to the amount of life insurance in force per capita.

US. Table 10.37 is referred. The final specific model of the liberal strategy (i.e. FSM-c) retained eight variables but the final specific model of the conservative strategy (i.e. FSM-d) retains a much smaller number of variables (i.e. three only). In FSM-c, the anticipated income per capita is associated positively while other variables such as the income per capita in the previous period, the anticipated change in the Treasury one-year yield, both the anticipated and past changes in crude death rate, the anticipated total fertility rate and both the anticipated and past changes in the life expectancy at birth for females are associated negatively with the change in the amount of life insurance in force per capita. On the other hand, in FSM-d, the anticipated inflation rate and the anticipated total fertility rate have a significant negative relationship with the change in the amount of life insurance in force per capita.

Malaysia vs US. Tables 10.36 and 10.37 are referred. A comparison of the results between Malaysia and the US reveals that, in general, the inflation rate, crude death rate and total fertility rate have an important relationship with life insurance business in force by amount in both countries. However, the findings on the relationship between life insurance business in force by amount and the inflation and total fertility rates for Malaysia and the US are inconsistent. Income level, interest rate and life expectancy at birth for females appear to be important factors in the US while the level of financial development seems to be crucial in Malaysia in relation to life insurance business in force by amount.

Demand Model by Number vs Demand Model by Amount. Comparing the two demand models for Malaysia (refer to Table 10.36), the demand models by number (i.e. have higher adjusted-R^2 with smaller σ values) appear to have a better goodness of fit than the demand models by amount (i.e. have slightly lower adjusted-R^2 with bigger σ values). The final specific models of the demand model by number (i.e. FSM-A, FSM-B and FSM-C) tend to retain one additional variable as compared with their corresponding final specific models of the demand model by amount (i.e. FSM-D and FSM-E) under the different modelling strategies. The demand level in the previous period, financial development, inflation rate, crude death rate and total fertility rate are the five variables that have a crucial relationship with life insurance business in force by number and by amount in Malaysia. The demand level in the previous period (t−1) is associated positively with the demand level in the following period (t). Both the financial development and inflation rate more frequently are related positively to life insurance business in force by number and by amount. The crude death rate unexpectedly is associated negatively and the total fertility rate is associated positively with life insurance business in force by number and by amount. On the other hand, income level, stock market return, crude live-birth rate and life expectancy at birth are found to have a significant relationship with life insurance business in force by number of policies only.

For the US (refer to Table 10.37), although the demand models by amount tend to have a higher adjusted-R^2 value than the demand models by number, they also tend to have a bigger σ value. The final specific model of the demand model by number (i.e. FSM-a) retains more variables than the final specific model of the demand model by amount (i.e. FSM-c) using the liberal strategy but it is the opposite when the conservative strategy is used for modelling (i.e. FSM-b vs FSM-d). Income levels, the interest rate on treasury bills, inflation rate, crude death rate, total fertility rate and life expectancy at birth are found to have an important relationship with life insurance business in force by number and by amount in the US. Income level is more frequently related positively whereas the total fertility rate is more frequently related negatively to life insurance business in force by number and by amount. The findings on the US Treasury yield are inconsistent, therefore the relationship between the interest rate on treasury bills and life insurance business in force by number and by amount cannot be ascertained. Meanwhile, the inflation rate, crude death rate and life expectancy at birth are found to be associated negatively with life insurance business in force by number and by amount in the US. The demand level in the previous period, stock market return, financial development and crude live-birth rate are found to have a vital relationship with life insurance business in force by number of policies only.

In general, the inflation rate, crude death rate and total fertility rate are the three factors that appear to have a significant relationship with life insurance business in force by number and by amount in Malaysia and the US. The crude death rate consistently is found to have an unexpected negative relationship with life insurance business in force by number and by amount in both countries. However, the findings on inflation rate and total fertility rate are inconsistent between the two countries. The inflation rate is found to have a negative relationship with life insurance business in force by number and by amount in the US but it more frequently tends to be associated positively with life insurance business in force by number and by amount in Malaysia. Meanwhile, the total fertility rate is found to have a positive relationship with life insurance business in force by number and by amount in Malaysia but it more frequently tends to be related negatively with life insurance business in force by number and by amount in the US.

Malaysia: Demand Models Using Business in Force vs Demand Models Using New Business. Tables 10.36 and 8.36 are referred. Only total fertility rate is found to be associated significantly with both the business in force and the new business of life insurance. Although the crude death rate also is found to have an important relationship with life insurance demand, its findings are contradictory for the two demand models.

The demand in the previous period, financial development and inflation are found to have a significant relationship with life insurance business in force only. On the other hand, income, stock market return, savings deposit rate, crude live-birth rate and life expectancy at birth are found to be important factors in relation to new life insurance business only.

The discussions below draw attention to the findings on the various factors affecting life insurance business in force by amount in Malaysia and the US in more detailed.

Consumers' Ability to Buy and the Size of the Potential Market. Income level is not an important determinant affecting life insurance business in force by amount in Malaysia. No income variable has been retained in the congruent models of Malaysia (refer to Tables 10.5 and 10.6). In contrast, income is found to have an important relationship with life insurance business in force by amount in the US. Two types of income are examined in this study but the income per capita (that appeared in Model-1, Model-4 and US6/FSM-c) seems to have a dominant effect over GDP (that appeared in Model-5) on life insurance business in force by amount in the US when the liberal strategy is used for modelling (refer to Table 10.21). The sign of the estimated coefficients for the income variables (i.e. usipc and usipc_1) are inconsistent. Therefore, even though income per capita is identified to be an important factor, its relationship with life insurance business in force by amount in the US cannot be confirmed with certainty. Further, when the conservative strategy is used for modelling, although both types of the income variables are retained in the congruent models (in Model-2 and Model-3) but neither of them is retained in the final specific model (i.e. FSM-d) when the union models are subject to a further simplification (refer to Table 10.23). This suggests that life insurance business in force by amount and income do not have a very strong relationship between them.

The performance of the stock market does not have any influence on life insurance business in force by amount in Malaysia and the US. The stock market return variables are not retained in the regression models of Malaysia (refer to Tables 10.5 and 10.6) and the US (refer to Tables 10.21 and 10.23) at all.

Financial development is found to be crucial in Malaysia (only) and it has a lagged relationship with life insurance business in force by amount. Similar to the findings of the demand models by number, only the simple measure for financial development (defined as M2) is retained in the regression models of Malaysia whereas the more complicated measure for financial development (defined as the percentage calculated as the ratio of quasi-money to broad money) is not retained. This finding firmly provides further evidence that M2 is indeed an adequate measure of financial development for a developing country like Malaysia. As the banking system improves and becomes more efficient in the previous period, more money is available in circulation in the financial market. The private sector becomes more liquid when it is able to mobilise money more easily and this has a positive impact on life insurance industry as it tends to boost a higher level of the amount of life insurance business in force in Malaysia. On the other hand, financial development has a weak relationship with the growth of life insurance business in force by amount in the US. The financial development variable (i.e. usm2_1) is retained in Model-2 and US5 when the liberal strategy is used for simplification (refer to Table 10.21) and in Model-4 when the conservative strategy is used for simplification (refer to Table 10.23) but it is not retained in the final specific models (i.e. FSM-c and FSM-d).

Based on the above findings, income is an important factor affecting life insurance business in force by amount in the US but not in Malaysia. The performance of the stock market does not have any impact on life insurance business in force by amount in both Malaysia and the US. The development in the financial market plays a crucial role in determining the amount of life insurance business in force in Malaysia but not in the US.

Consumers' Decisions on Savings and the Accumulation of Financial Assets. The interest rate variable (i.e. the average discount rate on 12-month treasury bills) is not retained in the regression models for Malaysia indicating that the treasury bills do not appear to be a competing savings product to life insurance. On the other hand, the US Treasury one-year yield is found to have a significant negative relationship with life insurance business in force by amount in the US. The US Treasury can be regarded to be a rival product to life insurance as a savings instrument. When a higher yield is offered by the US Treasury, this tends to be associated with a lower level of the amount of life insurance business in force because rational investors would divert their funds or prefer to invest in a financial asset that can generate a higher rate of return.

Consumers' Purchasing Power in Acquiring Financial Assets. The anticipated inflation rate is found to be associated negatively and significantly with life insurance business in force by amount in Malaysia and the US. The anticipated inflation rate does not appear in the final specific model of the liberal strategy for the US (i.e. FSM-c) but it is retained in four congruent models (i.e. Model-2, Model-3, Model-4 and Model-5) and also is found to have a negative relationship with life insurance business in force by amount (refer to Table 10.21). The negative relationship implies that an inflationary environment affects adversely life insurance business in force by amount. A high inflation rate causes life insurance appears to be an unattractive savings product. However, the inflation rate in the previous period in Malaysia also is found to be significant but it has a positive relationship with the amount of life insurance business in force. The signs for the estimated parameters for the original and lagged inflation variables (i.e. MIE and MIE_1) are inconsistent. Therefore, no conclusion can be made with respect to the findings on inflation for Malaysia.

Demographic Characteristics of the Population. The crude live-birth rate has a weak relationship with life insurance business in force by amount in the US. It is retained in the two of the congruent models (i.e. Model-1 and Model-2) under the liberal strategy but not in the final specific model (i.e. FSM-c) (Refer to Table 10.21). The crude live-birth rate is found to be related positively and significantly to life insurance business in force by amount in the US. This may be because upon the arrival of a new family member (i.e. a new born baby), the policyholders would think that life insurance plays an important role in providing financial protection to the surviving family members against the pre-matured death of the breadwinner so that at this time the need is even greater for the policyholders to keep their life policies in force or to purchase a greater amount of life insurance. Likewise, the crude live-birth rate also has a weak relationship with life insurance business in force by amount in Malaysia. Although the crude live-birth rate variables are retained in the congruent models of the liberal (in Model-2 and Model-3 in Table 10.5) and conservative (in Model-2 in Table 10.6) strategies but none of them is retained in the final specific models (i.e. FSM-D and FSM-E). The signs for the estimated parameters for the original and lagged variables are inconsistent. Therefore, we cannot make a conclusive remark on the relationship between crude live-birth rate and life insurance business in force by amount in Malaysia.

The findings on the crude death rate for Malaysia and the US are consistent between the two countries but the crude death rate unexpectedly is found to have a significant negative relationship with life insurance business in force by amount. The findings do not conform to the expectation that a high probability of death tends to support a higher level of the demand for life insurance.

The findings on total fertility rate are inconsistent between the two countries. The total fertility rate is related positively to the amount of life insurance business in force in Malaysia suggesting that the size of the expected completed family (under the assumption of no time trends in the period age specific fertility rates) is associated directly with the amount of life insurance business in force. Conversely, the finding for the US that the total fertility rate is related negatively to life insurance business in force by amount suggests otherwise.

Life expectancy at birth for females (but not for males) appears to have a significant negative relationship with life insurance business in force by amount in the US. For Malaysia, although life expectancy at birth for females is not retained in the final specific models (i.e. FSM-D and FSM-E), it has been retained in one of the congruent models of the liberal strategy (i.e. Model-2 in Table 10.5). It also has a significant negative relationship with life insurance business in force by amount. The findings substantiate the proposition that life expectancy at birth is related negatively to life insurance demand. This could possibly due to the delay in the ownership of life insurance when people generally have a longer life span. Further, it is noted that the life expectancy at birth for males has not been retained in any of the regression models of Malaysia and the US. This finding indicates that the life expectancy at birth for the females has a dominant gender effect over the males in its relationship with life insurance business in force by amount. The finding for this demand model (by amount) is different from that for the demand model by number (refer to section 10.4.1) which reveals that males have a stronger gender effect than females with respect to life expectancy at birth in its relationship with life insurance business in force by number. As this stage, we are not sure what causes the gender difference for life expectancy at birth in relation to life insurance business in force measured by number and by amount. Further research is warranted to investigate this issue more deeply.

Based on the above, the findings on crude death rate are consistent for Malaysia and the US. Although the crude death rate is an important factor, it unexpectedly has a negative relationship with life insurance business in force by amount. The findings on crude live-birth rate and total fertility rate are inconsistent between the two countries. The crude live-birth rate is associated positively with life insurance business in force by amount in the US but its relationship with life insurance business in force by amount in Malaysia cannot be ascertained. Meanwhile, the total fertility rate is found to be related positively to life insurance business in force by amount in Malaysia but it is the opposite in the US. Further, life expectancy at birth is found to be related negatively with life insurance business in force by amount in the US only.

This Study vs Past Studies. Truett and Truett (1990) and Browne and Kim (1993) have used a similar definition of life insurance demand in their studies. In the comparative study of Truett and Truett (1990), the demand for life insurance refers to the amount of insurance in force per economically active population for Mexico and the amount of insurance in force per family for the US. In the study of Browne and Kim (1993), the demand for life insurance refers to the amount of life insurance in force per capita. Therefore, a comparison of the findings can be made between their studies and this study.

The findings of Truett and Truett (1990) show that the levels of disposable income of the population in Mexico and the US are found to be associated positively and significantly with the demand for life insurance. Likewise, the findings of Browne and Kim (1993) also reveal that income per capita has a significant positive relationship with the demand for life insurance. However, the findings of this study do not confirm their findings. Only the findings of the demand models by number using the liberal strategy for Malaysia lend support to their findings – i.e. the disposable income is found to be related positively to the number of life policies in force. When individuals and families have a higher disposable income, this tends to encourage the ownership of life insurance in order to protect the living standard of their dependants in case they lose support from the primary income earner. On the other hand, the relationship between disposable income and life insurance business in force in the US cannot be ascertained because the estimated coefficients of the income variables have inconsistent signs.

Browne and Kim (1993) also find that the number of dependants has a direct significant relationship while inflation has an inverse significant relationship with the demand for life insurance. Further, their findings show that life expectancy at birth and the death rate among 30-34-year-old males (in which both are used to proxy the probability of death) are insignificant factors affecting the demand for life insurance.

If the total fertility rate is interpreted to be the average number of children that would be born to a woman during her lifetime, implying the expected completed family size (in the absence of further secular trends in fertility rates) (http://www.stats.gov.lc/demoexp.htm), it can be assumed to be related positively and closely with the number of dependants in a family. In this instance, the findings on the total fertility rate of Malaysia provide further evidence (indirectly) in support of the findings of Browne and Kim (1993) that the number of dependants has a direct significant relationship with the demand for life insurance. The total fertility rate variables are found to be associated positively with life insurance business in force in Malaysia. When the expected completed family size is increasing, it is natural to expect that the number of dependants will increase so that the need for life insurance protection for the dependants against the pre-matured death of the parents also increases. However, the relationship between total fertility rate and life insurance business in force in the US cannot be confirmed because the signs of the estimated parameters for the total fertility rate variables are inconsistent.

Browne and Kim (1993) find that inflation has a significant negative relationship with the demand for life insurance. The findings on inflation of this study are mixed. The inflation rate more frequently tends to be associated positively with life insurance business in force in Malaysia but negatively with life insurance business in force in the US. The explanation for these findings may be connected with the major intention of owning life insurance, and to what extent life insurance is purchased to provide protection to the beneficiaries or as an instrument for savings. The above findings may indicate that the ownership of life insurance among the Malaysians is primarily for protection purpose whereas among the Americans is mainly for savings purpose.

