Stock and Foreign Exchange Markets in the Pacific Basin Rim

Fabiola Ravazzolo

A Thesis Submitted for the Degree of
Doctor of Philosophy

City University Business School
Department of Banking and Finance

March 2002

To my parents

TABLE OF CONTENTS

CHAPTER SIX: MEASURING FINANCIAL AND ECONOMIC INTEGRATION WITH EQUITY PRICES IN EMERGING MARKETS........149

CHAPTER SEVEN: CURRENCY RISK IN EMERGING EQUITY MARKETS........191

CHAPTER EIGHT: CONCLUSION........243

8.1 INTRODUCTION........244

LISTS OF TABLES

LIST OF ILLUSTRATIONS

ACKNOWLEDGEMENT

I would like to first express my greatest thanks to my supervisor Professor Kate Phylaktis for the encouragement, guidance, and strict supervision to complete this thesis. Her inspiring suggestions and accurate comments helped me in the realisation of a valuable and rewarding research work. I would also like to thank the Economic Social Research Council (ESRC) for recognising the value of my doctoral thesis with an Award. I am also grateful to Professor Charles Baden-Fuller for offering me the job as research assistant at City University Business School, which helped me in supporting part of my study for the Ph.D. Finally, I would immensely like to thank my parents and my brother.

DECLARATION OF COPYRIGHT

ABSTRACT

The thesis examines the stock and foreign exchange markets of a group of Pacific Basin countries. The main purpose is to investigate the role of foreign ownership restrictions and taxes on potential linkages between these markets, and their interrelations with the rest of the world. The overall analysis highlights the presence of substantial financial links at the regional and global level. In particular, it shows close financial links even for markets with extensive capital controls. It also finds linkages between their stock and foreign exchange markets and that foreign currency risk is a significant component of domestic stock returns. When examining for potential sources of these close financial links, the research indicates that Country Funds have provided indirect ways of foreign participation in the local stock markets and contributed to these financial links. Furthermore, the thesis also emphasised the role of economic integration of the Pacific Basin countries for their financial integration. The study found that the Asian financial crisis of mid 1997 had some effects on the financial links of the Pacific Basin Rim at the regional and global level. In addition, while the turmoil has increased the economic integration at the regional level, it has reduced economic integration with the U.S. However, the thesis shows that neither Japan, nor the U.S., dominates the Pacific Basin Rim. Some countries, such as Thailand, present closer links with the U.S., and others, such as Korea and Taiwan, with Japan. The evidence provided in the thesis has implications for international portfolio diversification and for the use of foreign exchange restrictions to isolate local capital markets from world market influences.

ABBREVIATIONS

ADRs	American Depositary Receipts
AIC	Akaike Information Criterion
AR	Autoregressive
ARCH	Autoregressive Conditional Heteroscedasticity
ARMA	Autoregressive Moving Average
ARIMA	Autoregressive Integrated Moving Average
CAPM	Capital Asset Pricing Model
CPI	Consumer Price Index
ECM	Error Correction Model
FCF	First Country Fund
FIML	Full Information Maximum Likelihood
GARCH	Generalised Autoregressive Conditional Heteroscedasticity
GDP	Gross Domestic Product
GMM	Generalised Method of Moments
ICAPM	International Capital Asset Pricing Model
IFC	International Financial Corporation
iid	identically independent distributed
I(d)	Variable Integrated of order d
KOREA	The name Korea indicates only South Korea
LB	Ljung-Box statistic test
Ln	Logarithmic function
MA	Moving Average
ML	Maximum Likelihood
OLD	Official Liberalisation Date
OLS	Ordinary Least Squares
PBC	Pacific Basin Country
PPP	Purchasing Power Parity
QMLE	Quasi Maximum Likelihood Estimator
SIC	Schwarz Information criterion
UIRP	Uncovered Interest Rate Parity
VAR	Vector Autoregressive system
VECM	Vector Error Correction Model
UK	United Kingdom
U.S.	United States

TABLE OF SYMBOLS

$\alpha_{\perp}$ = orthogonal component of the vector α
cov(x,y) = covariance between x and y
d_t = log real dividend
dy_t = dividend yield
DC_i = a dummy variable assuming value of one before the liberalisation of country i and zero otherwise
Dum = a dummy variable assuming value of one from 1997.07 to 1998.02 and zero otherwise
δ_t = logarithmic of the dividend price ratio
Δ = the first difference operator ($\Delta r_t = r_t - r_{t-1}$)
e_t = log of the domestic excess stock return
$\tilde{e}_i$ = innovation of variable e_i
ε_t = disturbance
E_t = expectation operator at the end of period t
ex_t = the spot nominal exchange rate
exp(x) = exponential function of x
f_t = foreign excess stock returns
h_{xy} = covariance between variables x and y
h_{xx} = variance of the variable x
ir = nominal interest rate
$\hat{\lambda}_i$ = estimated parameter λ_i
log(x) = the logarithmic function of x
P_t = the nominal stock market index
% = percentage
$\prod_i^t$ = the product from 1 to t
q_t = the real exchange rate expressed as units of U.S. against a unit of PBC currency
R_t = the nominal stock market return
$\rho(x,y)$ = correlation between x and y
r_t = the log real interest rate
S_t = the real exchange rate expressed as units of PBC currency against a unit of U.S. dollar
$\sum_1^t$ = the sum from 1 to t
$\sqrt{x}$ = square root of x
var(x) = the variance of x
w_t = estimated error
X_t = nominal exchange rate return
Y_t = a vector of variables

CHAPTER ONE

INTRODUCTION

1.1 Objective of the thesis

The main objective of this thesis is to perform a comprehensive examination of the behaviour of the stock and foreign exchange markets for a group of Pacific Basin countries: Hong Kong, Indonesia, South Korea, Malaysia, Philippines, Singapore, Taiwan and Thailand. In particular, the overall purpose is to identify the role of foreign exchange restrictions on the links amongst these financial markets and between these markets and those of the industrialised world. In fact, this research intends to clarify the channels through which exogenous shocks impact on stock and foreign exchange markets and link them together. It also attempts to investigate the sources that contribute to the financial linkage of the Pacific Basin Rim. This is to establish if financial integration is a consequence of capital market liberalisation, or if there are alternative channels through which capital markets become closer.

When considering capital markets, which are subject to foreign ownership restrictions, Country Funds might be used by foreign investors as indirect ways to enter the local stock markets. The thesis intends to examine whether Country Funds contribute to financial linkages between capital markets. In addition, the open character of a country in terms of trade activity might also generate links of its other sectors with the rest of the world. Therefore, this work examines the role of economic integration on the financial integration of the Pacific Basin countries at the regional and global level.

Another objective of the thesis is to identify risks associated with stock and currency returns and to examine whether capital controls affect the sources of their premium. In particular, it is of interest to recognise if there has been a change in these sources of risk after foreign investors were allowed to enter the Pacific Basic capital markets. The thesis also examines whether the Asian financial crisis of mid 1997 affected the links amongst the Pacific Basin financial markets and their interrelations with the developed world.

Finally, this research attempts to establish whether Japan, or alternatively the U.S., dominates the Pacific-Basin capital markets, especially after the gradual relaxation of foreign exchange restrictions that has taken place in different periods, in the "Tigers" (Korea, Hong Kong, Taiwan and Singapore) and "Dragons" (Indonesia, Malaysia, Philippines and Thailand) East Asian economies.

1.2 Contribution to the literature

In the last two decades the interest of international investors in emerging capital markets has increased. In particular, much more attention has been turned to the Asian economies. Net private capital inflows[1] for developing countries as a whole, as measured by the capital account surplus (including balance of payments errors and omissions), increased from $18 billion in 1988 to $145.2 billion in 1993 and $207.8 billion in 1996. In East Asia[2], private capital flow averaged about $8 billion per year in the period 1986-89, and rose to $58.2 billion in 1993 and to $88.4 billion in 1996.[3] During the Mexican and the Asian crises the amount of private capital flows to emerging countries strongly decreased, for instance, the net private capital flows was as a whole $193.9 billion and for East Asia $68.5 billion in 1997 and $153.9 billion and $44.6 billion in 1998.[3] The interest of foreign investors almost returned to previous crisis level in 1999. In fact, net private capital flows was as a whole $184.8 billion and for East Asia $65.7 billion.[3] However, the recent global economic slowdown and fall of the financial markets of the developed world, made investment in emerging markets less attractive due to a decrease of the risk appetite of international investors. As a consequence, the net private capital flows to developing markets is expected to be as a whole $162.5 billion and for East Asia $40.4 billion in 2001.[3]

Lower short-term interest rates in United States, due to a business cycle and expansionary monetary policy in the early 1990s, "pushed" capital flows to emerging markets where ex ante returns were higher. The business cycle recession in the 1990s, first in United States and later in Japan and in many countries in Europe, made profit opportunities in developing countries appear more attractive. On the other hand, foreign capital was attracted by reforms adapted by local Authorities to improve macroeconomic performance through lower inflation and reductions in public sector deficits. Other relevant reforms included the reduction of governmental controls over economic activity, the privatisation of state-owned firms, and the lowering of tariffs and quantitative import barriers.