The findings on the life expectancy at birth and crude death rate of this study are not in total agreement with the findings of Browne and Kim (1993). Both the life expectancy at birth and death rate are found to be statistically insignificant in the study of Browne and Kim (1993). In contrast to the findings of Browne and Kim (1993), we find that both life expectancy at birth and crude death rate of this study have a significant relationship and are associated negatively with life insurance business in force in Malaysia and the US. As the life expectancy at birth, death rate and the cost of insurance are related indirectly with one another, it is suspected that the exclusion of the price variable (which is available for Malaysia only) from the analysis would have an impact on the results for Malaysia. In order to clear the doubt, the price variables (i.e. both the original and lagged variables: mpn and mpn_1) are included in FSM-A, FSM-B and FSM-C (being the final specific models for the demand models by number) in order to examine the price effect on life insurance business in force. The regression models obtained are Model-A, Model-B and Model-C (refer to Tables 10.38–10.40). The results of Model-A, Model-B and Model-C show that the price variables are indeed not statistically different from zero and do not affect the earlier findings in qualitative sense. When subject to simplification, Model-A, Model-B and Model-C are reduced to FSM-A, FSM-B and FSM-C respectively again. For the crude death rate, we note that it is not a good proxy for the probability of death for the population in a country because the rate tends to be biased upwards for a country that has a larger proportion of people at the older ages in the population. The age-adjusted death rate (which is adjusted for the changing proportion of people at each age in the population) is a better variable than the crude death rate in representing the average probability of death of the population. Since such data are available for the US (but only for the period 1960-1998), the age-adjusted death rate is used in place of the crude death rate in FSM-a and FSM-c (being the final specific models for the US when the liberal strategy is used for modelling) in order to investigate whether the age-adjusted death rate is able to produce the intended effect on life insurance business in force. The regression models obtained are Model-a and Model-c (refer to Tables 10.41 and 10.42). The results show that, although the age-adjusted death rate more frequently is statistically significant, it fails to exhibit the intended effect that it is related positively to the demand for life insurance. Further, the results of Model-a and Model-c are mixed as to whether the age-adjusted death rate is a better variable than the crude death rate in improving the goodness of fit of the regression model. The presence of the age-adjusted death rate has increased the significance of a few other variables such as the interest rate (i.e. DUSTBR1Y), crude live-birth rate (i.e. DUSCBR and DUSCBR_1) and life expectancy at birth (i.e. DUSLEm_1) in Model-a that has led to the enhancement of the goodness of fit of Model-a (i.e. adjusted-R^2=0.64515, σ=0.01110) as compared with FSM-a (i.e. adjusted-R^2=0.42938, σ=0.01434). However, the opposite effect has occurred to Model-c. The substitution of crude death rate for age-adjusted death rate has caused deterioration to the significance level of a number of variables such as the crude live-birth rate (i.e. DUSCBR) and life expectancy at birth (i.e. DUSLEf and DUSLEf_1) in Model-c. As a consequence, the goodness of fit of Model-c declines considerably (i.e. adjusted-R^2=0.58151, σ=0.01909) as compared with FSM-c (i.e. adjusted-R^2=0.69441, σ=0.01688).

10.4.3 Lapse Model Using Surrender Rate

Malaysia. Table 10.36 is referred. When the liberal strategy is used for modelling, each of the two final specific models (i.e. FSM-F and FSM-G) retain eight variables. On the other hand, when the conservative strategy is used for modelling, only four variables are retained in the final specific model (i.e. FSM-H). The surrender rate in the previous period, the stock market return in the previous period and the anticipated change in the life expectancy at birth for females that are retained in the final specific models of the liberal strategy (i.e. FSM-F and FSM-G) are retained in the final specific model of the conservative strategy (i.e. FSM-H). Similar to the final specific models of the liberal strategy (i.e. FSM-F and FSM-G), an income variable is retained in the final specific model of the conservative strategy (i.e. FSM-H). The final specific models of the liberal strategy (i.e. FSM-F and FSM-G) retain the acceleration of income whereas the final specific model of the conservative strategy (i.e. FSM-H) retains the anticipated income. The surrender rate in the previous period, the inflation rate in the previous period and the anticipated change in the life expectancy at birth for females have a positive relationship whilst both the anticipated income and the acceleration of income, both the anticipated and past stock market returns, the anticipated inflation rate and the change in the life expectancy at birth for females in the previous period have a negative relationship with the change in surrender rate.

A comparison between the two final specific models of the liberal strategy shows that the model with income per capita as the income variable (i.e. FSM-F) appears to be slightly more efficiently estimated than the model with GDP as the income variable (i.e. FSM-G). The former (i.e. FSM-F: adjusted-R^2=0.72755 and σ=0.16103) is able to explain a slightly greater proportion of the variance of the change in surrender rate with a slightly smaller regression standard error than the latter (i.e. FSM-G: adjusted-R^2=0.72063 and σ=0.16306).

US. Table 10.37 is referred. When the liberal strategy is used for modelling, the interest rate variable is the only variable retained in the final specific model (i.e. FSM-e). The change in the Treasury one-year yield in the previous period is found to be associated positively and significantly with the change in surrender rate. On the other hand, when the conservative strategy is used for modelling, the stringent criterion applied to the simplification process results in no variables being retained in the congruent models. Therefore, there is no final specific model under the conservative strategy.

Malaysia vs US. The results clearly demonstrate that there is a completely different set of factors that affects the surrender rate in Malaysia and the US. The surrender rate in Malaysia seems to be influenced by a number of macroeconomic factors such as income, the performance of the stock market and inflation rate, and the demographic factor such as the life expectancy at birth (refer to FSM-F, FSM-G and FSM-H). On the other hand, the interest rate of one-year Treasury appears to be the primary macroeconomic factor that is related significantly to the surrender rate in the US (refer to FSM-e). As a result, the lapse model of Malaysia has a much higher adjusted-R^2 value than the lapse model of the US that only has a single variable retained in its final specific model.

Below is the discussion about the findings on the various factors affecting the surrender rate in Malaysia and the US.

Emergency Fund Hypothesis (EFH). Disposable income appears to have a strong and important relationship with the surrender rate of life insurance in Malaysia but not in the US. Only the findings of Malaysia are in support of EFH, i.e. disposable income tends to affect inversely life insurance surrender rate. However, income is not a key factor affecting the surrender rate in the US.

The stock market return is found to have a significant negative relationship with the propensity to surrender a life policy in Malaysia. The findings provide strong evidence in favour of the EFH. However, the stock market return is not a crucial factor in the US as this variable is not retained in all of the regression models of the US.

Unemployment has a weak relationship with the surrender rate of life insurance in Malaysia. The anticipated registered unemployment rate is retained in two congruent models under the liberal strategy (in Model-3 and Model-4) but it is not retained in the final specific models (i.e. FSM-F and FSM-G) (refer to Table 10.7). Further, it is not retained in any congruent models when the conservative strategy is used for simplification (refer to Table 10.15). The findings on unemployment rate do not provide strong evidence to support the EFH for Malaysia. However, for the US, the findings on unemployment rate do not provide any support for the EFH as the unemployment rate does not have a significant relationship with life insurance surrender rate for the US.

Based on the above, the findings of Malaysia provide considerable support for the EFH but there is no evidence of the emergency fund effect in the US in connection with the propensity to surrender a life policy.

Interest Rate Hypothesis (IRH). Only the discount rate on one-year treasury bills is used to test the interest rate effect on the surrender rate of life insurance. The findings of the US lend support to the IRH as the interest rate variable is retained in the only surviving congruent model that is also the final specific model (i.e. FSM- e) (refer to Table 10.24). It is indeed the only variable that is retained in the model. It has a significant positive relationship with the surrender rate for the US. Changes in the yield of one-year US Treasury in the previous period are able to explain approximately 12% of the variance of the change in the surrender rate of the US. Other macroeconomic and demographic factors appear not to have a significant relationship with the surrender rate for the US as they are found to be statistically not significant and eventually being removed from the regression models. In contrast to the findings of the US, the findings of Malaysia provide no evidence of interest rate effect on the surrender rates. The interest rate variable is not retained in any of the congruent models of Malaysia.

Preservation of Purchasing Power. The inflation rate is found to have an important relationship with life insurance surrender rate in Malaysia but the estimated parameters for the inflation variables are inconsistent. Therefore, a conclusion cannot be made with regard to its relationship with the surrender rate for Malaysia. On the other hand, inflation rate does not seem to affect the surrender rate in the US.

Demographic Characteristics of the Population. Among the demographic variables investigated in this study, only the life expectancy at birth for females appear to be related significantly to the surrender rate of life insurance in Malaysia. However, the signs of the estimated coefficients for the anticipated and past changes in the life expectancy at birth for females are not consistent as their signs switch from positive to negative. Hence, no conclusion can be made with respect to their relationship. On the other hand, all of the demographic variables such as the crude live-birth rate, crude death rate, total fertility rate and life expectancy at birth examined in this study do not have an important association with the surrender rate of life insurance in the US.

This Study vs Past Studies. Dar and Dodds (1989) and Russell (1997) have examined the surrender rate of life insurance so that a comparison of like with like can be made between the findings of these two studies and this study. Dar and Dodds (1989) show that policy surrenders in the UK tend to be affected by the emergency fund effect but not by the interest rate effect. Their findings provide support for the EFH as unemployment is found to have a significant positive relationship with surrenders. However, their findings do not provide any support for the IRH as the alternative real rate of return is found to be statistically not significant. Further, their findings also reveal that inflation does not have any impact on surrenders. Russell (1997) finds weak evidence in support of EFH but strong evidence in support of IRH for the surrender activity among policyholders in the US. Only the findings on unemployment (i.e.

positive and significant) lend support to the EFH but the findings on income (i.e. unexpectedly positive and significant) do not. The findings on the long-term, intermediate-term and short-term yields of US Treasuries are found to be associated positively and significantly with surrender activity. Further, his study also finds that inflation is related positively to surrender activity.

In this study, the findings of Malaysia provide considerable support for the EFH but no evidence of IRH. However, the findings of the current study are not fully in agreement with the findings of Dar and Dodds (1989). Although the surrender rates in Malaysia tend to be affected by the emergency fund effect by way of income and stock market return, the unemployment rate does not contribute to this effect. Income and stock market return are found to be associated negatively and significantly with the surrender rates for Malaysia. When there is a sudden drop in disposable income and when the return from the stock market is not appealing due to a bearish capital market and a pessimistic economic outlook, the policyholders tend to fall back to draw on the cash values accumulated under their life policies in order to tide them over financial difficulties. Thus, these situations cause the surrender rates to surge to a higher level. The findings on the stock market return also confirm the proposition of Katrakis (2000) on the concept of dependent lapsing, i.e. a situation where the lapse rates would rise when the stock market is performing badly. Meanwhile, for the unemployment rate, this study has used the registered unemployment rate in the analysis but not the most commonly quoted measure for unemployment rate because the data series for the former (i.e. available for 1969-2001) is longer than the latter (i.e. available for 1976-2001). We note that the registered unemployment rate is not as good as the commonly defined unemployment rate to represent the unemployment rate. In order to investigate whether the commonly defined unemployment rate is able to deliver the intended effect, it is included into the final specific models of FSM-F, FSM-G and FSM-H. The regression models obtained are Model-F, Model-G and Model-H respectively as presented in Tables 10.43–10.45. The results show that the commonly defined unemployment rate, like the registered unemployment rate, does not have a significant relationship with the surrender rate for Malaysia. These findings reaffirm the earlier findings that unemployment indeed does not have an important relationship with life insurance surrender rate, or put it another way, there is no evidence that unemployment in Malaysia is likely to create an emergency fund effect on the surrender rate of life insurance. Further, there is a loss of significance for a number of variables and some of them even become statistically insignificant after the inclusion of the commonly defined unemployment rate into the regression models. Although the explanatory variables in the three re-estimated regression models (i.e. Model-F, Model-G and Model-H) jointly are now only able to explain a smaller proportion of the variance in the dependent variable as compared with their respective final specific models (i.e. FSM-F, FSM-G and FSM-H), it is surprising to note that their respective regression standard errors have improved slightly (i.e. smaller σ values). On the other hand, the surrender rates of Malaysia appear not to be affected by the interest rate effect. The discount rate on 12-month treasury bills is not retained in any of the regression models. This suggests that the competing interest rate of alternative investment such as the discount rate on treasury bills does not lead to a higher surrender rate of life insurance.

In the current study, the findings of the US are the opposite to the findings of Malaysia. The findings of the US provide further evidence in support of IRH but no evidence of EFH. The findings of the US in this study only partially support those of Russell (1997). Although the findings of both studies show that the surrenders rates in the US are affected by the interest rate effect, the findings on the EFH are not completely in agreement with each other. An increase in the US Treasury one-year yield would result in a decline in the value of life insurance, causing the policyholders tend to surrender their life policies in order to transfer the funds into the Treasury that offers a more attractive interest rate (i.e. interest rate arbitrage). However, unlike the study of Russell (1997) in which income is found to have a significant relationship with policy surrenders, income appears to be not an important determinant for the surrender rate of life insurance in the US in this study as none of the income variables are retained in the regression models of the US.

10.4.4 Cointegration and ECM

The analyses of cointegration and ECM are not performed for the lapse models of both Malaysia and the US because the long-run regression model is either not robust as having the problem of residual autocorrelation or all of the explanatory variables are statistically not significant. However, although further analysis is undertaken to conduct the cointegration test and the ECM estimation for the demand models by number and by amount of the US, the ECM results do not produce a sensible estimate for the equilibrium error term (i.e. λ). As the estimated parameters for λ fail to meet the stability condition (in which $\lambda<0$ must hold in order to ensure that the equilibrium errors are "corrected" in the following period), their ECMs are abandoned.

10.5 Concluding Comments

In summary, the major findings for the comparative study of the demand for and lapsation of life insurance between Malaysia and the US are as follows:

(a) For life insurance demand, although the inflation rate, crude death rate and total fertility rate are the three factors that are found to have a crucial relationship with the number of policies and the amount of life insurance business in force in Malaysia and the US, they do not have a consistent relationship between the two countries except for the crude death rate. For the crude death rate, even though its findings are consistent between both countries but it is found to have a negative relationship with life insurance business in force by number and by amount. The findings are not in line with the expectation that a high probability of death tends to support a higher level of the demand for life insurance.

(b) For lapsation of life insurance, the differences in the finding are apparent that while the macroeconomic and demographic variables examined in this study can explain the variance of the change in the surrender rate of Malaysia quite well, there are other variables that are important which have not been considered for the US in this study because only the Treasury one-year yield is retained in the final specific model for the US.

Given the above, the findings between Malaysia and the US are obviously different from each other. The differences might be because of the US has a much more developed economy than Malaysia and therefore its life insurance industry is affected by some other macroeconomic and demographic factors that have not been investigated in this study. Further, there is a possibility that the quality of the Malaysian data has caused the differences because some of the data, especially the demographic data, are combined to form a complete data set from various sources, or have to be computed, or derived using assumptions and approximation (see Chapter five).

APPENDIX CHAPTER 10

Table 10.1

Summary Results of Specific Models for the Demand Models by Number (Liberal Strategy) for Malaysia for the Sample Period 1971-2001

No.	Model	1	2	3	4	5	6	7	M1 = Model-1		M2 = Model-2		Re-specified M1 FSM-A		Re-specified M2 FSM-B	
1	Constant			0.41254 *** (0.4417)	0.41895 *** (0.4364)				Constant		Constant					
2	mnifptp_1	0.99794 *** (1.0000)	0.99800 *** (1.0000)	0.96779 *** (1.0000)	0.96742 *** (1.0000)	1.00028 *** (1.0000)	1.00061 *** (1.0000)	1.00053 *** (1.0000)	mnifptp_1	0.99794 *** (1.0000)	mnifptp_1	0.99800 *** (1.0000)	mnifptp_1	0.99822 *** (1.0000)	mnifptp_1	0.99829 *** (1.0000)
3	Dmgdp	0.06038 * (1.0000)		0.10840 *** (1.0000)				0.06297 * (0.7000)	Dmgdp	0.06038 * (1.0000)			Dmgdp	0.06374 ** (1.0000)		
4	Dmipc		0.06052 * (1.0000)		0.10825 *** (1.0000)		0.06321 * (0.7000)				Dmipc	0.06052 * (1.0000)			Dmipc	0.06391 ** (1.0000)
5	MSMR	-0.00019 * (0.7000)	-0.00019 * (0.7000)	-0.00023 * (0.7000)	-0.00023 * (0.7000)				MSMR	-0.00019 * (0.7000)	MSMR	-0.00019 * (0.7000)	MSMR	-0.00019 * (0.7000)	MSMR	-0.00019 * (0.7000)
6	MSMR_1			0.00024 * (1.0000)	0.00024 ** (1.0000)				MSMR_1		MSMR_1					
7	Dmm2n	0.16280 *** (1.0000)	0.16308 *** (1.0000)						Dmm2n	0.16280 *** (1.0000)	Dmm2n	0.16308 *** (1.0000)				
8	Dmm2n_1	-0.15002 *** (1.0000)	-0.15022 *** (1.0000)	-0.19676 *** (1.0000)	-0.19773 *** (1.0000)				Dmm2n_1	-0.15002 *** (1.0000)	Dmm2n_1	-0.15022 *** (1.0000)				
9	MIE	0.00993 *** (1.0000)	0.00994 *** (1.0000)	0.00590 *** (1.0000)	0.00587 *** (1.0000)	0.00549 *** (0.7000)	0.00627 *** (1.0000)	0.00626 *** (1.0000)	MIE	0.00993 *** (1.0000)	MIE	0.00994 *** (1.0000)	MIE	0.00983 *** (1.0000)	MIE	0.00985 *** (1.0000)
10	MIE_1					0.00311 ** (1.0000)			MIE_1		MIE_1					
11	MCBR_1	0.00794 *** (0.7000)	0.00799 *** (0.7000)			0.00806 *** (0.7000)	0.00203 *** (0.7000)	0.00198 *** (0.7000)	MCBR_1	0.00794 *** (0.7000)	MCBR_1	0.00799 *** (0.7000)	MCBR_1	0.00797 *** (0.7000)	MCBR_1	0.00803 *** (0.7000)
12	MCDR					-0.03466 ** (0.4000)			MCDR		MCDR					
13	MCDR_1	-0.03207 *** (0.7000)	-0.03214 *** (0.7000)	-0.03301 ** (0.4912)	-0.03335 ** (0.4885)				MCDR_1	-0.03207 *** (0.7000)	MCDR_1	-0.03214 *** (0.7000)	MCDR_1	-0.03227 *** (0.7000)	MCDR_1	-0.03235 *** (0.7000)
14	DMTFR			0.07823 *** (1.0000)	0.07782 *** (1.0000)				DMTFR		DMTFR					
15	DMTFR_1	0.09052 *** (1.0000)	0.09054 *** (1.0000)	0.13772 *** (1.0000)	0.13791 *** (1.0000)	0.05415 * (1.0000)	0.06985 ** (1.0000)	0.06978 ** (1.0000)	DMTFR_1	0.09052 *** (1.0000)	DMTFR_1	0.09054 *** (1.0000)	DMTFR_1	0.09142 *** (1.0000)	DMTFR_1	0.09145 *** (1.0000)
16	DMLEm_1	-0.02889 *** (1.0000)	-0.02870 *** (1.0000)			-0.02873 ** (1.0000)			DMLEm_1	-0.02889 *** (1.0000)	DMLEm_1	-0.02870 *** (1.0000)	DMLEm_1	-0.02854 *** (1.0000)	DMLEm_1	-0.02832 *** (1.0000)
17	DMLEf			-0.01528 * (1.0000)	-0.01508 * (1.0000)				DMLEf		DMLEf					
18	DMLEf_1			-0.01232 * (1.0000)	-0.01201 * (1.0000)				DMLEf_1		DMLEf_1					
19													DDmm2n	0.15418 *** (1.0000)	DDmm2n	0.15441 *** (1.0000)
	Number of GUM(s)	1	1	1	1	2	1	1								
	Adjusted-R^2	0.99947	0.99947	0.99942	0.99942	0.99922	0.99906	0.99906		0.99947		0.99947		0.99949		0.99949
	Sigma	0.01821	0.01822	0.01902	0.01903	0.02201	0.02421	0.02422		0.01821		0.01822		0.01781		0.01782
	Probability:															
	Chow (1998: 1)	0.2689	0.2734	0.1008	0.0964	0.2761	0.2486	0.2500		0.2689		0.2734		0.2477		0.2519
	Normality Test	0.1623	0.1656	0.8217	0.7994	0.7654	0.9597	0.9615		0.1623		0.1656		0.2229		0.2265
	AR 1-4 Test	0.7500	0.7622	0.2220	0.2168	0.3059	0.4582	0.4525		0.7500		0.7622		0.7921		0.8036
	Hetero Test	0.9075	0.9125	0.5338	0.5200	0.7149	0.9288	0.9298		0.9075		0.9125		0.9971		0.9975

Dependent Variable: mnifptp

Note for Table 10.1:
In the summary table, the regression coefficients, significance levels and reliability coefficients of the retained variables are reported. The significance levels are indicated by asterisk mark(s). Three asterisk marks indicate highly significant at 1% significance level, two asterisk marks indicate moderately significant at 5% significance level and one asterisk mark indicates marginally significant at 10% significance level. Meanwhile, "NS" is used to indicate that the retained variable is not significant. In each table, the regression coefficients are reported on top of the reliability coefficients and next to (and to the left of) the significance level indicators. The reliability coefficients are enclosed in parentheses.

Table 10.2
Full Results of Encompassing Test for M1 and M2 (Liberal Strategy) (Malaysia)

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Encompassing test statistics: 1971 to 2001

M1 is: mnifptp on
  mnifptp_1      Dmgdp       MSMR        Dmm2n       Dmm2n_1
  MIE            MCBR_1      MCDR_1      DMTFR_1     DMLEm_1

M2 is: mnifptp on
  mnifptp_1      Dmipc       MSMR        Dmm2n       Dmm2n_1
  MIE            MCBR_1      MCDR_1      DMTFR_1     DMLEm_1

Instruments used:
  mnifptp_1      Dmgdp       MSMR        Dmm2n       Dmm2n_1
  MIE            MCBR_1      MCDR_1      DMTFR_1     DMLEm_1
  Dmipc

sigma[M1] = 0.0182126   sigma[M2] = 0.0182162   sigma[Joint] = 0.0186621

Test          M1 vs. M2                            M2 vs. M1
Cox           N(0,1)    =     0.02514 [0.9799]     N(0,1)    =    -0.1142 [0.9091]
Ericsson IV   N(0,1)    =    -0.02070 [0.9835]     N(0,1)    =    0.09393 [0.9252]
Sargan        Chi^2(1) = 0.00042848 [0.9835]      Chi^2(1) = 0.0088056 [0.9252]
Joint Model   F(1,20)   = 0.00040809 [0.9841]      F(1,20)   = 0.0083898 [0.9279]
```

Table 10.3
Summary Results of Encompassing Test for R-M1 and R-M2 (Liberal Strategy) (Malaysia)

```
Encompassing test statistics: 1971 to 2001

sigma[R-M1] = 0.0178134   sigma[R-M2] = 0.0178172   sigma[Joint] = 0.0182324

Test          R-M1 vs. R-M2                        R-M2 vs. R-M1
Cox           N(0,1)    =     0.02395 [0.9809]     N(0,1)    =    -0.1178 [0.9062]
Ericsson IV   N(0,1)    =    -0.02018 [0.9839]     N(0,1)    =    0.09921 [0.9210]
Sargan        Chi^2(1) = 0.00040738 [0.9839]      Chi^2(1) = 0.0098283 [0.9210]
Joint Model   F(1,21)   = 0.00038887 [0.9845]      F(1,21)   = 0.0093857 [0.9237]
```

Table 10.4
Summary Results of Specific Models for the Demand Models by Number (Conservative Strategy) for Malaysia for the Sample Period 1971-2001

No.	Model	1	2	3	4	M3 = Model-1 FSM-C	
1	Constant			0.09403 *** (0.5466)		Constant	
2	mnifptp_1	0.99857 *** (1.0000)	1.00171 *** (1.0000)	0.99431 *** (1.0000)	1.00431 *** (1.0000)	mnifptp_1	0.99857 *** (1.0000)
3	Dmm2n	0.18668 *** (0.7000)				Dmm2n	0.18668 *** (0.7000)
4	Dmm2n_1	-0.12127 ** (0.4000)				Dmm2n_1	-0.12127 ** (0.4000)
5	MIE	0.00933 *** (1.0000)	0.00427 *** (0.7000)	0.00398 ** (0.6208)	0.00422 ** (0.7000)	MIE	0.00933 *** (1.0000)
6	MCBR_1	0.00846 *** (0.6133)	0.00200 *** (0.5805)			MCBR_1	0.00846 *** (0.6133)
7	MCDR_1	-0.03683 *** (0.3046)			0.00891 ** (0.5940)	MCDR_1	-0.03683 *** (0.3046)
8	DMLEm_1	-0.03190 *** (1.0000)				DMLEm_1	-0.03190 *** (1.0000)
	Number of GUM(s)	2	4	1	1		
	Adjusted-R^2	0.99930	0.99887	0.99885	0.99879		0.99930
	Sigma	0.02094	0.02652	0.02676	0.02746		0.02094
	Probability:						
	Chow (1998: 1)	0.6186	0.1582	0.1717	0.1208		0.6186
	Normality Test	0.5683	0.9210	0.9533	0.9970		0.5683
	AR 1-4 Test	0.6058	0.0913	0.0610	0.0509		0.6058
	Hetero Test	0.6502	0.2753	0.1087	0.1834		0.6502

Dependent Variable: mnifptp

Table 10.5

Summary Results of Specific Models for the Demand Models by Amount (Liberal Strategy) for Malaysia for the Sample Period 1971-2001

No.	Model	1	2	3	M4 = Model-1 FSM-D	
1	Constant	1.51980 ***	2.91467 ***	2.95475 ***	Constant	1.51980 ***
		(1.0000)	(0.5387)	(1.0000)		(1.0000)
2	maifpc_1	0.90864 ***	0.83359 ***	0.83557 ***	maifpc_1	0.90864 ***
		(1.0000)	(1.0000)	(1.0000)		(1.0000)
3	Dmm2n_1	0.33850 **			Dmm2n_1	0.33850 **
		(1.0000)				(1.0000)
4	MIE	-0.02471 ***	-0.02177 ***	-0.02055 ***	MIE	-0.02471 ***
		(1.0000)	(1.0000)	(1.0000)		(1.0000)
5	MIE_1	0.01276 ***	0.00616 **		MIE_1	0.01276 ***
		(1.0000)	(1.0000)			(1.0000)
6	MCBR		-0.03265 **	-0.02127 **	MCBR	
			(1.0000)	(0.7000)		
7	MCBR_1		0.01496 *		MCBR_1	
			(1.0000)			
8	MCDR	-0.12911 ***		-0.16095 ***	MCDR	-0.12911 ***
		(1.0000)		(1.0000)		(1.0000)
9	MCDR_1		-0.17117 ***		MCDR_1	
			(0.7000)			
10	DMTFR	0.15430 **	0.30298 ***	0.27005 ***	DMTFR	0.15430 **
		(0.7000)	(1.0000)	(1.0000)		(0.7000)
11	DMTFR_1	0.12430 **	0.22686 ***	0.22322 ***	DMTFR_1	0.12430 **
		(0.7000)	(0.7000)	(1.0000)		(0.7000)
12	DMLEf_1		-0.02681 *		DMLEf_1	
			(1.0000)			
	Number of GUM(s)	2	4	2		
	Adjusted-R^2	0.99860	0.99844	0.99836		0.99860
	Sigma	0.03895	0.04115	0.04218		0.03895
	Probability:					
	Chow (1998: 1)	0.2561	0.4257	0.5823		0.2561
	Normality Test	0.8239	0.6014	0.7913		0.8239
	AR 1-4 Test	0.2135	0.0344	0.0162		0.2135
	Hetero Test	0.6609	0.7040	0.7573		0.6609

Dependent Variable: maifpc

Table 10.6

Summary Results of Specific Models for the Demand Models by Amount (Conservative Strategy) for Malaysia for the Sample Period 1971-2001

No.	Model	1	2	3	4	M5 = Model-1 FSM-E	
1	Constant	1.30382 ***	2.98546 ***	2.05957 ***	1.20987 ***	Constant	1.30382 ***
		(0.7000)	(1.0000)	(1.0000)	(0.6071)		(0.7000)
2	maifpc_1	0.91952 ***	0.83032 ***	0.88057 ***	0.92264 ***	maifpc_1	0.91952 ***
		(1.0000)	(1.0000)	(1.0000)	(1.0000)		(1.0000)
3	Dmm2n_1	0.46752 ***			0.47616 ***	Dmm2n_1	0.46752 ***
		(1.0000)			(1.0000)		(1.0000)
4	MIE	-0.02748 ***	-0.02107 ***	-0.02047 ***	-0.02822 ***	MIE	-0.02748 ***
		(1.0000)	(0.7000)	(0.7000)	(1.0000)		(1.0000)
5	MIE_1	0.01522 ***			0.01612 ***	MIE_1	0.01522 ***
		(1.0000)			(1.0000)		(1.0000)
6	MCBR		-0.02267 **			MCBR	
			(0.6174)				
7	MCDR	-0.10880 ***		-0.17762 ***		MCDR	-0.10880 ***
		(1.0000)		(0.7000)			(1.0000)
8	MCDR_1		-0.14848 ***		-0.09444 ***	MCDR_1	
			(0.7000)		(0.3309)		
9	DMTFR		0.27460 ***	0.19092 ***		DMTFR	
			(0.7000)	(0.7000)			
10	DMTFR_1		0.23126 ***	0.16248 **		DMTFR_1	
			(1.0000)	(1.0000)			
	Number of GUM(s)	2	2	2	2		
	Adjusted-R^2	0.99819	0.99810	0.99804	0.99794		0.99819
	Sigma	0.04431	0.04547	0.04620	0.04730		0.04431
	Probability:						
	Chow (1998: 1)	0.3237	0.6316	0.6435	0.3344		0.3237
	Normality Test	0.4661	0.9800	0.5187	0.8334		0.4661
	AR 1-4 Test	0.6544	0.4370	0.0288	0.8191		0.6544
	Hetero Test	0.2787	0.5432	0.3949	0.8218		0.2787

Dependent Variable: maifpc

Table 10.7

Summary Results of Specific Models for the Lapse Models Using Surrender Rate (Liberal Strategy) for Malaysia for the Sample Period 1972-2001

No.	Model	1	2	3	4	M6		M7		Re-specified Model-1 FSM-F		Re-specified Model-2 FSM-G	
1	DMSRN_1	0.44656 *** (1.0000)	0.43716 *** (1.0000)			DMSRN_1		DMSRN_1		DMSRN_1	0.44978 *** (1.0000)	DMSRN_1	0.43977 *** (1.0000)
2	Dmgdp		-0.86493 *** (0.7000)		-1.12752 *** (1.0000)	Dmgdp	-0.83842 *** (0.7000)						
3	Dmgdp_1		0.83456 *** (1.0000)			Dmgdp_1							
4	Dmipc	-0.86856 *** (0.7000)		-1.13531 *** (1.0000)				Dmipc	-0.85139 *** (0.7000)				
5	Dmipc_1	0.83619 *** (1.0000)						Dmipc_1					
6	MSMR	-0.00151 * (0.7000)	-0.00150 * (0.7000)			MSMR	-0.00155 * (0.4000)	MSMR	-0.00153 * (0.4000)	MSMR	-0.00155 ** (1.0000)	MSMR	-0.00154 ** (1.0000)
7	MSMR_1	-0.00269 ** (1.0000)	-0.00272 ** (1.0000)			MSMR_1	-0.00327 *** (1.0000)	MSMR_1	-0.00328 *** (1.0000)	MSMR_1	-0.00270 ** (1.0000)	MSMR_1	-0.00273 ** (1.0000)
8	MRUR			-0.10169 * (0.4049)	-0.10297 * (0.1038)	MRUR		MRUR					
9	MIE	-0.03715 ** (0.7000)	-0.03730 ** (1.0000)	-0.07216 *** (1.0000)	-0.07184 *** (1.0000)	MIE	-0.04326 ** (0.7000)	MIE	-0.04323 *** (0.7000)	MIE	-0.03708 *** (0.7000)	MIE	-0.03730 *** (0.7000)
10	MIE_1	0.04207 *** (1.0000)	0.04146 *** (1.0000)			MIE_1		MIE_1		MIE_1	0.04263 *** (1.0000)	MIE_1	0.04192 *** (1.0000)
11	MCBR			-0.19185 ** (1.0000)	-0.19481 ** (1.0000)	MCBR		MCBR					
12	MCBR_1			0.12933 * (1.0000)	0.13296 * (1.0000)	MCBR_1		MCBR_1					
13	MCDR			0.40358 *** (0.4000)	0.40557 *** (0.4000)	MCDR	0.03324 ** (0.7000)	MCDR	0.02895 ** (0.4000)				
14	DMTFR			1.31210 ** (1.0000)	1.32388 ** (1.0000)	DMTFR		DMTFR					
15	DMLEm			0.60468 *** (1.0000)	0.60307 *** (1.0000)	DMLEm		DMLEm					
16	DMLEm_1			0.25729 *** (1.0000)	0.26101 *** (1.0000)	DMLEm_1		DMLEm_1					
17	DMLEf	0.32132 *** (1.0000)	0.32913 *** (1.0000)			DMLEf	0.37046 *** (1.0000)	DMLEf	0.37071 *** (1.0000)	DMLEf	0.31959 *** (1.0000)	DMLEf	0.32756 *** (1.0000)
18	DMLEf_1	-0.16820 * (0.7000)	-0.16114 * (0.7000)			DMLEf_1		DMLEf_1		DMLEf_1	-0.17147 ** (1.0000)	DMLEf_1	-0.16424 ** (1.0000)
19												DDmgdp	-0.85280 *** (1.0000)
20										DDmipc	-0.85534 *** (1.0000)		
	No. of GUM(s)	1	1	1	1								
	Adjusted-R^2	0.71471	0.70746	0.62529	0.62385		0.59967		0.60274		0.72755		0.72063
	Sigma	0.16478	0.16686	0.18884	0.18921		0.19519		0.19444		0.16103		0.16306
	Probability:												
	Chow (1999: 1)	0.8251	0.8202	0.1837	0.1795		0.6549		0.6552		0.8153		0.8092
	Normality Test	0.3624	0.3073	0.0192	0.0208		0.6035		0.6262		0.3479		0.2922
	AR 1-4 Test	0.4453	0.4182	0.4965	0.4984		0.8420		0.8166		0.4205		0.3982
	Hetero Test	0.9974	0.9984	0.9410	0.9406		0.9847		0.9834		0.9908		0.9927

Dependent variable: DMSRN

Table 10.8

Summary Results of Encompassing Test for M6 and M7 (Liberal Strategy) (Malaysia)

Encompassing test statistics: 1972 to 2001

sigma[M6] = 0.195194 sigma[M7] = 0.194444 sigma[Joint] = 0.196432

Test	M6 vs. M7				M7 vs. M6			
Cox	N(0,1)	=	-0.9502	[0.3420]	N(0,1)	=	0.8047	[0.4210]
Ericsson IV	N(0,1)	=	0.8464	[0.3974]	N(0,1)	=	-0.7223	[0.4701]
Sargan	Chi^2(1)	=	0.70750	[0.4003]	Chi^2(1)	=	0.52731	[0.4677]
Joint Model	F(1,23)	=	0.69861	[0.4118]	F(1,23)	=	0.51669	[0.4795]

Table 10.9

Summary Results of Encompassing Test for Model-1 and Model-2 (Liberal Strategy) (Malaysia)

Encompassing test statistics: 1972 to 2001

sigma[Model-1] = 0.164779 sigma[Model-2] = 0.166858 sigma[Joint] = 0.160411

Test	Model-1 vs. Model-2				Model-2 vs. Model-1			
Cox	N(0,1)	=	2.007	[0.0447]*	N(0,1)	=	-2.245	[0.0248]*
Ericsson IV	N(0,1)	=	-1.700	[0.0892]	N(0,1)	=	1.854	[0.0638]
Sargan	Chi^2(2)	=	2.9940	[0.2238]	Chi^2(2)	=	3.4399	[0.1791]
Joint Model	F(2,19)	=	1.5796	[0.2319]	F(2,19)	=	1.8610	[0.1828]

Table 10.10

Summary Results of Encompassing Test for Model-1 and M6 (Liberal Strategy) (Malaysia)

Encompassing test statistics: 1972 to 2001

sigma[Model-1] = 0.164779 sigma[M6] = 0.195194 sigma[Joint] = 0.172651

Test	Model-1 vs. M6				M6 vs. Model-1			
Cox	N(0,1)	=	-0.4094	[0.6822]	N(0,1)	=	-8.808	[0.0000]**
Ericsson IV	N(0,1)	=	0.3367	[0.7363]	N(0,1)	=	5.976	[0.0000]**
Sargan	Chi^2(2)	=	0.14136	[0.9318]	Chi^2(5)	=	9.1353	[0.1038]
Joint Model	F(2,19)	=	0.064382	[0.9379]	F(5,19)	=	2.3353	[0.0820]

Table 10.11

Summary Results of Encompassing Test for Model-1 and M7 (Liberal Strategy) (Malaysia)

Encompassing test statistics: 1972 to 2001

sigma[Model-1] = 0.164779 sigma[M7] = 0.194444 sigma[Joint] = 0.168416

Test	Model-1 vs. M7				M7 vs. Model-1			
Cox	N(0,1)	=	-0.4231	[0.6722]	N(0,1)	=	-8.671	[0.0000]**
Ericsson IV	N(0,1)	=	0.3477	[0.7280]	N(0,1)	=	5.901	[0.0000]**
Sargan	Chi^2(1)	=	0.10754	[0.7430]	Chi^2(4)	=	8.9960	[0.0612]
Joint Model	F(1,20)	=	0.10294	[0.7517]	F(4,20)	=	2.9979	[0.0433]*

Table 10.12

Summary Results of Encompassing Test for Model-2 and M6 (Liberal Strategy) (Malaysia)