---

[1] Net capital inflows include foreign direct investment, portfolio equity, bond issues, loans, and other net liabilities. Emerging markets include developing countries, countries in transition, Korea, Singapore, Taiwan Province of China, and Israel.

[2] East Asia includes the countries of Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan Province of China, and Thailand.

[3] *World Economic Outlook*, October 1996, table A33 and October 2001, table 1.2, International Monetary Fund periodically publications.

During this period an increase of the correlation between developing and industrialised financial markets has been noted. In particular, stronger financial links were not always associated with reforms introduced to open the new equity markets to foreign ownerships (for instance, see Bekaert and Harvey (1995)). Moreover, not only there has been an increase of the linkage on intermarket basis, but it has also been observed a more substantial link on crossmarket basis. The recent financial crises that occurred in the emerging world showed the existence of substantial links amongst developed and emerging equity markets and between their stock and foreign exchange markets. The Mexican crisis in 1994, the Asian crisis in 1997, the Russian crisis in 1998, and the Brazilian crisis in 1999 started with the devaluation of the currencies and therefore from the foreign exchange market turmoil. It simultaneously extended to the domestic stock market and to most of the financial markets around the world creating the so called "contagion effect". This evidence called for the examination of potential interrelations between stock and foreign exchange markets and for a clarification of the channels contributing to their linkages.

Economic theory suggests a relationship between stock and foreign exchange performances. "Flow oriented" models of exchange rate determination, (see e.g. Dornbush and Fisher (1980)), show that exchange rate movements affect international competitiveness and the balance of trade position, and consequently the real output of the country, which in turn affects current and future cash flows of companies and their stock prices. On the other hand, "stock" models of exchange rate of determination (see Branson (1983) and Frankel (1983)) indicate that any change in the demand for and supply of domestic money, domestic and foreign securities, will change the equilibrium exchange rate. Previous studies, which have examined the relationship between stock and foreign exchange markets mainly focusing on the U.S. (see e.g. Aggarwal (1981), Roll (1992), and Chow et al. (1997)), found different results regarding the links between the two markets. In particular, they only looked at short-term links. Alternative empirical work using an unconditional pricing multi-factor asset-pricing model generally reports that the exchange risk is not priced either in the U.S. or in the Japanese markets (see e.g. Jorion (1991), Hamao (1988) and Brown and Osaka (1990)). However, studies using a conditional international asset-pricing model with exchange risk find that the conditional model outperforms the unconditional one used in earlier studies and report that the exchange risk is priced for the major developed countries (see e.g. Dumas and Solnik (1995), De Santis and Gerard (1998), and Carrieri (2001)).

Thus, one contribution of the thesis to the literature is the clarification of the theoretical issues of the relationship between stock prices and foreign exchange rates. Particularly, the thesis discusses and investigates for potential channels through which exogenous shocks impact on these markets and link them together. One potential channel of link between foreign exchange and stock markets relates to the relationship of these markets and economic activity. On the one hand, the behaviour of the real exchange rate is one of the major determinants of economic activity. For instance, a fall in the real exchange rate affects the competitiveness of domestic goods versus foreign goods and the balance of trade of a country.[4] This increases the level of domestic aggregate demand and the level of output.[5] On the other hand, economic activity also affects the level of stock prices. In fact, the stock price of a firm reflects the expected future cash-flows, which are influenced by the future internal and external aggregate demand. Consequently, as shown in the studies of Fama (1981) and Geske and Roll (1983), stock prices incorporate today present and expected economic activity performances.[6] This scenario, which is based on the "flow" approach to exchange rate determination, suggests a negative relationship between stock prices and the real exchange rate. A second potential channel of link between stock and foreign exchange markets relates to the willingness of domestic and foreign investors to hold domestic and foreign assets. In fact, according to the "portfolio" model of exchange rate determination, agents allocate their wealth amongst alternative assets including domestic money, domestic and foreign securities. The role of the exchange rate is to balance the asset demands and supplies. Thus, any change in the demand for and supply of assets will change the equilibrium exchange rate. This scenario, which is based on the "stock" approach of exchange rate determination, suggests a positive relation between stock prices and the real exchange rates. The thesis provides a comprehensive empirical analysis in order to determine not only if there exists a link between the studied stock prices and foreign exchange rates, but also to identify if stock prices and foreign exchange rates are linked through

[4] A "fall" in the real exchange rate means a "depreciation" or a "devaluation" of the local currency, while a "rise" indicates an appreciation or revaluation of the domestic currency.
[5] For instance, see Cornell (1983) and Wolff (1988) as evidences indicating the existence of long-run relationship between exchange rates and economic activity.

a "flow" or/and a "stock" channel. In addition, the thesis tries to establish if the type of channel is related to the different degree of capital controls.

On the linkages between stock prices and foreign exchange rates, the thesis represents the first work that simultaneously examines both the short-run and the long-run dynamics of the financial markets. In fact, previous work only focused their analysis on the linkage between the returns in the two markets and did not consider the relationship between the *levels* of the series. This is to avoid spurious inferences based on regression analysis when operating with nonstationary financial time series such as stock prices and foreign exchange rates. However, by differing the variables, some information regarding possible linear combination between the levels of the variables may be lost. Thus, the use of the cointegration technique, developed initially by Granger (1981) to explore the long-run relationship between two series, overcomes the problem of nonstationarity and allows a simultaneous investigation into both, the levels and differences, of exchange rates and stock prices.

Another relevant contribution of the thesis, referring to the examination of links between stock prices and foreign exchange rates, is that in some cases the lack of casual relationship between the stock and foreign exchange markets in a country might be due to the omission of an important variable from the system, which might act as conduit through which the real exchange rate affects the stock markets. Based on the evidence of Caporale and Pittis (1997), indicating that inferences about long-run relationship of variables and the causality structure are invalid in an incomplete system, the thesis shows that the important variable omitted from the system is the U.S. stock market, which can be thought of as representing the influence of world markets. Thus, as foreign capital restrictions are lifted in the Pacific Basin Stock markets and the link between the foreign exchange market and the stock market increases, there will also be an increase in the degree of correlation between the local market and other financial markets around the world, as well as an increase in the link between the foreign exchange and stock markets.

Previous work, which focused on measuring the financial integration of emerging capital markets noted financial links also for equity markets with substantial foreign ownership restrictions. For instance, Bekaert and Harvey (1995) examined the one period returns of twelve emerging capital markets over the period 1975 to

[6] For instance, the empirical studies of Schwert (1990), Roll (1992) and Canova and DeNicole (1995) have confirmed the long-run positive relationship between stock prices and economic activity.

1992. The authors used a one factor asset-pricing model, which allowed conditionally expected returns to be affected by their covariance with a world benchmark portfolio if the market was perfectly integrated and by the variance of the country returns if the market was perfectly segmented. The results show integration during the 90s also for countries such as Korea and Taiwan, which had substantial foreign exchange restrictions. In particular, the extensive capital market integration in the Pacific Basin Region has also been supported by Phylaktis (1999). The author looked at long-run comovements of real interest rates, in addition she examined the speed of adjustment of real interest rates to long-run equilibrium following a shock in one of the markets. The findings indicate extensive linkages between Taiwan and to a lesser extent Korea with world capital markets. This evidence suggests that more work should be done in clarifying the channels contributing to the financial integration of capital markets restricted to foreign investors.

Bekaert and Havey (2000) point out that liberalisation may not be enough to induce foreign investors to actually invest in the country. Home bias or other concerns, such as lack of information on company stocks, may impede international investment.[7] However, Bekaert (1995) supports the view that as there exist *de facto* barriers that might affect portfolio diversification decision, then can also be a situation in which alternative vehicles like Country Funds can be used by foreign investors to enter equity markets with foreign restrictions. While Country Funds offer a way to foreign investors for accessing local markets, they also provide an increase of their integration with global markets even in the presence of foreign ownership restrictions. On this point, the empirical studies of Errunza, Senbet and Hogan (1998), Tandon (1997) and Urias (1994) show that Country Funds increase the integration of local markets with global markets.

Thus, a second contribution of the thesis is the investigation of whether Country Funds have been used by international investors to exploit diversification benefits provided by restricted capital markets and of whether this has contributed to the financial links between these markets with the rest of the world by using an innovative method that of recursive estimation of cointegrated systems. In addition, the recursive analyse helps to examine the evolution of the integration of these capital markets over the period 1980-1998. This is to identify if the relaxation of foreign

[7] See also Levine and Zervos (1996).

ownership restrictions might have contributed to an increase of the financial links of these equity markets with world markets. The thesis also contributes by using the moving average representation of the multivariate cointegration model to identify of whether the Pacific Basin capital markets present potential long and/or short-term portfolio diversification benefits. If stock markets are cointegrated, this indicates that international investors are exploiting long-term diversification opportunities, In - addition, by decompositing each time series into a permanent and a transitory component one can examine if international investors are exploiting long and or short term portfolio diversification benefits. In fact, in case of a substantial contribution from the transitory components, one can conclude that international investors are exploiting short-term benefits. Finally, the recursive estimation also allows the examination of the effect of the Asian financial crisis of mid 1997 on the long and short-term links amongst the financial markets.