```
Encompassing test statistics: 1972 to 2001

sigma[Model-2] = 0.166858  sigma[M6] = 0.195194  sigma[Joint] = 0.170449

Test          Model-2 vs. M6                      M6 vs. Model-2
Cox           N(0,1)    =  -0.4667 [0.6407]       N(0,1)    =   -7.979 [0.0000]**
Ericsson IV   N(0,1)    =   0.3822 [0.7023]       N(0,1)    =    5.429 [0.0000]**
Sargan        Chi^2(1)  =  0.12992 [0.7185]       Chi^2(4)  =   8.7495 [0.0677]
Joint Model   F(1,20)   =  0.12451 [0.7279]       F(4,20)   =   2.8686 [0.0499]*
```

Table 10.13

Summary Results of Encompassing Test for Model-2 and M7 (Liberal Strategy) (Malaysia)

```
Encompassing test statistics: 1972 to 2001

sigma[Model-2] = 0.166858  sigma[M7] = 0.194444  sigma[Joint] = 0.174399

Test          Model-2 vs. M7                      M7 vs. Model-2
Cox           N(0,1)    =  -0.4886 [0.6251]       N(0,1)    =   -7.829 [0.0000]**
Ericsson IV   N(0,1)    =   0.3997 [0.6894]       N(0,1)    =    5.342 [0.0000]**
Sargan        Chi^2(2)  =  0.24389 [0.8852]       Chi^2(5)  =   8.7154 [0.1210]
Joint Model   F(2,19)   =  0.11163 [0.8950]       F(5,19)   =   2.1668 [0.1012]
```

Table 10.14

Summary Results of Encompassing Test for R-Model1 and R-Model2 (Liberal Strategy) (Malaysia)

```
Encompassing test statistics: 1972 to 2001

sigma[R-Model1] = 0.161029  sigma[R-Model2] = 0.16306  sigma[Joint] =
0.152862

Test          R-Model1 vs. R-Model2               R-Model2 vs. R-Model1
Cox           N(0,1)    =    2.008 [0.0447]*      N(0,1)    =   -2.246 [0.0247]*
Ericsson IV   N(0,1)    =   -1.740 [0.0818]       N(0,1)    =    1.899 [0.0576]
Sargan        Chi^2(1)  =   3.0760 [0.0795]       Chi^2(1)  =   3.5445 [0.0597]
Joint Model   F(1,21)   =   3.4134 [0.0788]       F(1,21)   =   4.0332 [0.0576]
```

Table 10.15
Summary Results of Specific Models for the Lapse Models Using Surrender Rate (Conservative Strategy) for Malaysia for the Sample Period 1972-2001

No.	Model	1 FSM-H	2	3	4	M8		M9	
1	DMSRN_1	0.32776 *** (0.6241)				DMSRN_1		DMSRN_1	
2	Dmgdp	-0.59970 ** (0.6178)		-0.72529 ** (0.7000)		Dmgdp	-0.66687 ** (0.6384)		
3	Dmipc		-0.81453 ** (0.7000)					Dmipc	-0.75909 ** (0.7000)
4	MSMR_1	-0.00403 *** (1.0000)			-0.00440 *** (1.0000)	MSMR_1	-0.00381 *** (1.0000)	MSMR_1	-0.00374 *** (1.0000)
5	MIE		-0.05082 *** (0.7000)	-0.04730 *** (0.7000)		MIE	-0.01705 * (0.0920)	MIE	-0.02089 ** (0.1618)
6	DMLEm		0.48387 *** (1.0000)	0.47702 *** (1.0000)		DMLEm		DMLEm	
7	DMLEm_1		0.26105 *** (0.5920)	0.27237 *** (0.6057)		DMLEm_1		DMLEm_1	
8	DMLEf	0.36179 *** (1.0000)			0.32924 *** (1.0000)	DMLEf	0.39445 *** (1.0000)	DMLEf	0.39676 *** (1.0000)
	No. of GUM(s)	1	1	1	1				
	Adjusted-R^2	0.59122	0.46838	0.45332	0.43359		0.53043		0.54781
	Sigma	0.19724	0.22494	0.22810	0.23218		0.21140		0.20745
	Probability:								
	Chow (1999: 1)	0.6610	0.8282	0.8590	0.7337		0.6995		0.7074
	Normality Test	0.5654	0.6696	0.6867	0.4250		0.6132		0.5490
	AR 1-4 Test	0.9800	0.0434	0.0452	0.8488		0.7786		0.7596
	Hetero Test	0.8350	0.8318	0.8491	0.6886		0.9173		0.9117

Dependent variable: DMSRN

Table 10.16
Summary Results of Encompassing Test for M8 and M9 (Liberal Strategy) (Malaysia)

```
Encompassing test statistics: 1972 to 2001

sigma[M8] = 0.211401  sigma[M9] = 0.207452  sigma[Joint] = 0.199726

Test          M8 vs. M9                              M9 vs. M8
Cox           N(0,1)    =   -2.189  [0.0286]*      N(0,1)    =    1.718  [0.0858]
Ericsson IV   N(0,1)    =    1.997  [0.0458]*      N(0,1)    =   -1.627  [0.1037]
Sargan        Chi^2(1)  =   3.6850  [0.0549]       Chi^2(1)  =   2.8275  [0.0927]
Joint Model   F(1,25)   =   4.1284  [0.0529]       F(1,25)   =   3.0505  [0.0930]
```

Table 10.17
Summary Results of Encompassing Test for Model-1 and M9 (Liberal Strategy) (Malaysia)

```
Encompassing test statistics: 1972 to 2001

sigma[Model-1] = 0.197243  sigma[M9] = 0.207452  sigma[Joint] = 0.186495

Test          Model-1 vs. M9                         M9 vs. Model-1
Cox           N(0,1)    =   -4.455  [0.0000]**     N(0,1)    =   -8.300
[0.0000]**
Ericsson IV   N(0,1)    =    3.855  [0.0001]**     N(0,1)    =    6.888
[0.0000]**
Sargan        Chi^2(2)  =   4.5444  [0.1031]       Chi^2(2)  =   6.6042  [0.0368]*
Joint Model   F(2,24)   =   2.5416  [0.0997]       F(2,24)   =   4.0859  [0.0297]*
```

Table 10.18

Summary Results of Specific Models for the Demand Models by Number (Liberal Strategy) for the United States for the Sample Period 1972-2001

No.	Model	1	2	3	4	5	6	7	US1		US2 = Model-1 FSM-a		US3		US4	
1	Constant				0.12044 * (0.7000)				Constant		Constant		Constant		Constant	
2	Dusnifptp_1	-0.71149 ** (0.4000)							Dusnifptp_1		Dusnifptp_1	-0.71149 ** (0.4000)	Dusnifptp_1		Dusnifptp_1	
3	usgdp					-0.62343 ** (0.7000)			usgdp	-0.48484 * (0.7000)	usgdp					
4	usgdp_1	0.09247 *** (1.0000)				0.54524 ** (0.4599)			usgdp_1	0.41713 * (0.4556)	usgdp_1	0.09247 *** (1.0000)				
5	usipc_1			0.05536 *** (1.0000)			0.01852 ** (1.0000)						usipc_1		usipc_1	
6	USSMR			-0.00039 * (0.5086)					USSMR		USSMR		USSMR		USSMR	
7	USSMR_1	-0.00051 ** (0.4000)	-0.00045 ** (0.4000)	-0.00036 * (0.1828)	-0.00052 ** (0.4777)		-0.00049 ** (0.7000)		USSMR_1	-0.00043 * (0.7000)	USSMR_1	-0.00051 ** (0.4000)	USSMR_1	-0.00033 * (0.7000)	USSMR_1	-0.00042 * (0.2393)
8	usm2		0.33325 *** (1.0000)			0.44497 *** (0.5182)			usm2	0.41893 *** (0.5407)			usm2			
9	usm2_1		-0.33437 *** (1.0000)			-0.39918 ** (0.4321)			usm2_1	-0.37888 ** (0.4620)			usm2_1			
10	USFD_1	-0.00500 ** (1.0000)		-0.00434 ** (1.0000)							USFD_1	-0.00500 ** (1.0000)			USFD_1	
11	DUSTBR1Y	0.00649 ** (0.4000)			0.00358 * (1.0000)	0.00926 *** (1.0000)	0.00395 ** (1.0000)		DUSTBR1Y	0.00938 *** (1.0000)	DUSTBR1Y	0.00649 ** (0.4000)	DUSTBR1Y	0.00375 * (1.0000)	DUSTBR1Y	
12	USIE		0.00695 *** (1.0000)						USIE		USIE		USIE		USIE	
13	USIE_1	-0.00628 *** (1.0000)	-0.00572 *** (1.0000)	-0.00456 *** (1.0000)	-0.00397 *** (1.0000)	-0.00389 ** (1.0000)	-0.00352 *** (1.0000)		USIE_1	-0.00429 *** (1.0000)	USIE_1	-0.00628 *** (1.0000)	USIE_1	-0.00121 ** (1.0000)	USIE_1	-0.00280 ** (1.0000)
14	DUSCBR	0.08991 ** (1.0000)		0.04062 * (1.0000)	0.04347 * (0.7000)				DUSCBR		DUSCBR	0.08991 ** (1.0000)	DUSCBR		DUSCBR	0.04890 ** (0.7000)
15	DUSCBR_1	0.03640 ** (1.0000)		0.03156 ** (1.0000)					DUSCBR_1		DUSCBR_1	0.03640 ** (1.0000)	DUSCBR_1		DUSCBR_1	
16	DUSCDR	-0.14665 *** (0.7000)		-0.05338 * (0.5021)	-0.09248 * (0.7000)				DUSCDR		DUSCDR	-0.14665 *** (0.7000)	DUSCDR		DUSCDR	
17	DUSCDR_1	-0.11936 ** (0.2407)							DUSCDR_1		DUSCDR_1	-0.11936 ** (0.2407)	DUSCDR_1		DUSCDR_1	
18	USTFR	-0.94818 *** (1.0000)		-0.49494 *** (1.0000)	-0.37432 ** (1.0000)		-0.08695 ** (1.0000)	-0.00467 ** (1.0000)	USTFR		USTFR	-0.94818 *** (1.0000)	USTFR		USTFR	-0.34267 ** (0.7000)
19	USTFR_1	0.76557 *** (1.0000)		0.39513 ** (1.0000)	0.32557 * (0.7000)				USTFR_1		USTFR_1	0.76557 *** (1.0000)	USTFR_1		USTFR_1	0.34890 ** (0.7000)
20	DUSLEm	-0.09127 *** (0.7000)		-0.05353 ** (0.5082)					DUSLEm		DUSLEm	-0.09127 *** (0.7000)	DUSLEm		DUSLEm	
21	DUSLEm_1	-0.07805 * (0.5498)							DUSLEm_1		DUSLEm_1	-0.07805 * (0.5498)	DUSLEm_1		DUSLEm_1	
22	DUSLEf				-0.06094 * (0.7000)				DUSLEf		DUSLEf		DUSLEf		DUSLEf	
	Number of GUM(s)	1	1	1	1	1	1	1								
	Adjusted-R^2	0.42938	0.41081	0.41001	0.30428	0.27596	0.26457	0.01483		0.35292		0.42938		0.13453		0.17660
	Sigma	0.01434	0.01457	0.01458	0.01583	0.01615	0.01628	0.01884		0.01527		0.01434		0.01766		0.01723
	Probability:															
	Chow (1999: 1)	0.7892	0.4314	0.3565	0.2085	0.1327	0.1246	0.3358		0.2236		0.7892		0.1646		0.0621
	Normality Test	0.0140	0.8755	0.5671	0.4267	0.5042	0.8166	0.3366		0.1375		0.0140		0.5023		0.1144
	AR 1-4 Test	0.7650	0.2876	0.5593	0.3454	0.7306	0.4385	0.6020		0.8759		0.7650		0.7601		0.6233
	Hetero Test	0.6787	0.8378	0.4287	0.2412	0.7158	0.2736	0.1540		0.9868		0.6787		0.4695		0.4731

Dependent Variable: Dusnifptp

Note: One GUM is removed because its congruent model has negative adjusted-R-squared value. Therefore, only seven GUMs have been estimated.

Table 10.19
Summary Results of Encompassing Test for US1 and US2 (Liberal Strategy) (United States)

```
Encompassing test statistics: 1972 to 2001

sigma[US1] = 0.0152703  sigma[US2] = 0.0143398  sigma[Joint] = 0.0145468

Test          US1 vs. US2                              US2 vs. US1
Cox           N(0,1)    =   -7.133  [0.0000]**     N(0,1)   =  -0.8161  [0.4144]
Ericsson IV   N(0,1)    =    4.659  [0.0000]**     N(0,1)   =   0.5771  [0.5638]
Sargan        Chi^2(10) =   11.203  [0.3420]       Chi^2(3) =   2.6219  [0.4537]
Joint Model   F(10,13)  =   1.2344  [0.3543]       F(3,13)  =  0.84927  [0.4914]
```

Table 10.20
Summary Results of Final Specific Model (FSM-b) for the Demand Models by Number (Conservative Strategy) for the United States for the Sample Period 1972-2001

$Dusnifptp_t$ = –0.00467 ($USTFR_t$)**
[1.0000]

Number of GUMs	= 3
Adjusted-R^2	= 0.01483
Sigma	= 0.01884
Probability:	
Chow (1999:1)	= 0.3358
Normality Test	= 0.3366
AR 1-4 Test	= 0.6020
Hetero Test	= 0.1540

NB: The value for the reliability coefficient is reported in squared bracket.
Five GUMs are removed because their congruent models have negative adjusted-R^2 values. Therefore, only three GUMs have been estimated.

Table 10.21

Summary Results of Specific Models for the Demand Models by Amount (Liberal Strategy) for the United States for the Sample Period 1972-2001

No.	Model	1	2	3	4	5	US5		US6 FSM-c	
1	Constant	1.03785 *** (1.0000)	2.96010 *** (1.0000)	0.37050 *** (1.0000)	1.31232 *** (1.0000)		Constant		Constant	
2	usgdp					0.00473 *** (1.0000)	usgdp			
3	usipc	0.71557 *** (1.0000)							usipc	0.60366 *** (1.0000)
4	usipc_1	-0.81618 *** (1.0000)			-0.12773 *** (1.0000)				usipc_1	-0.57039 *** (1.0000)
5	usm2_1		-0.19423 *** (1.0000)				usm2_1	0.03683 *** (1.0000)	usm2_1	
6	DUSTBR1Y	-0.00734 *** (1.0000)					DUSTBR1Y		DUSTBR1Y	-0.00680 *** (0.7000)
7	DUSTBR1Y_1		-0.00588 * (1.0000)				DUSTBR1Y_1		DUSTBR1Y_1	
8	USIE		-0.00677 *** (1.0000)	-0.00765 *** (1.0000)	-0.00705 *** (1.0000)	-0.00395 ** (1.0000)	USIE	-0.00611 *** (1.0000)	USIE	
9	DUSCBR	0.02222 ** (1.0000)	0.03877 *** (1.0000)				DUSCBR	-0.00471 NS (0.0000)	DUSCBR	
10	DUSCDR	-0.16670 ** (1.0000)	-0.21353 *** (1.0000)				DUSCDR	-0.17946 ** (1.0000)	DUSCDR	-0.16765 ** (1.0000)
11	DUSCDR_1	-0.25491 *** (1.0000)	-0.24690 *** (1.0000)				DUSCDR_1	-0.29639 *** (1.0000)	DUSCDR_1	-0.27931 *** (1.0000)
12	USTFR			-0.16141 *** (1.0000)			USTFR	-0.23723 *** (1.0000)	USTFR	-0.14468 *** (1.0000)
13	DUSLEf	-0.11814 *** (1.0000)	-0.14558 *** (1.0000)				DUSLEf	-0.11223 *** (1.0000)	DUSLEf	-0.11169 *** (1.0000)
14	DUSLEf_1	-0.17017 *** (1.0000)	-0.15603 *** (1.0000)				DUSLEf_1	-0.17646 *** (1.0000)	DUSLEf_1	-0.18195 *** (1.0000)
15										
	Number of GUM(s)	1	1	1	1	1				
	Adjusted-R^2	0.65748	0.61057	0.47341	0.37003	0.16925		0.63041		0.69441
	Sigma	0.01787	0.01906	0.02216	0.02424	0.02784		0.01857		0.01688
	Probability:									
	Chow (1999: 1)	0.3507	0.3783	0.0162	0.0680	0.0079		0.0235		0.0939
	Normality Test	0.8139	0.3329	0.0778	0.2531	0.1839		0.5640		0.7901
	AR 1-4 Test	0.8175	0.9996	0.3956	0.2216	0.1861		0.1962		0.4374
	Hetero Test	0.7695	0.6173	0.4916	0.6539	0.4645		0.4147		0.9458

Dependent Variable: Dusaifpc

Note: Two GUMs are removed because they do not pass the Chow test and one GUM is removed because its congruent model has negative adjusted-R-squared value. Therefore, only five GUMs have been estimated.

Table 10.22

Summary Results of Encompassing Test for US5 and US6 (Liberal Strategy) (United States)

```
Encompassing test statistics: 1972 to 2001

sigma[US5] = 0.0185672  sigma[US6] = 0.0168834  sigma[Joint] = 0.0180796

Test          US5 vs. US6                          US6 vs. US5
Cox           N(0,1)    =   -2.928  [0.0034]**     N(0,1)    = -0.09062  [0.9278]
Ericsson IV   N(0,1)    =    2.131  [0.0331]*      N(0,1)    =  0.07715  [0.9385]
Sargan        Chi^2(3)  =   3.9847  [0.2631]       Chi^2(3)  =  0.21211  [0.9756]
Joint Model   F(3,19)   =   1.4009  [0.2733]       F(3,19)   = 0.061656  [0.9794]
```

Table 10.23

Summary Results of Specific Models for the Demand Models by Amount (Conservative Strategy) for the United States for the Sample Period 1972-2001

No.	Model	1	2	3	4	US7 = Model-1 FSM-d		US8 = Model-1 FSM-d	
1	Constant	0.37050 *** (1.0000)	0.75847 *** (1.0000)		1.54863 ** (0.7000)	Constant	0.37050 *** (1.0000)	Constant	0.37050 *** (1.0000)
2	usgdp		-0.08286 *** (1.0000)			usgdp			
3	usipc			0.73248 *** (1.0000)				usipc	
4	usipc_1			-0.73145 *** (1.0000)				usipc_1	
5	usm2_1				-0.10128 ** (0.7000)	usm2_1		usm2_1	
6	USIE	-0.00765 *** (1.0000)	-0.00784 *** (1.0000)		-0.00681 *** (1.0000)	USIE	-0.00765 *** (1.0000)	USIE	-0.00765 *** (1.0000)
7	USTFR	-0.16141 *** (1.0000)				USTFR	-0.16141 *** (1.0000)	USTFR	-0.16141 *** (1.0000)
	Number of GUM(s)	1	1	1	1				
	Adjusted-R^2	0.47341	0.36019	0.32763	0.32715		0.47341		0.47341
	Sigma	0.02216	0.02443	0.02504	0.02505		0.02216		0.02216
	Probability:								
	Chow (1999: 1)	0.0162	0.0681	0.1793	0.0526		0.0162		0.0162
	Normality Test	0.0778	0.3281	0.2954	0.2373		0.0778		0.0778
	AR 1-4 Test	0.3956	0.1612	0.6957	0.1416		0.3956		0.3956
	Hetero Test	0.4916	0.6815	0.9327	0.7036		0.4916		0.4916

Dependent Variable: Dusaifpc

Note: Two GUMs are removed because they do not pass the Chow test and two GUMs are removed because their congruent models have negative adjusted-R-squared values. Therefore, only four GUMs have been estimated.

Table 10.24
Summary Results of Final Specific Model (FSM-e) for the Lapse Models Using DUSSR (Liberal Strategy) for the United States for the Sample Period 1973-2001

$DUSSR_t$ = 0.00482 $(DUSTBR1Y_{t-1})^*$
[1.0000]

Number of GUM	= 1
Adjusted-R^2	= 0.11894
Sigma	= 0.02080

Probability:

Chow (1999:1)	= 0.0259
Normality Test	= 0.7891
AR 1-4 Test	= 0.1167
Hetero Test	= 0.9725

NB: The value for the reliability coefficient is reported in squared bracket.
Three GUMs are removed because there is nothing to model. Therefore, only one GUM has been estimated.

Table 10.25
Preliminary Regression Model for the Lapse Model with Income per Capita as Income Variable (Malaysia)

```
Modelling MSRN by OLS, 1970 - 2001

                Coeff      StdError  t-value    t-prob
Constant      9.06095      3.20157     2.830    0.0084
mipc         -0.50621      0.32461    -1.559    0.1297
MLEf         -0.04152      0.03806    -1.091    0.2843

sigma                    0.486549  RSS                   6.86517907
R^2                      0.152849  F(2,29) =          2.616 [0.090]
log-likelihood           -20.7777  DW                         0.494
no. of observations            32  no. of parameters              3
mean(MSRN)                1.80076  var(MSRN)               0.253245

                        value        prob
Chow(1998:1)           1.2773       0.3029
normality test         0.2317       0.8906
AR   1-4 test          6.3608       0.0011
hetero test            6.5269       0.1631
```

Table 10.26

Preliminary Regression Model for the Lapse Model with GDP as Income Variable (Malaysia)

```
Modelling MSRN by OLS, 1970 - 2001

                Coeff     StdError  t-value    t-prob
Constant      6.84916     2.56416     2.671    0.0123
agdp         -0.53937     0.26944    -2.002    0.0547
MLEf          0.01372     0.05109     0.268    0.7902

sigma                   0.474797  RSS                 6.53752917
R^2                      0.19328  F(2,29) =       3.474 [0.044]*
log-likelihood          -19.9952  DW                       0.468
no. of observations           32  no. of parameters            3
mean(MSRN)               1.80076  var(MSRN)             0.253245

                      value       prob
Chow(1998:1)         1.8099      0.1701
normality test       0.0242      0.9880
AR   1-4 test        6.9779      0.0006
hetero test          7.1805      0.1267
```

Table 10.27

Re-estimated Regression Model for the Lapse Model with GDP as Income Variable (Malaysia)

```
Modelling MSRN by OLS, 1970 - 2001

                Coeff     StdError  t-value    t-prob
Constant      7.25156     2.04797     3.541    0.0013
agdp         -0.48696     0.18281    -2.664    0.0123

sigma                   0.467396  RSS                 6.55377604
R^2                     0.191276  F(1,30) =       7.095 [0.012]*
log-likelihood          -20.0349  DW                       0.476
no. of observations           32  no. of parameters            2
mean(MSRN)               1.80076  var(MSRN)             0.253245

                      value       prob
Chow(1998:1)         1.9036      0.1528
normality test       0.2572      0.8793
AR   1-4 test        7.2293      0.0005
hetero test          1.0078      0.6042
```

Table 10.28
Preliminary Regression Model for the Demand Model by Number (United States)

Modelling usnifptp by OLS, 1970 - 2001

	Coeff	StdError	t-value	t-prob
Constant	13.15026	0.53643	24.514	0.0000
USTBR1Y	0.00799	0.00226	3.531	0.0015
USCBR	-0.00003	0.00607	-0.005	0.9957
USCDR	-0.17491	0.03133	-5.582	0.0000
USLEm	-0.06071	0.00398	-15.266	0.0000

sigma	0.0263046	RSS	0.0186822095
R^2	0.952191	F(4,27) =	134.4 [0.000]**
log-likelihood	73.7287	DW	0.971
no. of observations	32	no. of parameters	5
mean(usnifptp)	7.36411	var(usnifptp)	0.0122116

	value	prob
Chow(1998:1)	0.6092	0.6155
normality test	0.8012	0.6699
AR 1-4 test	3.7886	0.0165
hetero test	0.3172	0.9491

Table 10.29
Re-estimated Regression Model for the Demand Model by Number (United States)

Modelling usnifptp by OLS, 1970 - 2001

	Coeff	StdError	t-value	t-prob
Constant	13.14993	0.52337	25.125	0.0000
USTBR1Y	0.00799	0.00217	3.681	0.0010
USCDR	-0.17494	0.03017	-5.798	0.0000
USLEm	-0.06071	0.00389	-15.602	0.0000

sigma	0.0258307	RSS	0.01868223
R^2	0.952191	F(3,28) =	185.9 [0.000]**
log-likelihood	73.7287	DW	0.972
no. of observations	32	no. of parameters	4
mean(usnifptp)	7.36411	var(usnifptp)	0.0122116

	value	prob
Chow(1998:1)	0.6015	0.6201
normality test	0.8006	0.6701
AR 1-4 test	3.9401	0.0135
hetero test	0.4863	0.8111

Table 10.30
Unit Root Test Results for the Residuals of the Re-estimated Regression Model for the Demand Model by Number (United States)

```
Unit-root tests for 1971 (1) to 2001 (1)

Augmented Dickey-Fuller test for Resid5; regression of DResid5 on:

              Coefficient    Std.Error      t-value
Resid5_1        -0.48966       0.15978      -3.0646
Constant       0.00063090    0.0039038      0.16161

sigma = 0.0217318  DW = 2.011  DW-US1 = 0.9773  ADF- Resid5 = -3.065***
Critical values used in the cointegration test: 1% = -2.5899
RSS = 0.01369592582 for 2 variables and 31 observations
```

Table 10.31
ECM for the Demand Model by Number (United States)

```
Modelling Dusnifptp by OLS, 1972 - 2001

                        Coeff     StdError  t-value    t-prob
Constant             -0.01446     0.00850   -1.701     0.1036
Resid5_1              0.47203     0.15781    2.991     0.0070
Dusnifptp_1          -0.08995     0.23048   -0.390     0.7003
DUSTBR1Y              0.00404     0.00253    1.597     0.1251
DUSTBR1Y_1           -0.00067     0.00217   -0.307     0.7618
DUSCDR               -0.05343     0.03910   -1.366     0.1862
DUSCDR_1              0.00654     0.04461    0.147     0.8849
DUSLEm               -0.02213     0.02329   -0.950     0.3528
DUSLEm_1              0.03515     0.02715    1.295     0.2095

sigma                  0.0159709  RSS              0.00535644608
R^2                     0.487442  F(8,21) =        2.496 [0.044]*
log-likelihood           86.8916  DW                        1.36
no. of observations           30  no. of parameters            9
mean(Dusnifptp)      -0.00874678  var(Dusnifptp)     0.000348347

                       value        prob
Chow(1999:1)           1.0814       0.3591
normality test         0.0801       0.9607
AR   1-4 test          5.2575       0.0061
hetero test            0.2903       0.9673
```

Table 10.32
Preliminary Regression Model for the Demand Model by Amount (United States)