A third major contribution of the thesis is the examination of whether observed financial links for capital markets with substantial foreign ownership restrictions are due to the presence of economic linkages between the countries. The open character of these economies in terms of exports and imports and the substantial trade with Japan and the U.S. provides a reason for investigating for the role of economic integration on financial links. A country's external trade to another country measures the degree of economic integration between them and the degree of how much the two economies' cash flows are related. In particular, economic integration between countries implies a comovement in their output, corporate earnings and consequently in their stock markets (see Cheung and Ng (1998), Canova and DeNicole (1995), Roll (1992), and Schwert (1990) on the relationship between economic activity and stock prices). Thus, economic integration might provide a channel for financial integration even in the presence of foreign exchange controls. [8]

[8] The Pacific Basin economies under analysis witnessed an impressive rate of growth over the decades 80s and 90s. Moreover, the external sector operated as an "engine of growth". In fact, exploiting technical information imported by advanced technology economies of U.S. and more in particular Japan thought the participation of the developed economies in the form of joint ventures in the export-oriented sector; these countries learned and specialised in producing sophisticated electronics and machinery. These products were really attracting to advanced countries because of their quality combined with their low cost. These facts represent potential indicators for a strong dependence of the economic activity of the PBCs to economic performance of the developed world supporting the existence of strong economic links between them. They also suggest for a potential dependence of the local firms' profits from the ones of economically related countries.

The thesis uses a different way to measure economic and financial linkages of the Pacific Basin Countries based on the framework developed by Ammer and Mei (1996) for Europe and the U.S. The method consists of a simultaneous estimation of the degree of economic and financial linkages between a pair of countries by analysing the covariance of excess returns on national stock markets. This approach presents several advantages. First, it examines financial integration by studying the comovement of future returns aggregated over long horizon instead of comovement of one period expected returns as used in studies by Bakaert and Harvey (1995, 2000). As Ammer and Mei (1996) support this methodology could detect small but persistent comovement of one period expected returns. Second, the framework allows the simultaneous estimation of both economic and financial links and this is important for examining the role of economic integration in financial integration. In fact, the framework uses the Campbell and Shiller (1988) approximate present value model to decompose excess stock return innovations between different countries into news about excess returns, dividend growth rates, interest rates and exchange rates. Analysing the covariances between the components of the excess stock returns of two different countries one can get an insight into the type of international linkage among these economies. Real economic integration is measured by the correlations of dividend innovations between two countries, while financial integration is measured by the correlations between innovations in future expected stock returns.

In examining the role of economic integration on the financial links amongst the PBCs the thesis investigates the relationship between foreign investment restrictions and the integration of capital markets since the emerging markets in our sample differ in the degree of capital markets openness. Moreover, the thesis provides the first comprehensive study of the issue of regional integration i.e. integration amongst the PBCs, including the more developed stock market of Japan as a possible driving force, in addition to examining integration with world markets as represented by U.S. It also tests the Asian crisis effect on these links.

Changes in the volatility of these financial markets are important in determining the level of risk of their returns. International investors, deciding on their portfolio strategies, consider two facts: investment performances and diversification opportunities. However, currency movements might imply an increase in the degree of risk in investing internationally. On this point, Dumas (1994) shows theoretically, while Dumas and Solnik (1995) show empirically, that by applying the world CAPM framework with exchange risk the currency risk is priced. Dumas (1994) notes that if PPP does not hold, any investment in a foreign asset is a combination of an investment in the performance of the foreign asset and an investment in the performance of the domestic currency relative to the foreign currency. In addition, the recent work of De Santis and Gerard (1998) using a conditional version of the international capital asset-pricing model including the exchange risk and applied to Germany, Japan, United Kingdom, and the U.S. indicates that for this equity returns the currency risk is priced. Carrieri (2001) repeating the same analysis of De Santis and Gerard (1998), but for France, Italy, Germany and UK, finds that also for these European equity returns the currency risk is priced.

Based on this evidence, the thesis proposes a dynamic integration capital asset-pricing model inclusive of the currency risk for emerging markets, where expected equity returns are related to country-specific risk before liberalisation and to world market risk thereafter. This is to examine, with a different method, the integration of the Pacific Basin countries with global markets, but more importantly to examine if currency risk is an important source of equity returns for these markets. In addition, the study contributes to the literature by indicating if there exists a switch on the sources of risk associated with equity and currency returns when these markets open to foreign investors.

1.3 Structure of the thesis

The thesis consists of seven chapters. Chapter 4, 5, 6, and 7 are the four papers that represent the main body of this doctoral dissertation. Chapter 2 reports the characteristics of the analysed equity markets, relevant information regarding the institutional background of the countries under research such as details on regulations of their capital markets, and their exchange rate regimes.

Chapter 3 is devoted to a comprehensive explanation of the econometric methodologies applied in the four papers. The chapter is divided in three sections. Section one covers an explanation of the cointegration analysis technique, which is applied in two of the papers and reported in chapteres 4 and 5 respectively. In section two the variance decomposition models is introduced. This method is used in the paper reported in the sixth chapter. Finally, section three discusses the Generalised

Autoregressive Heteroscedastic Models, which are the frameworks used in the empirical analysis of the paper included in chapter 7.

The main empirical body of the thesis starts in the fourth chapter. In fact, the paper included in chapter 4, examines the short-run and long-run dynamics between the stock and foreign exchange markets. Exploiting the nonstationarity of financial variables such as stock prices and exchange rate levels, the theoretical links between the stock and foreign exchange markets are analysed within the cointegration procedure. This technique allows to explore both the long-run as well as the short-run dynamics of these financial markets within a unified framework. Conducting the empirical analysis on a pre and post liberalisation period, it is possible to evaluate the effects of financial liberalisation on the links between these financial markets as well as to identify any differences in the results between open and semi-open markets.[9] Secondly, the multivariate Granger causality test, recommended by Dolado and Lutkelpohl (1996) is applied to clarify the direction of causality and the channels through which stock and foreign exchange markets are linked. Finally, using the recursive-based method developed by Hansen and Johansen (1998), the constancy of the relationships under analysis is tested in order to identify any potential effects of the recent Asian financial crisis on these linkages.

Chapter 5 reports a paper that examines potential long-run financial links of the selected group of Pacific Basin countries with U.S. and Japan over the period 1980-1998. Furthermore, the work attempts to date the beginnings of these links, how they evolved over time and the existence of potential drivers in the region.

By exploiting the nonstationarity of stock prices and the presence of stochastic trends on the dynamic path of these financial variables, the multivariate cointegration model in the autoregressive form is used to detect potential links amongst the stock markets of the Pacific Basin Rim and industrialised equity markets of Japan and the U.S. On the other hand, the moving average form, of the same cointegrating model,

[9] In defining the dates corresponding to the liberalisation of the capital markets under study, we were faced with two problems. First, liberalisation can take many forms, such as relaxing currency restrictions, reducing foreign ownership restrictions, allowing capital and dividends to be repatriated e.t.c. In addition, these reforms might not take place at the same time. Second, in some countries foreigners had been allowed to participate in local markets through indirect means, such as Country Funds and American Depositary Receipts (ADRs), prior to the lifting of various restrictions on foreign investment. In our analysis we have used both the Official Liberalisation Date (OLD), which is based on information obtained from a variety of sources reported in the table 3.3.A, and the date of the introduction of the First Country Fund (FCF) to divide the sample period into pre and post liberalisation sub-periods.

is estimated to identify of whether the Pacific Basin capital markets present potential long and/or short-term portfolio diversification benefits. In addition, the recursive analysis helps to evaluate when linkages began. Moreover, the recursive analysis is also an appropriate instrument to measure potential effects of the Asian crisis of mid 1997 on the analysed relationships. Also in this work, the analysis is conducted by dividing the sample period into two subperiods, the pre and post liberalisation period, to verify the role of foreign exchange restrictions on the integration of studied Asian-Pacific capital markets with the developed world. The period division is also useful in studying the evolution of the degree of integration when switching from the 1980s to the 1990s.

Chapter 6 consists of a paper that explores the role of economic integration of the countries under consideration on their financial integration. The paper examines real and financial links simultaneously at the regional and global level for the selected Pacific Basin countries by analysing the covariance of excess returns on national stock markets over the period 1980-1998.

The framework uses the Campbell and Shiller (1988) approximate present value model to decompose excess stock return innovations of the countries into news about future excess returns, dividend growth rates, interest rates and exchange rates. The role of economic integration on the financial integration of each of the eight considered Pacific-Basin countries is evaluated by measuring the degree of correlation between dividends innovations and news of future excess stock returns components of each country with the ones of Japan or U.S. In order to compare the degree of economic integration estimated by financial data as well as to test the power of this technique, the analysis reports evaluation of the degree of correlation between the industrial production of these economies, the strength of their trade links and the extent of existing trade restrictions. The effect of the Asian financial crisis of mid 1997 is also tested. The results should be useful in the establishment of whether Japan or U.S. is more important in leading these economies.

The paper in chapter 7 studies expected stock and foreign exchange returns and volatility of the considered countries. In particular, using a dynamic integration asset-pricing model, the work intents to identify the sources of risk associated to expected local stock and foreign exchange returns. Moreover, by using a framework that allows full market segmentation until liberalisation date and full integration thereafter, the study investigates if there exists a regime switch of the sources of risk determining expected returns when these capital markets open to foreign investors. The paper represents one of the first studies testing the importance of currency risk on stock returns as well as its magnitude under the two different regimes of full segmentation and full liberalisation.

A multivariate Generalised Autoregressive Heteroskedastic process is used to estimate the conditional variances and covariances of stock and foreign exchange returns. In particular, the work also verifies if there exists an effect on the conditional volatilities of stock and foreign exchange returns due to the openness of their economies to the rest of the financial world as well as due to the recent Asian financial crisis of mid 1997.

In this doctoral thesis, we perform the proposed empirical analysis by using monthly data. The choice of monthly data as alternative to higher frequency data is based on the following arguments. First, for the countries under study high frequency time series for stock market indices and nominal exchange rates were available only since the end of the 1980s, a sample period that did not allow to examine the objectives of this work in particular the role of foreign exchange restrictions on the capital market integration of these countries. In addition, for economic time series, such as CPI, only monthly data were available. Secondly, monthly data present the advantages of averaging out a lot of noise. However, the use of monthly data presents some limitations. First, highly parameterised models are estimated with a limited number of observations (100-200 records). In addition, when testing for causality and linkages, short-term movements are lost. While the former limitation might make inferences fragile; the later does not represent a limitation in the studies for the reason that the thesis mainly focuses on the analysis of long-horizon linkages.

Finally, chapter 8 summarises and concludes this thesis. The chapter also includes a discussion of the policy implications of the research as well as suggestions for further work.

Three of the four papers have already been submitted for publication to international academic journals. Some of the papers have been presented at various conferences, such as the European Meeting of the Financial Management Association in Edinburgh in May 2000, and in Paris in May/June 2001; at the Money and Finance Conference in Oxford in September 1999 and at the City University Business School in London workshops.

CHAPTER TWO

INSTITUTIONAL BACKGROUND

2.1 *Characteristics of the new capital markets*

In the last two decades there has been the emergence of a considerable number of new equity markets. Their high remuneration, even if associated with large level of risk, and their low degree of correlation with the developed financial markets, have attracted the attention of investors around the world as a possibility for portfolio diversification benefits. In particular, the enormous increased in importance of these capital markets has been facilitated by the relaxation of foreign investment restrictions and by the introduction of financial instruments such as Country Funds and American Depositary Receipts (ADRs), which have created possibilities for foreign investors to enter also restricted equity markets.

One might have undervaluated the importance of the emerging equity markets in Asia, Europe and Latin America, thinking that these new markets were small in terms of market capitalisation and therefore quite illiquid. This can be true if they are compared to the U.S., Japan and United Kingdom equity market capitalisation. In reality, these markets are larger than one expects. For instance, the capitalisation of the Mexican and the Taiwanese stock markets is similar to those of the well-established equity markets of Italy and the Netherlands (Harvey, 1995a). The market capitalisation, expressed in U.S.$ million, of the equity markets of the countries studied in this doctoral thesis, are reported in panel A of Table 2.1 for several years from 1985 to 1999. Panel B reports the value traded for the respective years. The indices indicate the existence of small in magnitude, but active Pacific Basin stock markets. Moreover, the turnover ratios of these equity markets, reported in panel C of Table 2.1, show that some of them are more liquid that the established financial markets of U.S. and Japan. The impressive turnover ratios of Taiwan, Thailand, and Korea during the eighties and nineties, confirmed Harvey's (1995a) argument that, in the early 1990s, five emerging markets had higher turnover than the average turnover in the United States, Japan, and the United Kingdom and that ten emerging markets had higher turnover than the United Kingdom.

Another relevant consideration is that the attention of international investors to the new emerging markets was reinforced by the focus on performance measurement relative to international benchmarks (such as the MSCI or FT/S&P international indexes) including only developed markets. Stock markets from developing countries were not included in these indices. However, investors came to realize the stock market development and economic growth potential of many emerging countries. The World Bank, which was involved in assisting those developing countries, decided to promote their stock markets. In the beginning of 1981, the International Financial Corporation (IFC) started to publish monthly Emerging Stock Market Indexes, which allowed money managers to measure the performance of their portfolio invested in developing countries. In particular, these indexes now cover over fifty emerging capital markets. More recently, other index publications have been introduced, such as Morgan Stanley Capital Index (MSCI) or ING Barings for major emerging stock and bond markets.

The establishment of emerging financial markets and their specific financial characteristics are the basic reasons of the increased interest of international investors to these economies. These markets are characterised by historically high returns. Harvey's (1995a) empirical study provides a report, dated to the beginning of 1990s, showing the existence of a wide spread between the annualised emerging and developed markets' returns in both US dollar and local currencies. However, emerging equity markets' impressive returns are often associated with high volatility, which in most of the cases is much higher than the developed market return movements. Goetzmann and Jorion (1999), using the IFC emerging market index from 1975 to 1996, show that the average dollar returns for the emerging markets was 18.4% and that the correspondent volatility was 41.6%. In the last five years, practitioners and academicians have been examining the reasons of such high returns and volatility (see for instance, Harvey (1995a); Bekaert and Harvey (1995, 1997 and 2000); Richards (1996); De Santis and Imrohoroglu (1997); and Kim and Singal (2000)). Many studies focus on explaining the importance of local factors as well as external factors in studying the behaviour of emerging financial markets. Other studies measure how much of the returns and their volatility is explained by local and how much by external factors in order to measure the degree of integration of those economies to the rest of the financial world. In analysing the returns and risk of new emerging markets the dynamic between emergence and stock returns-risk in new markets should be taken in consideration. Froot, O'Connell and Seasholes (1998) discover regularity in the dynamic link between emergence and returns. They find that a good past return attracts foreign capital inflows. Therefore, they conclude that an increase in foreign capital flows is a prediction of an increase in equity returns in the short-horizon. Foreign presence contributes to higher returns investment as soon a new equity market is emerging. Investors that detect the emergence of a market early are likely to enjoy large returns. However, as soon as new markets develop and local Authorities allow greater presence of foreign investment, their returns decrease. In particular, Bekaert and Harvey (1998a) in studying the impact of capital flows to the behaviour of equity returns, on the structural characteristics of the new capital market, on exchange rates and on the strength of the economy, found that an increase of capital inflows to the new emerging economies contributes in the long horizon to a decrease of their stock returns level. Regarding the dynamic link between risk and emergence, financial literature provides contrasting empirical evidences. For instance, Bekaert and Harvey (1997) find that market volatility is a function of the openness of the economy. However, further research by De Santis and Imrohoroglu (1997), Bekaert and Harvey (1998a, 2000) and Bekaert, Harvey and Lumsdaine (1998) does not confirm these findings. Another group of financial studies (i.e. Erb, Harvey, and Viskanta (1996a, 1996b)) has related market volatility to variables such as the country demographics and inflation risks. However, independent of the fact that the new equity markets present high level of volatility, their high level of returns, associated with their considerable potential growth, together with their low correlation with the well-established financial markets contribute in attracting considerable amount of international attention.

Another important characteristic that has been witnessed in emerging equity markets is the positive correlation between their stock and foreign exchange markets (see Solnik (1999)). Generally, local stock markets increase when the value of their local currency depreciates, the argument is based on an improvement in the international competitiveness of local firms. This is not the case for emerging stock markets. Both the stock market and the currency value are affected by the state of the economy. In period of crisis, both drop significantly. For example, the Korean won lost more than 50% of its value in 1997, and the Seoul stock market also dropped. Both went up significantly in 1998, when the Korean situation showed some encouraging signs of recovering. Numerous similar cases could be reported for Asian and Latin American countries. The important thing is that this positive correlation indicates that foreign investors suffer doubly from currency risk in emerging markets. Therefore, in making their asset allocation decision, institutional investors should consider not only the performance of equity markets, but also the behaviour of the local currencies as well as linkages between the local stock and foreign exchange markets.

2.2 *Exchange rate regime history*

In the late 1980s and early 1990s most of developing economies abandoned fixed exchange rate rates to adopt more flexible exchange rate regimes. However, monetary authorities continued to adjust frequently the nominal exchange rate to control possible domestic or external and monetary or real shocks. Managed exchange rate regimes were established to keep under control the level of real and nominal exchange rate. This is to avoid big movements that could cause outflows of foreign investments, instability as well as loss of competitiveness and deterioration of the balance of trade. Most of those regimes have failed to sustain financial growth and competitiveness. Therefore, because of increasing pressure to liberalise capital markets, capital controls have slowly been lifted in order to attract foreign investments. Managed exchange rate regimes have been abandoned giving place to floating exchange rates.