```
Modelling usaifpc by OLS, 1970 - 2001

                  Coeff      StdError   t-value    t-prob
Constant      -10.68890      1.45418    -7.350    0.0000
USTBR1Y        -0.01928      0.00378    -5.096    0.0000
USCBR           0.02070      0.01020     2.030    0.0524
USCDR           0.46309      0.06566     7.052    0.0000
USLEf           0.21384      0.01177    18.175    0.0000

sigma                    0.0443252  RSS                0.0530475965
R^2                       0.969382  F(4,27) =      213.7 [0.000]**
log-likelihood             57.0308  DW                         1.08
no. of observations             32  no. of parameters             5
mean(usaifpc)              10.2141  var(usaifpc)           0.054142

                        value        prob
Chow(1998:1)           0.6777      0.5742
normality test         0.5625      0.7548
AR   1-4 test          2.9921      0.0399
hetero test            1.2361      0.3344
```

Table 10.33
Unit Root Test Results for the Residuals of the Re-estimated Regression Model for the Demand Model by Amount (United States)

```
Unit-root tests for 1971 (1) to 2001 (1)

Augmented Dickey-Fuller test for Resid6; regression of DResid6 on:

               Coefficient    Std.Error       t-value
Resid6_1          -0.55147      0.16390       -3.3646
Constant        0.00091606    0.0067620       0.13547