As reported in Table 2.2, the exchange rate regimes of the economies studied in this doctoral thesis have varied widely and they have been adopted in diverse periods.

In Hong Kong, since the 17th October of 1983, the Hong Kong dollar has been fixed against the U.S. dollar at the exchange rate of 7.83 Hong Kong dollars to U.S. $1. In Indonesia, the Ruphian was pegged to a basket of currencies between the 1st November of 1978 to the 13th August of 1997. However, during this period local Authorities have shown willingness to adopt a more flexible exchange rate. There have also been several increases of the margin that the currency was allowed to move, which have created period of instability of the local currency that have contributed to the building of currency depreciation expectations. In fact, the 14th August of 1997 a free-floating exchange rate arrangement was introduced in Indonesia.

In Korea, the 2nd March of 1990 the fixed exchange rate was abandoned and a controlled effective exchange rate was established. Under this new regime the Korean won market average rate (MAR) was established by the Central Bank and it was allowed to move only within an established margin. This margin has been increased few times over the period 1990 to 1995. However, since the 1st December of 1997 the Korean Authorities introduced an independent floating exchange rate regime. In Malaysia, from the 27th September of 1975 to the 31st January of 1990 the Malaysian ringgit was pegged to a basket of currencies. Since the 1st January of 1990, Malaysia is under a managing floating exchange rate regime. However, during the period 1st September of 1998 to the 15th February of 1999 the local Central Bank established that any investment in rinngit has to be held for at least 12 months.

In Philippines, since the 1st October of 1984, a new exchange rate regime has been established to replace the previous defacto multiple rate structure. Under the new regime, the external value of the Philippines Peso is determined by market forces with periodic Central Bank interventions. In Singapore, the Singaporean dollar is under a managed float regime since the 1st January of 1986.

In Taiwan, the Taiwanese dollar was under a controlled floating exchange rate regime from the 1st February of 1979 to the 31st March of 1989. Since the 1st April of 1989 the Taiwanese dollar is set to float according to demand for and supply of foreign exchange. In Thailand, between the 1st January of 1978 to the 1st July of 1997, the value of the Thai Baht was pegged to a basket of currencies. In November 1984, the basket of currencies was revised to include the U.S. dollar, the German mark, the British pound, the Malaysian ringgit, the Hong Kong dollar and the Singaporean dollar. However, since the 2nd July of 1997, the Thai Baht is allowed to float freely.

2.3 *Capital market liberalisation*

The emergence of new equity markets has been frequently associated with the possibility for international investors to enter capital markets previously restricted to foreign presence. Therefore, one may expect the existence of a relationship between the relaxation of foreign exchange restrictions with the financial integration of new equity markets with the rest of the world. Nevertheless, financial literature shows that this has not always happened. Many studies, for instance Bekaert (1995), and Bekaert and Harvey (1995, 1997, 1998a and 2000) show that the increase of foreign investment activity for a considerable number of new capital markets did not correspond with the relaxation of capital restriction s. The evidence makes the choice of "liberalisation date" for studying capital market integration a sensitive issue. Appendix 2.A chronologies reports the most important financial events that took place in each of the studied countries in the last two decades. According to Bekaert and

Harvey (2000), one should take into consideration alternative indicators of the financial openness of a country: the actual lifting of investment restrictions, the introduction of American Depositary Receipts and of Country Funds. Panel A Table of 2.3 reports a summary of Appendix 2.A indicating for each country the dates for three different signals of liberalisation. The International Financial Corporation (IFC) official liberalisation date, which is based on the IFC Investability Index. The Index represents the ratio of the market capitalisation of stocks that foreigners can legally hold to total market capitalisation. A large jump in the Index is evidence of an official liberalisation. The other two signals are the introduction of Country Funds and American Depositary Receipts (ADR). These are indirect ways of foreign participation in the local stock markets, which are usually available prior to the lifting of various restrictions on foreign investors. Moreover, Country Funds and ADRs provide the advantage of trading in transparent and liquid markets such as New York and London. In contrast, although countries may enact official liberalisations of their capital markets, foreign investors may still face many market imperfections, such as poor liquidity, lack of information, high transaction costs and taxes. What is clear from these various signals of liberalisation is that all countries had either liberalised or started the process of liberalisation by the beginning of the 1990's. Panel B of Table 2.3 gives the extent of some of the main direct and indirect barriers at the end of 1989. This is to underline that in some cases the studied capital markets are still presenting strong forms of indirect barriers such high levels of taxes on dividend and capital gains, and the impossibility to repatriate dividends and capital gains. Another form of indirect barrier can be represented by the lack of information on local corporations required by investors to make their asset allocation decisions. Panel C of Table 2.3 reports some indications provided by the International Financial Corporation (IFC) in its annual publication *Emerging Stock Markets Factbook,* regarding the quality of information and investors protection for the countries in our analysis at the end of the year 1989.

Considering the foreign ownership restrictions of the capital markets under research at the end of 1989, it is possible to divide the analysed countries in three groups. The capital markets of Hong Kong and Singapore, had virtually no foreign exchange controls and foreign ownership regulations since January 1973 and June 1978 respectively. Malaysia, which has been considered a quite open country, completed its liberalisation process only in December 1988 with the possibility for foreign investors to own up to 100% of local companies. However, to perceive economic stability following the Asian turmoil in mid 1997, the Malaysian Governmental Authorities re-imposed some foreign exchange restrictions from the 1st September 1998 to the 15th February 1999. On the other hand, Indonesia, Philippines and Thailand had significant controls at the end of 1989. According to the International Financial Corporation liberalisation dates, Indonesia allows foreign presence since September 1989, under a foreign ownership limit of 49%. For Philippines, not only the presence of investors was allowed only since June 1991[10], but also the foreign ownership limit was even more stringent than the Indonesian one, 40%. In Thailand, the first form of foreign allowance was introduced in September 1987[11], date that corresponds to the launch of the Alien Board in the Thai stock exchange. Board in which are traded the securities available to foreign investors. However, also for Thailand, international investors faced a foreign ownership limit of 49%, with a more restricted of 25% for commercial banks and finance companies. Finally, controls were even more stringent in the case of Taiwan and Korea. For Taiwan up to January 1991 foreigners could access local investment only through approved investment vehicles, such as Closed-end Country Funds. For Korea, even if the local Authorities showed their intention to open to foreign investment since the second half of the 1980s, reforms aim to the liberalisation of the local capital market took place only since January 1992. However, the foreign ownership limit was considerable low (10%).

An important fact is that most of the countries have experienced the introduction of Country Funds before the relaxation of foreign investment restrictions. As it was discussed above, this could have contributed to the openness of these capital markets to foreign investors before the official liberalisation date. For example, in Korea, IFC official liberalisation date corresponds to January 1991, while the Korea Fund partially opened up the Korean equity market to foreign investors in August 1984[12]. Also the Thai stock market was accessible by foreign investors much before the official liberalisation date of September 1987. In fact, in July 1985 the First Thai Country Fund was launched. Similarly, Taiwan, which had a highly restricted equity

[10] The IFC official liberalisation date for Phillipines is October 1989. However, as noted by Bekaert and Harvey (2000), this date is not associated with any particular regulatory changes.
[11] The IFC official liberalisation date is December 1988. However, Bekaert and Harvey (2000) noted that this date is not associated with any particual regulatory changes.

market accord to the IFC official liberalisation date and was open to foreign ownership only in January 1991, witnessed the introduction during the 1986 of three Country Funds[13] that considerably helped willing foreign investors to indirectly own Taiwanese securities. Philippines introduced in May 1986 its First Country Fund allowing foreign presence much before the official liberalisation date of June 1991. Finally, Indonesia and Malaysia had their First Country Funds introduced just several months before their IFC official liberalisation dates. In particular, in Indonesia the First Country Fund was launched in February 1989, while its IFC official liberalisation date corresponds to September 1989. In Malaysia the First Country Fund was launched in December 1987, exactly 12 months before its IFC official liberalisation date of December 1988.

[12] Two Trust Funds, the Korea International and the Korea Trust, were launched in the earlier November 1981.
[13] In the earlier October 1983 a Trust Fund, the Taiwan (Roc) Fund, was launched.

Tables

Table 2.1: Market indicators

Panel A: Market capitalisation (US$ million, end of the period).

Country	*1985*	*1990*	*1995*	*1996*	*1997*	*1998*	*1999*
Hong Kong	34,504	83,397	303,705	449,381	413,323	343,395	609,090
Indonesia	117	8,081	66,585	91,016	29,105	22,104	64,087
Japan	978,663	2,917.679	3,667,292	3,088,850	2,216,699	2,495,757	4,546,937
Korea	7.381	110,594	181,955	138,817	41,881	114,593	308,534
Malaysia	16,229	48,611	222,729	307,179	93,608	98,557	145,445
Philippines	669	5,927	58,859	80,649	31,361	35,314	48,105
Singapore	11,069	34,308	148,004	150,215	106,317	94,469	198,407
Taiwan	10,432	100,710	187,206	273,608	287,813	260,015	375,991
Thailand	1,856	23,896	141,507	99,828	23,539	34,903	58,365
U.S.	2,324,646	3,089,651	6,857,622	8,484,433	11,308,779	13,451,352	16,635,114

Source: Emerging Stock Markets Factbook (1993-1999).

Panel B: Value Traded (US$ million, end of the period).

Country	*1985*	*1990*	*1995*	*1996*	*1997*	*1998*	*1999*
Hong Kong	9.732	34,633	106,888	166,419	489,365	205,918	244,886
Indonesia	3	3,992	14,403	32,142	41,650	9,709	19,903
Japan	329,970	1,602,388	1,231,552	1,251,998	1,251,750	948,522	1,849,228
Korea	4,162	75,949	185,197	177,266	170,237	137,859	733,591
Malaysia	2,335	10,871	76,822	173,568	147,036	28,835	48,512
Philippines	111	1,215	14,724	25,519	19,783	9,992	19,673
Singapore	1,383	20,293	60,461	42,739	63,954	50,735	97,985
Taiwan	4,899	715,005	383,099	470,193	1,297,474	884,698	910,016
Thailand	568	22,894	57,000	44,365	23,119	20,734	41,604
U. S.	997,189	1,815,476	5,108,591	7,121,487	10,216,074	13,148,480	18,574,100

Source: Emerging Stock Markets Factbook (1993-1999).

Panel C: Stock markets turnover ratios

	Ratios							Rankings						
	85	*90*	*95*	*96*	*97*	*98*	*99*	*85*	*90*	*95*	*96*	*97*	*98*	*99*
HK	33.5	43.0	37.3	44.2	1,113	54.4	51.4	5	8	6	5	3	6	7
IN	2.9	75.8	25.3	40.7	64.2	59.4	46.1	10	3	10	6	6	5	9
JP	40.1	43.8	33.3	37.1	47.2	40.3	52.5	4	7	8	7	8	8	6
KO	61.8	67.3	97.8	110.	172.	184.	346.	1	4	2	2	2	2	1
MA	13.4	24.6	35.9	65.1	72.6	30.9	39.8	8	9	7	4	5	10	10
PH	14.1	13.5	25.8	36.5	34.8	31.1	47.2	7	10	9	9	10	9	8
SG	11.9	57.8	42.8	28.7	49.9	50.5	66.9	9	5	4	10	7	7	5
TA	48.4	430	175.	204.	440.	333.	286.	2	1	1	1	1	1	2
TH	32.1	92.6	41.4	36.7	39.2	71.2	89.2	6	2	5	8	9	4	4
US	47.6	55.0	85.7	92.8	103.	106.	123.	3	6	3	3	4	3	3

Source: Emerging Stock Markets Factbook (1993-1999).

Table 2.2: Summary of exchange rate regimes history

Country	*Period*	*Exchange rate regime*
Hong Kong	01.74-10.83	Floating exchange rate regime;
	Since 17.10.83	The Hong Kong dollar is pegged to the US dollar.
Indonesia	11.78-13.08.97	The Indonesia ruphian is pegged to a basket of currencies. The ruphian was allowed to move within ± 1.00% of the fixed rate. During this period there have been several times in which the Central Bank has increased the spread within the ruphian is allowed to move as follows. There are also been interesting announcement by the Central Bank.
	30.03.83	Announced the idea of a managing floating exchange rate regime.
	16.09.89	Bank of Indonesia announced that the pegged exchange rate has to be applied only to certain transactions undertaken at certain time of the day.
	09.92	Increased buying and selling spread from 6 Rp to 10 Rp.
	11.93	Increased margin from ±1.00% to ±2.00%.
	06.96	Increased margin to ± 5.00%.
	09.96	Increased margin to ± 8.00%.
	Since 14.08.97	Floating exchange rate regime.
Korea	02.03.90	Introduction of a managed floating exchange rate regime, where the Korean won market average rate (MAR) was established by the Central Bank and it was allowed to move with a margin of ± 0.60%;
	01.06.92	Enlarged the margin to ± 0.80%;
	01.02.93	Increased the margin to ± 1.00%;
	01.11.94	Increased the margin to ± 1.50%;
	01.12.95	Increased the margin to ± 2.25%;
	16.12.97	Introduction of an independent floating exchange rate regime.
Malaysia	27.09.75-01.91	The Malaysian ringgit is pegged to a basket of currencies.
	01.91	Introduced a managed floating regime. The Central Bank intervenes only to keep the ringgit within a margin to an established rate computed respect a basket of currencies.
	01.09.98-15.02.99	Proceed establishing that any investment in ringgit has to be holding for at least 12 months.
Philippines	Since 10.84	Introduced a floating exchange rate regime, where the exchange rate is determinate by market forces. The Central Bank may intervene to keep stability in the forex market.
Singapore	Since 01.86	Introduced a floating exchange rate regime.
Taiwan	02.79-03.89	Introduced of a controlled floating basis with its exchange rate linked against a basket of currencies.
	Since 04.89	Introduction of a floating exchange rate regime.
Thailand	01.78-01.07.97	The Thai Baht is pegged to a basket of currencies, where the major weight is the one related to the US dollar.
	Since 02.07.97	Introduced a floating exchange rate regime.

Source: *Exchange rate arrangements* (various issues from 1973 to 2000), International Monetary Fund annual publication.

Table 2.3: Signals of liberalisation

Panel A: Comparison of different signals of liberalisation

Country	IFC official liberalisation	First Country Fund	First ADR introduction
Hong Kong	01.73[a]	-	-
Indonesia	09.89[b]	02.89[b]	04.91[f]
S.Korea	01.92[b]	08.84[b]	11.90[b]
Malaysia	12.88[b]	12.87[b]	08.92[b]
Philippines	06.91[c]	05.86[b]	03.91[b]
Singapore	06.78[a]	-	-
Taiwan	01.91[b]	05.86[b]	12.91[b]
Thailand	09.87[d,e]	07.85[b]	01.91[b]

Source:
[a] *Exchange arrangements and restrictions*, IMF publications, (varies issues 1973-1999).
[b] Bekaert, G. and C.R. Harvey, 1998, "Capital flows and the behaviour of emerging market equity returns", NBER working paper N. 6669.
[c] Bekaert, G. and C.R. Harvey, 2000, "Foreign Speculators and Emerging Equity Markets", Journal of Finance, 55, 565-613. The authors, in Appendix B, report the following. Philippines: June 1991. A Foreign Investment Act is signed into law. The Act removes, over a period of three years, all restrictions on foreign investments. Under the provisions, foreign investors are required only to register with the Securities and Exchange Commission and most sectors of the economy are opened to 100 percent foreign ownership. The IFC official liberalisation date is October 1989, but that is difficult to justify.
[d] Bekaert, G. and C.R. Harvey, 2000, "Foreign Speculators and Emerging Equity Markets", Journal of Finance, 55, 565-613. The authors, in Appendix B, report the following. Thailand: September 1987. Inauguration of the Stock Exchange of Thailand's Alien Board. The Alien Board allows foreigners to trade stocks of those companies that have reached their foreign investment limits. Thais continue to trade stocks on the Main Board. The IFC liberalisation date is December 1988, which is not associated with any particular regulatory changes.
[e] Bailey, W. And J., Jagtiani, 1994, "Foreign ownership restrictions and stock prices in the Thai capital market", Journal of Financial Economics, 36, 57-87. The authors just elencated the events. They do not mention the IFC liberalisation date.
[f] Bekaert, G. and C.R. Harvey, 2000, "Foreign Speculators and Emerging Equity Markets", Journal of Finance, 55, 565-613. In the paper Bekaert and Harvey (1998a) they report: 02.1992 first launched ADR.

Panel B: Emerging stock markets - Direct and Indirect Barriers for Institutional Investors (end-1989)

	Foreign ownership Limit	Dividends Repatriation	Capital Repatriation	Withholding Taxes on Dividend	Taxes on Capital Gains
Hong Kong	100%	Free	Free	0.0%	0.0%
Indonesia	49%[a]	Free	Free	20.0%	20.0%
Japan	100%(25%)[b]	Free	Free	20.0% (0-15%)	0.0%
Korea	10%(8%)[c]	Some Restrictions[d]	Some Restrictions[d]	25.0% (10-21.5%)	0.0% (11-27%[e])
Malaysia	100%[f, g]	Free	Free	35%(0%)	0.0%
Philippines[h]	40%[i]	Free	Free	15.0%	0.25%
Singapore	100%	Free	Free	0.0%	0.0%
Taiwan[h, l]	Special Funds only[m]	Free	Free	20.0%	0.6%
Thailand	49% (25%)[n]	Free[o]	Free	20%(10)	25%(10)

Source: The table is based on the information provided in the *International Financial Corporation's Factbook*, the *Euromoney annual report* and the *Exchange arrangements and restrictions*, IMF. All the data are as of end-1989. Rates shown in brackets apply only to approve new money Country Funds, where these may be different from normal treatment.