sigma = 0.0376459  DW = 1.923  DW-US2 = 1.076  ADF- Resid6 = -3.365***
Critical values used in the cointegration test: 1% = -2.5899
RSS = 0.04109927635 for 2 variables and 31 observations
```

Table 10.34

ECM for the Demand Model by Amount (United States)

Modelling Dusnifptp by OLS, 1972 - 2001

	Coeff	StdError	t-value	t-prob
Constant	0.03185	0.01380	2.309	0.0324
Resid6_1	0.23812	0.16680	1.428	0.1696
Dusaifpc_1	0.13054	0.28077	0.465	0.6473
DUSTBR1Y	-0.00543	0.00437	-1.243	0.2290
DUSTBR1Y_1	-0.00472	0.00429	-1.099	0.2853
DUSCBR	-0.00127	0.01982	-0.064	0.9496
DUSCBR_1	0.00784	0.01570	0.499	0.6235
DUSCDR	-0.06140	0.12864	-0.477	0.6386
DUSCDR_1	-0.09906	0.11882	-0.834	0.4148
DUSLEf	-0.05315	0.06444	-0.825	0.4197
DUSLEf_1	-0.05957	0.06375	-0.934	0.3618

sigma	0.026048	RSS	0.0128914763
R^2	0.52343	F(10,19) =	2.087 [0.080]
log-likelihood	73.7176	DW	1.24
no. of observations	30	no. of parameters	11
mean(Dusaifpc)	0.0202521	var(Dusaifpc)	0.000901684

	value	prob
Chow(1999:1)	2.4106	0.1198
normality test	0.0621	0.9694
AR 1-4 test	5.1845	0.0080
hetero test	18.4832	0.5556

Table 10.35

Preliminary Regression Model for the Lapse Model (United States)

Modelling USSR by OLS, 1971 - 2001

	Coeff	StdError	t-value	t-prob
Constant	0.16140	0.01706	9.459	0.0000
USTBR1Y	0.00593	0.00222	2.675	0.0122

sigma	0.032894	RSS	0.0313784728
R^2	0.197859	F(1,29) =	7.153 [0.012]*
log-likelihood	62.895	DW	0.56
no. of observations	31	no. of parameters	2
mean(USSR)	0.204213	var(USSR)	0.00126188

	value	prob
Chow(1998:1)	0.5472	0.6545
normality test	6.3640	0.0415
AR 1-4 test	11.2363	0.0000
hetero test	4.4646	0.0215

Table 10.36

Summary Results of Final Specific Models (FSMs) for Life Insurance Demand and Lapse Models for Malaysia
(for Variables being Made Constant Using a Combination of Average and End-of-Year CPIs as Deflators)
Using Liberal Strategy (LS) and Conservative Strategy (CS) as the Modelling Starategies

Model	Demand by Number			Demand by Amount		Lapse Using Surrender Rate		
	FSM-A (LS)	FSM-B (LS)	FSM-C (CS)	FSM-D (LS)	FSM-E (CS)	FSM-F (LS)	FSM-G (LS)	FSM-H (CS)
Constant				1.51980 *** (1.0000)	1.30382 *** (0.7000)			
mnifptp_1 / maifpc_1 / DMSRN_1	0.99822 *** (1.0000)	0.99829 *** (1.0000)	0.99857 *** (1.0000)	0.90864 *** (1.0000)	0.91952 *** (1.0000)	0.44978 *** (1.0000)	0.43977 *** (1.0000)	0.32776 *** (0.6241)
Dmgdp	0.06374 ** (1.0000)							-0.59970 ** (0.6178)
DDmgdp							-0.85280 *** (1.0000)	
Dmipc		0.06391 ** (1.0000)						
DDmipc						-0.85534 *** (1.0000)		
MSMR	-0.00019 * (0.7000)	-0.00019 * (0.7000)				-0.00155 ** (1.0000)	-0.00154 ** (1.0000)	
MSMR_1						-0.00270 ** (1.0000)	-0.00273 ** (1.0000)	-0.00403 *** (1.0000)
Dmm2n			0.18668 *** (0.7000)					
Dmm2n_1			-0.12127 ** (0.4000)	0.33850 ** (1.0000)	0.46752 *** (1.0000)			
DDmm2n	0.15418 *** (1.0000)	0.15441 *** (1.0000)						
MIE	0.00983 *** (1.0000)	0.00985 *** (1.0000)	0.00933 *** (1.0000)	-0.02471 *** (1.0000)	-0.02748 *** (1.0000)	-0.03708 *** (0.7000)	-0.03730 *** (0.7000)	
MIE_1				0.01276 *** (1.0000)	0.01522 *** (1.0000)	0.04263 *** (1.0000)	0.04192 *** (1.0000)	
MCBR_1	0.00797 *** (0.7000)	0.00803 *** (0.7000)	0.00846 *** (0.6133)					
MCDR				-0.12911 *** (1.0000)	-0.10880 *** (1.0000)			
MCDR_1	-0.03227 *** (0.7000)	-0.03235 *** (0.7000)	-0.03683 *** (0.3046)					
DMTFR				0.15430 ** (0.7000)				
DMTFR_1	0.09142 *** (1.0000)	0.09145 *** (1.0000)		0.12430 ** (0.7000)				
DMLEm_1	-0.02854 *** (1.0000)	-0.02832 *** (1.0000)	-0.03190 *** (1.0000)					
DMLEf						0.31959 *** (1.0000)	0.32756 *** (1.0000)	0.36179 *** (1.0000)
DMLEf_1						-0.17147 ** (1.0000)	-0.16424 ** (1.0000)	
Adjusted-R^2	0.99949	0.99949	0.99930	0.99860	0.99819	0.72755	0.72063	0.59122
Sigma	0.01781	0.01782	0.02094	0.03895	0.04431	0.16103	0.16306	0.19724
Probability:								
Chow (1999: 1)	0.2477	0.2519	0.6186	0.2561	0.3237	0.8153	0.8092	0.6610
Normality Test	0.2229	0.2265	0.5683	0.8239	0.4661	0.3479	0.2922	0.5654
AR 1-4 Test	0.7921	0.8036	0.6058	0.2135	0.6544	0.4205	0.3982	0.9800
Hetero Test	0.9971	0.9975	0.6502	0.6609	0.2787	0.9908	0.9927	0.8350
Dependent Variable:	mnifptp	mnifptp	mnifptp	maifpc	maifpc	DMSRN	DMSRN	DMSRN

Note: The results for liberal strategy have a plain background; the results for conservative strategy have a shaded background.

Table 10.37
Summary Results of Final Specific Models (FSMs) for Life Insurance Demand and Lapse Models for the United States
(for Variables being Made Constant Using a Combination of Average and End-of-Year CPIs as Deflators)
Using Liberal Strategy (LS) and Conservative Strategy (CS) as the Modelling Starategies

Model	Demand by Number		Demand by Amount		Lapse Using Surrender Rate
	FSM-a (LS)	FSM-b (CS)	FSM-c (LS)	FSM-d (CS)	FSM-e (LS)
Constant				0.37050 *** (1.0000)	
Dusnifptp_1 / Dusaifpc_1 / DUSSR_1	-0.71149 ** (0.4000)				
usgdp_1	0.09247 *** (1.0000)				
usipc			0.60366 *** (1.0000)		
usipc_1			-0.57039 *** (1.0000)		
USSMR_1	-0.00051 ** (0.4000)				
USFD_1	-0.00500 ** (1.0000)				
DUSTBR1Y	0.00649 ** (0.4000)		-0.00680 *** (0.7000)		
DUSTBR1Y_1					0.00482 * (1.0000)
USIE				-0.00765 *** (1.0000)	
USIE_1	-0.00628 *** (1.0000)				
USCBR	0.08991 ** (1.0000)				
USCBR_1	0.03640 ** (1.0000)				
USCDR	-0.14665 *** (0.7000)		-0.16765 ** (1.0000)		
USCDR_1	-0.11936 ** (0.2407)		-0.27931 *** (1.0000)		
USTFR	-0.94818 *** (1.0000)	-0.00467 ** (1.0000)	-0.14468 *** (1.0000)	-0.16141 *** (1.0000)	
USTFR_1	0.76557 *** (1.0000)				
DUSLEm_1	-0.09127 *** (0.7000)				
DUSLEm_1	-0.07805 * (0.5498)				
DUSLEf			-0.11169 *** (1.0000)		
DUSLEf_1			-0.18195 *** (1.0000)		
Adjusted-R^2	0.42938	0.01483	0.69441	0.47341	0.11894
Sigma	0.01434	0.01884	0.01688	0.02216	0.02080
Probability:					
Chow (1998: 1)	0.7892	0.3358	0.0939	0.0162	
Chow (1999: 1)					0.0259
Normality Test	0.0140	0.3366	0.7901	0.0778	0.7891
AR 1-4 Test	0.7650	0.6020	0.4374	0.3956	0.1167
Hetero Test	0.6787	0.1540	0.9458	0.4916	0.9725
Dependent Variable:	Dusnifptp	Dusnifptp	Dusaifpc	Dusaifpc	DUSSR

Note: The results for liberal strategy have a plain background; the results for conservative strategy have a shaded background.

Table 10.38
Regression Model for Model-A (Liberal Strategy) for Malaysia

Modelling mnifptp by OLS, 1971 - 2001

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Mnifptp_1	0.99911	0.00649	154.012	0.0000	0.0000	0.0000	1.0000
Dmgdp	0.06421	0.02906	2.210	0.0390	0.0327	0.1364	0.7000
MSMR	-0.00022	0.00011	-1.931	0.0677	0.0033	0.0833	0.7000
DDmm2n	0.15150	0.04433	3.418	0.0027	0.0037	0.0218	1.0000
MIE	0.01063	0.00255	4.175	0.0005	0.0119	0.0025	1.0000
MCBR_1	0.00825	0.00223	3.704	0.0014	0.2674	0.0097	0.7000
MCDR_1	-0.04103	0.02222	-1.846	0.0797	0.0389	0.3730	0.5881
DMTFR_1	0.09533	0.03127	3.049	0.0063	0.0014	0.0007	1.0000
DMLEm_1	-0.02796	0.00878	-3.185	0.0047	0.0012	0.0238	1.0000
mpn	0.04150	0.09897	0.419	0.6795	0.9429	0.1219	0.1171
mpn_1	-0.03104	0.09734	-0.319	0.7531	0.7027	0.1688	0.1892

RSS	0.00685	sigma	0.01850	R^2	0.99963	Radj^2	0.99945
LogLik	130.48010	AIC	-7.70839	HQ	-7.54253	SC	-7.19956
T	31	p	11				

	value	prob
Chow(1998:1)	1.4580	0.2613
normality test	3.1760	0.2043
AR 1-4 test	0.9240	0.4744
hetero test	19.2509	0.6298

Table 10.39
Regression Model for Model-B (Liberal Strategy) for Malaysia

Modelling mnifptp by OLS, 1971 - 2001

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
mnifptp_1	0.99922	0.00649	153.947	0.0000	0.0000	0.0000	1.0000
Dmipc	0.06445	0.02918	2.209	0.0390	0.0321	0.1356	0.7000
MSMR	-0.00022	0.00011	-1.929	0.0680	0.0033	0.0824	0.7000
DDmm2n	0.15184	0.04435	3.424	0.0027	0.0036	0.0212	1.0000
MIE	0.01065	0.00255	4.180	0.0005	0.0121	0.0025	1.0000
MCBR_1	0.00831	0.00223	3.734	0.0013	0.2660	0.0094	0.7000
MCDR_1	-0.04124	0.02223	-1.855	0.0784	0.0382	0.3698	0.5891
DMTFR_1	0.09535	0.03127	3.049	0.0063	0.0014	0.0007	1.0000
DMLEm_1	-0.02773	0.00880	-3.153	0.0050	0.0013	0.0260	1.0000
mpn	0.04143	0.09898	0.419	0.6800	0.9308	0.1181	0.1208
mpn_1	-0.03084	0.09736	-0.317	0.7547	0.6902	0.1653	0.1929

RSS	0.00685	sigma	0.01850	R^2	0.99963	Radj^2	0.99945
LogLik	130.47777	AIC	-7.70824	HQ	-7.54238	SC	-7.19941
T	31	p	11				

	value	prob
Chow(1998:1)	1.4405	0.2659
normality test	3.1289	0.2092
AR 1-4 test	0.8835	0.4958
hetero test	19.1534	0.6358

Table 10.40

Regression Model for Model-C (Conservative Strategy) for Malaysia

Modelling mnifptp by OLS, 1971 - 2001

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
mnifptp_1	1.00277	0.00707	141.881	0.0000	0.0000	0.0000	1.0000
Dmm2n	0.22139	0.07079	3.127	0.0049	0.0482	0.0060	1.0000
Dmm2n_1	-0.13812	0.05102	-2.707	0.0129	0.0245	0.1021	0.7000
MIE	0.00770	0.00274	2.814	0.0101	0.2064	0.0273	0.7000
MCBR_1	0.00846	0.00258	3.284	0.0034	0.5171	0.0261	0.5449
MCDR_1	-0.04385	0.02418	-1.813	0.0835	0.1360	0.6999	0.1900
DMLEm_1	-0.03148	0.00996	-3.162	0.0045	0.0150	0.0919	0.7000
mpn	-0.08499	0.11315	-0.751	0.4605	0.1736	0.7741	0.1678
mpn_1	0.08941	0.11015	0.812	0.4256	0.1299	0.7153	0.1854

RSS	0.01019	sigma	0.02152	R^2	0.99946	Radj^2	0.99926
LogLik	124.32070	AIC	-7.44005	HQ	-7.30434	SC	-7.02373
T	31	p	9				

	value	prob
Chow(1998:1)	0.6005	0.6226
normality test	3.2253	0.1994
AR 1-4 test	0.5524	0.6998
hetero test	16.1482	0.5822

Table 10.41

Regression Model for Model-a (Liberal Strategy) for the United States

Modelling Dusnifptp by OLS, 1972 - 1998

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
Dusnifptp_1	-0.86163	0.26875	-3.206	0.0069	0.0611	0.0013	1.0000
usgdp_1	0.07569	0.02055	3.682	0.0028	0.0220	0.0003	1.0000
USSMR_1	-0.00051	0.00018	-2.870	0.0131	0.0618	0.0592	1.0000
USFD_1	-0.00413	0.00145	-2.850	0.0136	0.0512	0.0015	1.0000
DUSTBR1Y	0.01016	0.00272	3.731	0.0025	0.0673	0.0008	1.0000
USIE_1	-0.00787	0.00155	-5.085	0.0002	0.0023	0.0000	1.0000
DUSCBR	0.08931	0.02713	3.292	0.0058	0.0022	0.0036	1.0000
DUSCBR_1	0.03503	0.01029	3.404	0.0047	0.0064	0.0002	1.0000
DUSADR	-0.24445	0.06193	-3.947	0.0017	0.0844	0.0007	1.0000
DUSADR_1	-0.17855	0.06490	-2.751	0.0165	0.1081	0.0137	1.0000
USTFR	-0.90903	0.19812	-4.588	0.0005	0.0004	0.0004	1.0000
USTFR_1	0.75773	0.19242	3.938	0.0017	0.0009	0.0074	1.0000
DUSLEm	-0.10840	0.02741	-3.954	0.0016	0.1121	0.0002	1.0000
DUSLEm_1	-0.08074	0.02768	-2.917	0.0120	0.0258	0.0125	1.0000

RSS	0.00160	sigma	0.01110	R^2	0.82257	Radj^2	0.64515
LogLik	131.38982	AIC	-8.69554	HQ	-8.49575	SC	-8.02363
T	27	p	14				

	value	prob
Chow(1996:1)	1.1344	0.3565
normality test	0.3429	0.8424
AR 1-4 test	1.8534	0.2030
hetero test	Not enough observations to carry out the test	

Table 10.42
Regression Model for Model-c (Liberal Strategy) for the United States

Modelling Dusaifpc by OLS, 1972 - 1998

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
usipc	0.63074	0.16343	3.859	0.0011	0.0009	0.0709	1.0000
usipc_1	-0.61056	0.16528	-3.694	0.0015	0.0014	0.1743	0.7000
DUSTBR1Y	-0.00862	0.00289	-2.985	0.0076	0.0014	0.0138	1.0000
USADR	-0.17040	0.08766	-1.944	0.0669	0.7097	0.0046	0.4871
USADR_1	0.16693	0.08780	1.901	0.0725	0.7035	0.0235	0.4889
USTFR	-0.08311	0.04377	-1.899	0.0728	0.0267	0.0152	1.0000
DUSLEf	-0.08011	0.03696	-2.168	0.0431	0.4165	0.0361	0.5750
DUSLEf_1	-0.03968	0.01986	-1.998	0.0603	0.0016	0.3084	0.6075

RSS	0.00692	sigma	0.01909	R^2	0.69418	Radj^2	0.58151
LogLik	111.62450	AIC	-7.67589	HQ	-7.56172	SC	-7.29194
T	27	p	8				

	value	prob
Chow(1996:1)	0.9669	0.4002
normality test	3.6607	0.1604
AR 1-4 test	0.7431	0.5774
hetero test	13.3698	0.6456

Table 10.43
Regression Model for Model-F (Liberal Strategy) for Malaysia

Modelling DMSRN by OLS, 1978 - 2001

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
DMSRN_1	0.31501	0.18586	1.695	0.1122	0.5890	0.1970	0.2233
DDmipc	-0.94082	0.23323	-4.034	0.0012	0.0068	0.0657	1.0000
MSMR	-0.00196	0.00111	-1.764	0.0996	0.4461	0.0303	0.5662
MSMR_1	-0.00337	0.00135	-2.492	0.0259	0.0680	0.0029	1.0000
DMUR	0.06387	0.05166	1.236	0.2367	0.0796	0.6301	0.2110
DMUR_1	-0.03209	0.06062	-0.529	0.6048	0.9786	0.3190	0.0107
MIE	-0.03952	0.02722	-1.452	0.1686	0.3952	0.0158	0.5815
MIE_1	0.04545	0.02735	1.662	0.1187	0.5218	0.0066	0.5435
DMLEf	0.35519	0.07936	4.476	0.0005	0.0003	0.0028	1.0000
DMLEf_1	-0.17547	0.09004	-1.949	0.0716	0.4397	0.1860	0.2681

RSS	0.35681	sigma	0.15964	R^2	0.78277	Radj^2	0.64313
LogLik	50.50323	AIC	-3.37527	HQ	-3.24504	SC	-2.88441
T	24	p	10				

	value	prob
Chow(1999:1)	0.6091	0.5598
normality test	2.2134	0.3307
AR 1-4 test	0.1976	0.9340
hetero test	22.4351	0.3174

Table 10.44

Regression Model for Model-G (Liberal Strategy) for Malaysia

Modelling DMSRN by OLS, 1978 - 2001

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
DMSRN_1	0.30037	0.18890	1.590	0.1341	0.6712	0.2082	0.1987
DDagdp	-0.94206	0.24268	-3.882	0.0017	0.0090	0.0767	0.7000
MSMR	-0.00193	0.00113	-1.707	0.1099	0.4893	0.0333	0.5532
MSMR_1	-0.00343	0.00139	-2.468	0.0271	0.0774	0.0029	0.7000
DMUR	0.06431	0.05274	1.219	0.2429	0.0790	0.6277	0.2117
DMUR_1	-0.03059	0.06183	-0.495	0.6284	0.9258	0.3165	0.0273
MIE	-0.04100	0.02800	-1.464	0.1653	0.3740	0.0150	0.5878
MIE_1	0.04577	0.02806	1.631	0.1252	0.5405	0.0067	0.5378
DMLEf	0.36504	0.08168	4.469	0.0005	0.0003	0.0027	1.0000
DMLEf_1	-0.16684	0.09127	-1.828	0.0889	0.5170	0.2045	0.2449

RSS	0.37158	sigma	0.16291	R^2	0.77378	Radj^2	0.62836
LogLik	50.01661	AIC	-3.33472	HQ	-3.20449	SC	-2.84386
T	24	p	10				

	value	prob
Chow(1999:1)	0.6127	0.5580
normality test	2.1610	0.3394
AR 1-4 test	0.2322	0.9140
hetero test	22.4956	0.3142

Table 10.45

Regression Model for Model-H (Conservative Strategy) for Malaysia

Modelling DMSRN by OLS, 1978 - 2001

	Coeff	StdError	t-value	t-prob	Split1	Split2	reliable
DMSRN_1	0.05569	0.17166	0.324	0.7494	0.6335	0.6702	0.0089
Dagdp	-0.76468	0.32992	-2.318	0.0324	0.0118	0.3825	0.5853
MSMR_1	-0.00258	0.00153	-1.687	0.1088	0.0794	0.0358	0.7000
DMUR	0.08195	0.06033	1.358	0.1912	0.0749	0.1600	0.7000
DMUR_1	0.01059	0.05965	0.178	0.8610	0.5592	0.6455	0.0386
DMLEf	0.34940	0.08340	4.190	0.0006	0.0009	0.0039	1.0000

RSS	0.64342	sigma	0.18906	R^2	0.60828	Radj^2	0.49947
LogLik	43.42815	AIC	-3.11901	HQ	-3.04088	SC	-2.82450
T	24	p	6				

	value	prob
Chow(1999:1)	0.5568	0.5837
normality test	2.8116	0.2452
AR 1-4 test	0.2678	0.8938
hetero test	0.1770	0.9934

CHAPTER 11
CONCLUSIONS AND FUTURE RESEARCH

11.1 Overview and Major Findings

This thesis is undertaken to examine two important aspects of life insurance business, namely the demand for and lapsation of life insurance, from a macroeconomic perspective. More formally, this thesis examines the relationship between the demand for and lapsation of life insurance and specific macroeconomic and demographic factors in the context of Malaysia and the United States (US).

Chapter one highlights the importance of the contribution of life insurance business to the gross domestic product of a nation and the adverse impact of lapsation of life insurance that may hinder the development of life insurance industry. This has prompted this study which seeks evidence of the significance of and relationship between specific macroeconomic and demographic factors and the demand for and lapsation of life insurance.

Chapter two summarises the different definitions for life insurance demand that have been adopted by researchers in the past, noting that the differences are caused by the availability of data. Some researchers focus on the savings element or the protection element of life insurance while some do not differentiate between the two elements. The chapter also reviews the literature related to the demand for life insurance.

The demand for life insurance in this thesis does not differentiate between the savings and protection elements. In the study of Malaysia, life insurance demand refers to new life insurance business defined in three different ways by number, by amount and by premium. In the comparative study between Malaysia and the US, life insurance demand refers to life insurance business in force defined in two different ways by number and by amount. A different representation of life insurance demand is used in the latter study and this is mainly due to the availability of data for the US. Further, the use of an alternative representation for life insurance demand allows us to examine the demand for life insurance from a different perspective.

Chapters three and four are related to the lapsation of life insurance. The earlier part of chapter three provides a summary of the various types of lapse rate that have been used by researchers in their studies, noting that the differences arise not only because of the availability of data but also because of the context and environment where the studies are undertaken (such as different countries have different regulations governing the life insurance industry and thus a different way of defining the lapse rate). The latter part of chapter three reviews the literature addressing lapsation of life insurance.

Chapter four examines the various types of lapse rate that have been utilised for reporting in Malaysia since 1963. The Insurance Act 1996 of Malaysia clearly differentiates two types of lapse rate: the forfeiture rate (for life policies that are terminated within the first three years of their inception, prior to the acquisition of cash values) and the surrender rate (for life policies that are terminated after having been in force for three years or more that have acquired cash values). The surrender rate was first introduced in 1978 in the insurance annual report and the rates are made available dated back to 1970. The forfeiture rate was introduced since 1963 and its method of computation has been redefined and improved from time to time in order to reflect better the forfeiture experience of Malaysia. The forfeiture rate formula (i.e. MFR1) reported in the insurance annual report with the largest data series (i.e. 1964 to 1993) is chosen for investigation in this thesis. However, the formula does not correspond with the definition in the Insurance Act of Malaysia (because the denominator fails to take into account three years of new life insurance business as the exposed to the risk of forfeiture). Thus, three new methods for computing the forfeiture rate [in which two of them are assumed to be dependent on calendar year (i.e. MFR2 and MFR3) and another one is dependent on duration] are explored, where the exposed to the risk of forfeiture considers three years of new life insurance business. However, the methodology for the forfeiture rate dependent on duration fails to work and subsequently has been abandoned.

In the study of Malaysia, lapsation of life insurance refers to four types of lapse rate. Three of the lapse rates are forfeiture rates computed using different methods, namely MFR1, MFR2 and MFR3 and the other one is the surrender rate. In the comparative study, lapsation of life insurance refers to the surrender rate only.

Chapter five describes the nature and characteristics of the data in this thesis. There are two major data sets: the Malaysian and US data sets. All of the data are secondary in nature. They are annual aggregate data and can be classified into three different categories, namely the insurance, macroeconomic and demographic data. The data collected for Malaysia are subject to the availability of data published in the various annual reports. Due to this limitation, a similar type of data is collected for the US so that a comparison of the findings between the two countries can be made.

Chapter six illustrates the specification of the two major models of this thesis, i.e. the demand and lapse models. It also provides the operational definitions for the variables and their hypothesised relationships with respect to the demand for and lapsation of life insurance.

The demand for life insurance is modelled as a function of (a) the factors that affect the consumers' ability to buy and the size of the potential market – the proxy variables are income, stock market performance and financial development, (b) the factors that affect the consumers' decisions on savings and the accumulation of financial assets – the proxy variables are the savings deposit rate, the 12-month fixed deposit rate, the average discount rate on three-month treasury bills and the Treasury one-year yield, (c) the factors that affect the consumers' purchasing power in acquiring financial assets – the proxy variables are inflation and the price of insurance and (d) the demographic characteristics of the population – the proxy variables are crude live-birth rate, death rate, total fertility rate and the life expectancy at birth for males and females. Income, stock market return, financial development and death rate are hypothesised to relate positively to life insurance demand. The interest rates of alternative investment, the price of insurance and life expectancy at birth are hypothesised to relate negatively to life insurance demand. The inflation rate is hypothesised to have a positive relationship with the demand for life insurance protection but a negative relationship with the demand for life insurance savings. At this stage, it is not clear how the crude live-birth rate and total fertility rate are related to the demand for life insurance but the prior expectation is that they are related positively to life insurance demand.

Lapsation of life insurance is modelled as a function of (a) the need for cash due to the liquidity constraints of policyholders [i.e. the emergency fund hypothesis (EFH)] – the proxy variables are income, stock market performance and unemployment, (b) interest rate arbitrage (i.e. the interest rate hypothesis) – the proxy variables are the savings deposit rate, the 12-month fixed deposit rate, the average discount rate on three-month treasury bills and the Treasury one-year yield, (c) the preservation of purchasing power – the proxy variables are inflation and the price of insurance and (d) the demographic characteristics of the population – the proxy variables are crude live-birth rate, death rate, total fertility rate and the life expectancy at birth for males and females. Income, stock market return and the price of insurance are hypothesised to relate negatively to lapses. Unemployment, the interest rates of alternative investment and inflation are hypothesised to relate positively to lapses. However, it is not clear how the demographic variables are related to lapsation of life insurance.

Chapter seven outlines in detail the procedures to analyse the data. A dynamic, general-to-specific (Gets) approach is adopted in order to analyse the data. PcGets, a computer-automated software for econometric model selection, is used in order to facilitate the analysis in this thesis. A general estimation equation in the form of an autoregressive distributed lag model with one lag for each of the potential variables [i.e. ADL(1,1)] is formulated to be subject to a subsequent simplification. The general model is examined against a range of mis-specifications tests such as the residual autocorrelation test (i.e. Lagrange Multiplier test), the heteroscedasticity test (i.e. White test), the normality test (i.e. Jacque-Bera normality test) and the parameter constancy test (i.e. Chow test) to ensure data coherence. If the general model passes all of the mis-specification tests, the general model is subject to subsequent simplifications. In the simplification process, the statistically insignificant variables are eliminated with the various mis-specification tests checking the validity of the reduction. The completely irrelevant variables are removed first. Then, all of the initially feasible reduction paths are explored in order to remove the less obviously irrelevant variables before selecting a non-dominated model between the contending models by using the encompassing test. Consequently, the specific model obtained is parsimonious, encompassing the general model, and is not dominated by any other models.

The investigations in this thesis use the two built-in pre-defined modelling strategies available in PcGets, i.e. the liberal and conservative strategies. The liberal strategy focuses on minimising the non-selection probability of relevant variables so that there is a higher probability of retaining the relevant variables. The conservative strategy focuses on minimising the non-deletion probability of irrelevant variables so that there is a higher probability of eliminating the irrelevant variables. The two extreme modelling strategies are used for analysis so that a comparison can be made between the findings of the liberal and conservative strategies in order to identify the variables that are related strictly to the demand for and lapsation of life insurance.