[a] The limit is reduced to 25% of own capital for foreign exchange banks and nonbank financial institutions.

[b] The foreign ownership limit is up to 100% in case of companies classified as "non-strategic". The limit is reduced to 25% in case of "national interest" companies such as mining, agriculture, nuclear power, gas, railways, banks, aircraft, pharmaceutical industries and oil refineries. Direct inward investment in a listed corporation, which represents more than 10% of the corporation's issued capital when aggregated with the existing holdings of the investor and its related parties, or in the acquisition of shares in any non-listed corporation, requires a specific report to be filed with the Ministry of Finance and other Ministries prior to the transactions.
[c] Foreign ownership restriction of up 10% of market capitalisation for "nonlimited" industries and of up 8% of market capitalisation for "limited" industries.
[d] The repatriation of initial capital, capital gains and dividend is subject to approval by the Ministry of Finance.
[e] Of net capital gains or gross sales proceeds, respectively.
[f] Foreign acquisition of investments exceeding M$ 5 million in value or equivalent of 15% or more of voting power in a Malaysian company requires the prior approval of the Foreign Investment Committee.
[g] See Exchange arrangements.
[h] Transaction taxes on gross transaction value.
[i] Foreign nationals may purchase shares up to 40% of a company's share via B shares. Foreign participation beyond 40% needs to have prior approval by the Board of Investment (BOI). Investment not exceeding 40% need simply to be reported to BOI and the Central Bank of the Philippines for purposes of repatriation of capital and remittance of profits.
[l] Available only to investors in approved investment vehicles.
[m] Foreign investors who open an account in a local brokerage house may only invest in four listed funds -Kwang Hua Growth Fund, NITC Fuyuan Fund and Citizen Fund. Domestic residents are allowed to remit outwards up to US$5 million per annum.
[n] Foreign investors are allowed to hold up to 50% of companies listed on the SET with the exception of the commercial banks and finance companies, where foreign ownership is restricted to 49% of the capital.
[o] A report is required for the repatriation of dividends and capital gains.

Panel C: Emerging markets information and investor protection (end-1989)

	Securities Exchange Public. (1)	Regular Publication of P/E, P/D (2)	Market commentaries in English (3)	Company brokerage reports (4)	Interim statement (5)	Accounting Standards (6)	Investor Protect (7)
Indonesia	AMD	C	LR, IR	LR,IR	S	G	AS
Korea	AMWD	C	LR,IR	LR,IR	S	G	GS
Malaysia	A(M/2)WD	C	LR,IR	LR,IR	S	G	G -
Philippines	AMWD	C	LR,IR	LR,IR	S	G	AS
Taiwan	AMWD	C	LR,IR	LR,IR	Q	P	PS
Thailand	AQMWD	C	LR,IR	LR,IR	Q	A	AS

Source: The table is based on the information provided in the International Financial Corporation' s *Emerging Stock Markets Factbook.* All the data are as of end-1989.

(1) A=Annual, Q=Quarterly, M=Monthly, (M/2)=Biweekly, W=Weekly, D=Daily.
(2) P=published, C=Comprehensive and published internationally.
(3) & (4) LR=Prepared by local broker or analysts; IR=Prepared by international brokers or analysts.
(5) Q = Quarterly results must be published, S = Semiannual results must be published.
(6) & (10) G = Good of internationally acceptable quality; A = Adequate; P = Poor, requires reform;
S = Functioning Securities Commission or similar government agency concentrating on regulating market activity.

Appendix 2.A: Major financial events for the studied countries

Indonesia

Date	Events
07-81	Presidential Decree on the Foreign Capital Investment Law. In principle, foreign investments may be undertaken only through a joint venture with an Indonesian partner. All investments in Indonesia require the approval of the President on the recommendation of the Investment Coordinating Board (BKPM). Among the inducements offered is exemption from, or reduction in, corporate and dividend taxes and customs duties on imported raw materials and capital goods for a certain number of years. Investors are granted the right to make capital repatriation, to transfer profits (after settlement of taxes and financial obligations in Indonesia) and to make transfers relating to expenses connected with the employment of foreign nationals in Indonesia, and in respect of depreciation allowances after the expiration of the tax holiday from corporation tax. Permits for investment projects are valid for 30 years.[f]
01-84	New incentives for foreign capital investment were introduced by a newly issued Income Tax Law. The incentives currently applied for foreign investments are: exemption from the capital stamp duty and from import duties on capital goods, raw materials, auxiliary goods, and spare parts: an annual depreciation allowance of 25 percent for fiscal purposes on virtually all machinery and other productive capital goods; and deferral of certain taxes on imports of capital goods.[f]
12-87	Government introduces measures to allow foreigners to purchases shares in eight non-joints venture companies.
00-87	Full Financial sector liberalisation. Established over-the-counter market to encourage firms to go public.[m]
00-88	The legal reserve requirement for foreign currency was reduced from 15 percent to 2 percent.
02-89	Malacca Fund (Cayman) Ltd launched as the first Country Fund.[b]
09-89	IFC Official liberalisation date.
09-89	Minister of Finance allows foreigners to purchase up to 49 percent, of all companies listing shares on the domestic exchange excluding financial firms. The net open foreign exchange position is limited to not more than 25 percent of own capital for foreign exchange banks and nonbank financial institutions. Foreign exchange banks' offshore borrowing is not regulated, which was previously subject to approval by Bank of Indonesia. The prior approval of the Minister of Finance is required before any public enterprise or public sector body may accept a loan from abroad.[f]
09-89	The system of foreign exchange dealings between Bank Indonesia and commercial banks was modified substantially. Henceforth, Bank Indonesia's announced exchange rate would apply only to certain transactions undertaken at certain times of the day. For all other transactions banks would be free to set their own rates.[f]
03-91	Bank Indonesia reduced the limits on banks' net open position in foreign currency and on their outstanding stock of swaps to 20 percent from 25 percent of capital and ceased to accept swaps with one-month or shorter.[f]
04-91	First ADR introduction.[b]
06-91	Investment-licensing requirements were liberalized. The number of activities included in the negative list was reduced to 60 from 70, and domestic and foreign investors were allowed to grant licenses under pre-specified conditions, thus partially deregulating 31 other activities.[f]
11-91	Bank Indonesia limited banks' short-term foreign exchange liabilities to 30 percent of capital, and required that at least 80 percent of all foreign exchange loans be allocated to businesses earning foreign exchange.[f]

Continue: Indonesia

01-92	Government announces it will allow foreign shareholders to invest up to 49% of bank stocks.
04-92	Full foreign ownership of foreign direct investments by non-residents was permitted. Foreign direct investments with a minimum capital of $250,000 would be permitted in certain cases; and (3) foreign investors would be allowed to reinvest profits in the shares of other foreign firms.[f]
07-92	Capital markets supervisory board creates a foreign board for trading stocks by foreign investors. Standard and Poor's assigned a first time rating of BBB to sovereign debt.[i]
10-92	Implementation of Bank Act of 1992 allowed foreign investors to own 49% of private national banks.
06-93	Restrictions on foreign direct investment were relaxed, by reducing the number of sectors closed to foreign investment and reclassifying sectors to fall under less stringent bans.[f]
10-93	Requirements on foreign direct investment, in particular on land- use rights and environmental standards, were liberalised. In addition, divestiture requirements were relaxed.[f]
09-94	Indosat, Asia's largest IPO ($1 billion) offered 25% on overseas markets in the form of ADR's.
10-94	Indosat begins trading on NYSE.
12-94	Announcement that Jakarta Stock Exchange will split its listings into 2 boards in 4/95. One for blue chips and the other for smaller companies.
07-97	Devaluation of the Thai Baht. The Bank Indonesia widened the dollar-rupiah intervention band to 12% from 8%.
08-97	Devaluation of the Indonesian Rupiah. The managing floating exchange regime was replaced by a freely floating arrangement.
09-97	Foreign investors were allowed to purchase unlimited domestic shares, except banking shares.
10-97	Moody's cut the country's sovereign credit rating. IMF-led aid package was formally announced.
12-97	Foreign companies have been permitted to issue Indonesian Depositary Receipts (IDRs are instruments that facilitate the trading of share of foreign companies in the Indonesian capital market), though custodian banks in Indonesia.
03-98	A tax on the purchase of foreign currencies was imposed to curtail speculation.