Chapters 8–10 present and discuss the findings of the analysis. Chapter eight and nine are devoted to the demand and lapse models for Malaysia respectively. Chapter ten deals with the comparative study of the demand and lapse models between Malaysia and the US.

In chapter eight, there are two sets of empirical findings for the demand models of Malaysia that have used the liberal and conservative strategies for simplification. In SET-1, all of the stock and flow variables at market prices are deflated by the average annual consumer price indices (CPIs) into constant price (although we note that this is not a completely correct way of deflating the stock variables). In SET-2, the end-of-year and average annual CPIs are used as deflators as appropriate. The analysis of SET-2 is made possible when the missing (unpublished) end-of-year CPIs were provided by the central bank of Malaysia at a later stage of this project. The analysis of life insurance demand of Malaysia reveals the following:

(a) The final specific models obtained under SET-1 and SET-2 are different, which indicates the effect of an inappropriate approach to deflation of the stock and flow variables.

(b) There is more variation in terms of the number and type of variables retained in the final specific models of the liberal strategy (that has a more lenient removal criterion) than in those of the conservative strategy (that has a more stringent removal criterion) under both SET-1 and SET-2.

(c) The demand models by amount and by premium conform more closely to expectation than the demand models by number. However, the demand model by number appears to have a better goodness of fit (as having higher adjusted-R^2 and lower σ values) than the demand models by amount and by premium.

(d) The group of variables that relates significantly to new life insurance business is not the same when the demand is defined by number, by amount and by premium. Only the change in total fertility rate in the previous period consistently is found to have a significant positive relationship with new life insurance business by number, by amount and by premium. The findings suggest that when fertility rates are increasing, the purchase of new life insurance tends to increase.

(e) For the factors that affect the consumers' ability to buy, only income and stock market return are found to have the expected significant positive relationship with new life insurance business by amount and by premium. Although stock market return and financial development are found to have a significant relationship with new life insurance business by number, their findings do not conform to expectation.

(f) The findings on whether gross domestic product (GDP) or income per capita is a better proxy for the income variable are mixed and inconclusive.

(g) The savings deposit rate emerges to be a better interest rate proxy over the fixed deposit rate and the discount rate on treasury bills in explaining new life insurance business by amount and by premium. However, savings deposits seem not to be a competing product to life insurance as a savings instrument.

(h) The inflation rate appears not to be an important factor affecting new life insurance business by amount and by premium. It is found to have a significant relationship with new life insurance business by number of policies only. On the other hand, the price of insurance appears to be a determining factor of the consumers' decisions to acquire life insurance. A high insurance cost tends to discourage the purchasing of life insurance (by number, by amount and by premium).

(i) For the demographic variables, the total fertility rate is found to be of paramount importance in relation to new life insurance business by number, by amount and by premium [refer to (d)]. The crude death rate is found to have a significant positive relationship with new life insurance business by amount only. The findings suggest that a high probability of death tends to induce the purchasing of a larger amount of life insurance. The findings on the crude live-birth rate and life expectancy at birth are inconsistent. Therefore, no conclusion can be drawn in connection with their relationship with new life insurance business.

(j) Only the GDP and life expectancy at birth for males are found to have a long-term relationship with new life insurance business by amount. The short-term changes in the expected life span for males are not an important factor affecting the amount of new life insurance business. In the short-run, only the changes in income level affect significantly the amount of new life insurance business but the speed of adjustment towards equilibrium in response to the changes in income seems to be plausible.

In chapter nine, there are also two sets of empirical findings, namely SET-1 and SET-2 as discussed in chapter eight, for the lapse models of Malaysia using the liberal and conservative strategies for simplification. The major findings indicate the following:

(a) The final specific models obtained under SET-1 and SET-2 are different, which indicates the effect of an inappropriate approach to deflation of the stock and flow variables.

(b) The final specific models under the liberal strategy tend to retain more in terms of number and type of variables as compared with those under the conservative strategy for both SET-1 and SET-2.

(c) The variables retained in the lapse models using the improved formulae (i.e. MFR2 and MFR3) to compute the forfeiture rate are almost identical but they are quite different from those retained in the lapse models using the formula adopted by the central bank of Malaysia (i.e. MFR1) in reporting the forfeiture rates in the insurance annual reports. The former two lapse models using the refined formulae (i.e. MFR2 and MFR3) are superior models than the latter lapse models using the formula adopted by the central bank of Malaysia (i.e. MFR1) in terms both of the computation method of the forfeiture rate and the goodness of fit of the estimated model.

(d) Considering the lapse models using MFR2 and MFR3, the MFR2 models appear to be superior relative to the MFR3 models, allowing for the time and work involved in calculating the forfeiture rate and the degree of accuracy of the estimated model. MFR2 is a simpler computation method for estimating the forfeiture rate than MFR3. Although the lapse models using MFR2 can explain a slightly smaller proportion of the variance in forfeiture rate than the lapse models using MFR3, the models estimated using MFR2 have a greater degree of accuracy (as reflected by lower σ values).

(e) The stock market return in the previous period is found to have an important relationship with lapsation of life insurance. Specifically, the stock market return in the previous period (i.e. negative) and the crude death rate in the previous period (i.e. positive) have a significant relationship with the forfeiture rate of life insurance. The surrender rate in the previous period (i.e. positive), the stock market return in the previous period (i.e. negative) and the anticipated change in the life expectancy at birth for females (i.e. positive) have an important relationship with the surrender rate of life insurance.

(f) Both the forfeiture and surrender rates of life insurance appear to be affected by the emergency fund effect with respect to the performance of the stock market in the previous period. However, income levels and unemployment do not seem to have an emergency fund effect on life insurance forfeiture rate. Whilst both the income levels and unemployment are found to have a significant relationship with life insurance surrender rate, no conclusion can be drawn in connection with their effects on EFH.

(g) Income per capita is found to be a better income variable than the GDP in explaining the surrender rate of Malaysia.

(h) The discount rate on treasury bills is identified to be an important interest rate but it does not produce the intended (positive) interest rate effect on the forfeiture rate of life insurance. On the other hand, the fixed deposit rate is found to have a significant positive interest rate effect on the surrender rate of life insurance.

(i) The inflation rate has a significant relationship with the propensity to forfeit or surrender a life policy. It is related negatively to the surrender rate for Malaysia, suggesting that in an environment of rising inflation rate, the policyholders tend not to surrender their life policies because the subsequent replacement cost with a new policy would be expected to be higher. The relationship between the inflation rate and forfeiture rate cannot be clearly ascertained because of inconsistent findings.

(j) The price of insurance is found to be associated significantly with life insurance forfeiture and surrender rates. When the costs of obtaining insurance protection become more expensive, the forfeiture rate tends to be lower. However, it is an unexpected finding that when the cost of insurance is rising, the surrender rate tends to be higher.

(i) For the demographic factors, the crude live-birth rate and crude death rate are found to have a significant positive (lagged) relationship with the forfeiture rate of life insurance. The total fertility rate has a significant positive (lagged) relationship with the surrender rate of life insurance. For life expectancy at birth, its relationship with the forfeiture rate is positive but its relationship with the surrender rate cannot be confirmed because of inconsistent findings.

In chapter 10, the comparative study examines the demand for and the surrender rate of life insurance between Malaysia and the US. The stock and flow variables are deflated as appropriate.

The primary results for life insurance demand are as follows:

(a) A judgement cannot be made as to (i) whether the demand models by number or by amount and (ii) whether the demand models for Malaysia or the US conform more closely to expectation. In general, all of the demand models for Malaysia appear to have a higher adjusted-R^2 value but all of the demand models for the US tend to have a lower σ value.

(b) No specific variable consistently is found to have a significant relationship with life insurance business in force by number and by amount for both Malaysia and the US. Broadly speaking, the demand level in the previous period, income, stock market return, financial development, inflation rate, crude live-birth rate, crude death rate, total fertility rate and life expectancy at birth for males are found to have an important relationship with the number of life policies in force in the two countries. On the other hand, generally speaking, the inflation rate, crude death rate and total fertility rate are found to have an important relationship with the amount of life insurance in force in Malaysia and the US. In general, the inflation rate, crude death rate and total fertility rate are the three factors that appear to have a significant relationship with life insurance business in force by number and by amount in Malaysia and the US.

(c) The findings on income and stock market return are consistent for Malaysia and the US but they do not have a strong relationship with life insurance business in force by number of policies. Having a higher income enhances the consumers' ability to purchase new policies and to preserve their existing policies but a booming stock market does not seem to be associated with a higher level of the number of life policies in force. Meanwhile, the findings on financial development are inconsistent for the two countries. A more developed financial market tends to relate to having a higher number of life policies in force in Malaysia but the opposite tends to hold for the US.

(d) On the other hand, income is found to be an important factor in the US only but its relationship with life insurance business in force by amount cannot be confirmed with certainty. The performance of the stock market does not have any association with life insurance business in force by amount in both Malaysia and the US. Higher financial development plays a crucial role in Malaysia in boosting the amount of life insurance in force.

(e) The simple measure for financial development (being the broad definition of money or M2) is deemed to be an appropriate and adequate proxy for financial development for a developing country like Malaysia in explaining the variance in life insurance business in force by number and by amount in Malaysia.

(f) There is no interest rate effect on life insurance business in force by number and by amount in Malaysia as the discount rate on treasury bills is not retained in all of the demand models of Malaysia. Although the Treasury one-year yield is found to be associated significantly with life insurance business in force by number and by amount in the US, its relationship with life insurance business in force is inconclusive. The Treasury one-year yield has a positive interest rate effect on the number of life policies in force (unexpectedly) but a negative interest rate effect on the amount of life insurance in force in the US.

(g) The inflation rate is found to have a negative relationship with life insurance business in force by number and by amount in the US but it more frequently tends to be associated positively with life insurance business in force by number and by amount in Malaysia.

(h) The crude live-birth rate is found to be associated positively with life insurance business in force by number in both Malaysia and the US, and with life insurance business in force by amount in the US only The findings on crude death rate are consistent for Malaysia and the US but the crude death rate unexpectedly is found to have a negative relationship with life insurance business in force by number and by amount. The findings on total fertility rate are mixed. The total fertility rate is related positively and significantly to life insurance business in force in Malaysia but its relationship with life insurance business in force in the US cannot be confirmed. The findings on life expectancy at birth are as expected since life expectancy at birth is found to relate negatively to life insurance business in force by number and by amount.

The following conclusions are reached for the surrender rate of life insurance:

(a) The surrender rates in Malaysia and the US are affected by a completely different set of factors. A number of factors such as income, the performance of the stock market, inflation rate and life expectancy at birth are found to have a significant relationship with the surrender rate in Malaysia. On the other hand, the Treasury one-year yield appears to be the primary macroeconomic factor that is related significantly to the surrender rate in the US.

(b) The findings for Malaysia provide considerable support for the EFH. Disposable income tends to affect inversely the surrender rate. When the stock market is in a bearish condition, the surrender rate tends to be high. The surrender rate tends to be high during a period of high unemployment. However, there is no evidence of the emergency fund effect on the surrender rate in the US.

(c) The income per capita is found to be a better income variable than GDP in explaining the surrender rate in Malaysia.

(d) The findings on Treasury one-year yield lend support to the IRH for the US. The Treasury one-year yield is found to have a significant positive relationship with the surrender rate for the US. The findings for Malaysia discover no evidence of an interest rate effect on surrender rate. The discount rate on treasury bills is not retained in any regression models for Malaysia.

(e) The inflation rate is found to be an important factor but a conclusion cannot be made with regard to its relationship with the surrender rate for Malaysia.

(f) Among the demographic variables, only the life expectancy at birth for females appear to be related significantly to the surrender rate of Malaysia but no conclusion can be made with respect to their relationship. All of the demographic variables examined in this study are not important factors affecting the surrender rate of the US.

11.2 Concluding Remarks

Comparing the results between the demand for and lapsation of life insurance in Malaysia (refer to Tables 8.36 and 9.39), the following major conclusions can be made:

(a) The findings on income show that it is positively associated with new life insurance business but negatively associated with the surrender rate. This implies that declining disposable income has an adverse impact on the life insurance industry in Malaysia. Lower disposable income tends to support a lower level of the demand for new life insurance (by amount). Further, due to the emergency fund effect, the policyholders tend to surrender their life policies for cash values in order to ease their financial difficulties.

(b) The findings that the stock market return has a positive relationship with new life insurance business (by amount) but a negative relationship with both the forfeiture and surrender rates demonstrate that the life insurance industry in Malaysia is vulnerable at the times when there is a decline in stock market return in the previous period.

(c) The findings on the various interest rates show that among the three alternative rates of return from the investment in savings deposits, fixed deposits and treasury bills, only fixed deposits appear to be a competing product to life insurance (as reflected by the positive relationship between the surrender rate and fixed deposit rate).

(d) The findings on the cost of insurance indicate that the pricing of insurance plays a crucial role in the life insurance industry of Malaysia with respect to its new business. When the costs of obtaining life insurance become more expensive, the demand for life insurance declines and the forfeiture rate tends to be lower. However, the findings for the surrender rate indicate otherwise, since we would have expected it to be lower as well. The higher surrender rate might be caused by the genuine monetary need of the policyholders in order to serve a specific purpose.

(e) The findings that (i) the crude death rate has a positive relationship with new life insurance business (by amount) and the forfeiture rate, and (ii) the total fertility rate has a positive relationship with new life insurance business (by amount) and the surrender rate suggest that the net positive effect on the new business of the life insurance industry in Malaysia is reduced as it is offset by the lapses.

A comparison between the findings of the demand models for Malaysia using a different representation for life insurance demand, i.e. when life insurance demand is defined as new life insurance business and when it is defined as life insurance business in force (refer to Tables 8.36, 10.36, 10.38–10.42), the following major conclusions are reached:

(a) Total fertility rate is found to be of paramount importance in relation to life insurance business for both the new business and the business in force. The findings strongly suggest that when total fertility rates are increasing, the need for life insurance is essential. Hence, it tends to support a higher demand for new life insurance and a higher level of life insurance in force.

(b) The findings on the cost of insurance show that the price of insurance is a key factor to the consumers at the point when they make a decision to purchase new life insurance but not in the situation when they are current owners of life policies.

For the comparative study between Malaysia and the US, the primary findings can be concluded as follows (refer to Tables 10.36 and 10.37):

(a) Treasury yield is found to be an important interest rate affecting the life insurance industry in the US but it is not the case in Malaysia.

(b) Both the demand and lapse models of the US have a substantially lower adjusted-R^2 value than those of Malaysia indicating that there are other variables that are important in explaining the demand for and the surrender rate of life insurance in the US. The US has a much more developed economy than Malaysia, and further research would be needed to identify the relevant variables and to improve these US models.

The above findings may be useful to policymakers, especially the life insurance companies. As the findings indicate that declining disposable income and unattractive stock market return have an adverse impact on life insurance industry, insurance companies can provide training to their sales representatives or agents so that they only recommend life insurance that is affordable to their prospects but not resort to pressure selling. The finding that the cost of insurance is a key factor in the consumers' decision to acquire life insurance can contribute to the growth of life insurance industry. In this respect, if the insurance companies can price their life insurance products at a reasonable cost, life insurance become more affordable, and this will help to boost the demand for life insurance to a higher level. With regard to the findings on the interest rate effect and the offsetting effect produced by the crude death rate and total fertility rate, the insurance companies and the government can play a role in educating the population on the importance of life insurance and the negative effects of lapsing a life policy.

11.3 Future Research

This section considers some useful areas for future research as the possible extensions to this thesis:

(a) This thesis suffers from two major setbacks. First, it has a small sample size because of the limited availability of the data, especially the insurance related data (i.e. the dependent variables). Second, alternative proxy variables are used in place of more favourable proxy variables because of certain data for the explanatory variables needed for the studies in this thesis are either not available or their data series are too short for analysis. For example, the registered unemployment rate and crude death rate are used in place of the most commonly quoted measure for unemployment rate and age-adjusted death rate respectively. Therefore, further research is warranted. It is suggested that a study be conducted in the future when the database has grown larger so that a bigger sample size would be available for capturing the "real" relationship between the macroeconomic and demographic factors and the demand for and lapsation of life insurance.

(b) The US models indicate that there are other variables that are important have not been considered. As the US is a developed country and has an advanced economy, other types of macroeconomic and demographic factors are affecting its life insurance industry. Therefore, it is suggested that further study also includes other variables that might of importance to the demand for and lapsation of life insurance in the US.

(c) In this thesis, a general model is formulated which includes both the macroeconomic and demographic variables together but only allows one proxy representing a variable to enter the general model at a time. It is suggested that further study can take a different approach in which two general models are formulated so that the macroeconomic and demographic variables enter the general models separately and are combined at a later stage.

(d) In performing the simplification of the general model, we started the work by doing it manually in the econometric package EView. Then, we employed the backward method of stepwise regression analysis in SPSS to automate the simplification process before finally deciding to use PcGets, the automated software for econometric model selection, to facilitate the analysis. It is suggested that a further study can try to use another new tool for model building which is called the Relevant Transformation of the Inputs Network Approach (RETINA) (Perez-Amaral, Gallo and White, 2003; Castle, 2004). RETINA is different from PcGets. PcGets adopts the Gets methodology but RETINA uses a specific-to-general approach in which variables are added into the model depending on a given set of criteria. Further, RETINA could be a useful tool in deriving a parsimonious model conditional on a set of variables deemed to be of interest in a particular situation where a strong prior opinion of the form of the suitable function linking available information, or the relevance of individual variables, is not known.

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The data on the Dow Jones Industrial Average (DJIA) index are extracted from the online service of Datastream database.