Korea

Date	Events
09-80	Liberalisation of foreign investment rules.[d]
11-81	Korea International Trust Fund and Korea Trust Fund launched by the Korea Investment Trust and by the Daehan Investment Trust Company, respectively. Both Investment Trust Fund were launched with an initial capital of U.S.$25 million each.[e]
07-84	Amendment to the Foreign Capital Inducement Act, a negative list system was introduced which permitted foreign investments in all areas not on the list. Foreign equity participation of up 100% is allowed in a limited number of industries.[d]
08-84	Korea Fund, close-end fund, launched by Scudder, Stevens & Clark. The Country Fund was launched with an initial capital value of US$ 25 million.[e]
01-88	Korean government plan for liberalisation. However, after the announcement the liberalisation plan was put on hold due to an increase of money supply. The liberalisation plan defined two categories of industry, Limited and non-Limited. Non-Limited industries will have foreign investment limits of up 10% of market Capitalisation. Limited industries will have foreign investment limits up to 8% of Market capitalisation. Furthermore, a limit of 3% is imposed for any single investor for any industries. Most bank and non-bank financial institution lending rates and long-term deposit rates liberalised. Bank of Korea still controls short-term deposit rates, total volume of credit and minimum credit guidelines to small and medium firms and conglomerates.[1]
11-90	First ADR introduced.[b]
11-90	Ministry of Finance announced guidelines governing the opening of the securities to foreign institutions. The regulations call for a high entry fee a required commitment of at least 10 years. No more ten licenses are expected initially.[f]
01-91	Market opening to foreign investors. Notification System makes authorization of foreign investment subject to approval or notification. Foreign participation will be easier under new law. Repatriation of capital freely permitted.[d]
09-91	Announcement that the stock market will open to investors in January 1992. The announced regulations are that a foreign investor cannot own more than 3% of a company's shares and foreigners cannot own collectively more than 10% of a company. The government later raised the limit to 25% for 45 companies that already had more than 10% ownership by foreigners. The announcement is not well received by foreign investors. Korea admitted in to the United Nations.
01-92	IFC Official liberalisation date.
01-92	Partially opening of the stock market to foreigners. Foreigners can now own up to 10% of domestically listed firms. 565 foreign investors registered with the Securities Supervisory Board.
05-92	Government approves lifting of foreign ownership restrictions on Korea Electric Power and Poland Iron Steel.
11-92	Korea Electronic Power lifts foreign ownership restrictions from 8% total and 1% individual to 10 % total and 3% individual.
10-93	Sixty-day amnesty period concluded in implementation of the Real Name Financial System. Panic quells as uncertainty over the business climate abates. By the end of 1993 foreigners own up to 9.8% of market capitalization and close to 9% of share outstanding. Most companies have reached their 10% limit of foreign ownership restrictions.
12-94	Limit of foreign ownership of domestically listed firms rose from 10% to 12%. KEPCO and POSCO retain their limits of 8%. Government announces its intention to raise the overall limit from 12% to 15% sometimes in 1995.
03-95	Korean Stock Exchange had 702 listed firms. 98 have reached their 12% foreign ownership limit. 8.6% of the total market capitalisation was owned by foreigners.

Continue: Korea

05-95	Announcement that foreign ownership limits will be raised from 12% to 15% in July.
07-95	Government raised foreign stock ownership from 12% to 15% and raised the limit for single investors from 3% to 5%. KEPCO and POSCO limits rose to 10%. $1.3 billion of fresh foreign investment entered the market. Ministry of Finance plans to deregulate the securities business by lifting interest rate controls on margin accounts, easing government control on the international activities of securities firms, and permitting local securities firms to borrow from the cheap foreign currency fund in order to underwrite overseas securities. Most important, the registration period for foreign investment will decrease from 14 to 5 days.
09-95	Government announced that foreign firms will be able to list on the Korean Stock Exchange as of 1996.
05-96	Limit of foreign ownership of domestically listed firms rose from 15% to 18%.
07-96	Short-term abolition of the capital gains tax.
09-96	Government relaxes foreign ownership restrictions from 18% to 20% and from 12% to 15% for state owned enterprises.
11-96	Government announced that in two years it will relax foreign ownership restrictions of telecommunications industry to 33%.
03-97	Government announced plans to lift foreign ownership restrictions from 20% percent to 23% percent in May 1997.
05-97	Government raised foreign ownership restriction from 20% percent to 23% percent.
10-97	Government raised foreign ownership restriction from 23% percent to 26% percent.
12-97	Government raised foreign ownership restriction from 26% percent to 50% percent.
02-98	Standard and Poor's upgraded the country's foreign currency debt rating by three notches, one grade below investment grade. The government listed all restrictions on listed companies' right offering from February 20.
05-98	Foreign investment limit on Korean securities was raised to 55%. Foreign investment ceiling on state-run corporations, Pohang Iron & Steel as well as Korea Electric Power was boosted to 30% from 25% cap.

Malaysia

Date	Events
10-75	Introduction of regulations, which establishes that foreign equity participation, requires prior approval by the Foreign Investment Committee. In particular, industries exporting more than 80 per cent of their production and using mainly imported materials could be considered for majority foreign ownership, ranging from 51 to 70 per cent, but in exceptional cases 100 per cent foreign ownership might be considered.[f]
08-81	Commercial banks ordered to stop lending to Malaysian companies for investment abroad, especially in property and equity shares.[d]
03-82	Foreign exchange controls loosened. Banks were allowed to lend foreign currency to residents and borrow funds from abroad.[f]
04-83	Limitation on access to domestic credit by companies in Malaysia controlled by nonresidents was relaxed for cases in which such credit was to finance the expansion of production capacity for existing products or the installation of production capacity for new products in Malaysia.[f]
08-84	It was announced that majority equity shares could be held by large foreign firms engaged in capital-intensive and resource-oriented enterprises. In addition, the possibility of 100 percent foreign ownership, previously limited to export industries, was extended to other sectors.[f]
01-85	Singaporean businessmen were authorised to retain up to 70 percent of the shares in their companies in Malaysia even if such investment was not export-oriented[f].
02-85	Announced a change in the approval of foreign investment to encourage and expedite them.[f]
10-85	Introduced an incentive measure, interest payments to nonresidents by the commercial banks were exempted from the withholding tax of 20 percent.[f]
03-86	Corporatization Policy whereby approved financial institutions, including foreign brokers, were permitted to acquire up to 30% of local brokerage bourses.[g]
07-87	Foreign institutions limit brokers raised to 49%.[g]
12-87	Malaysia Fund Inc, "The Wardley GS Malaysia Fund", launched on the NYSE[b].
10-88	Budget calls for liberalisation of foreign ownership policies to attract more foreign investors.[g]
12-88	IFC Official liberalisation date.
12-88	The limit on new foreign capital equity participation in firms manufacturing impressed/imprinted products was reduced to 60 percent to 100 percent.
06-91	New economic plan termed the Outline Perspective Plan passed. The plan emphasized economic growth and encourage private, including foreign investment. This plan served as a successor to New Economic Policy of 1971. Government stated that future regulatory process governing foreign investment would be decided on a case-by-case basis. However, a 30% foreign ownership restriction was still in affect so that the policy might not have been fully commensurate with a liberalisation of the capital account.[l]
08-92	First ADR introduced.[b]
09-92	Liberalisation of foreign equity ownership. Companies exporting at least 80 percent of their production were no longer subject to any equity requirements, whereas companies exporting between 50 percent and 79 percent of their production were permitted to hold 100 percent, provided that they have invested $50 million or more in fixed assets or completed projects with at least 50 percent local value added and that the company's products do no compete with those produced by domestic firms. These guidelines would not apply to sectors in which limits on foreign equity participation have been established.

Continue Malaysia

12-93	Nonresident-controlled companies involved in manufacturing and tourism-related activities were freely allowed to obtain domestic credit facilities to finance the acquisition and/or the development of immovable property required for their own business activities.[f]
02-94	Residents were prohibited to sell to nonresidents all forms of private of private debt securities with a remaining maturity of one year or less. The restriction on the sale of Malaysian securities to nonresidents was extended to both the initial issue of the relevant security and the subsequent secondary market trade.
08-94	Lifted the restriction on sale of Malaysian securities imposed on January and February 1994.[f]
01-95	Removed ceilings on the net external liability positions of banks imposed since January 1994.[f]
01-95	Reduction of maximum personal income taxes from 34% to 32% and corporate rate from 32% to 30%.
06-95	Revision of the commission structure of the Kuala Lumpur Stock Exchange. Foreign brokers cannot be exchange members. Foreign brokers complained that even the new schedule would slash profits on large transactions.
08-97	Kuala Lumpur Stock Exchange imposed trading controls on benchmark sectors. To curb speculations, investors required to pay full price for a stock and sellers to deliver all shares before signing the contract. Elimination of short selling, which causes panic among investors wanting to hedge positions.
09-98	The authorities introduced an approval requirement for investments abroad exceeding RM 10,000 in any form. A limit of RM 1,000 a person on the exports of domestic currency by resident and non resident travellers was introduced. Non resident sellers of Malaysian securities were required to hold on to their ringgit proceeds for at least one year and to carry out all purchases and sales of ringgit securities through authorized depositary institutions.[f]
02-99	Foreign direct investors were allowed to repatriate the proceeds from portfolio investments, subject to paying a levy. The requirement that nonresident holdings of Malaysian securities be kept in Malaysia for at least one year was replaced by a graduated system of exit taxes on capital and capital gains.[f]

Philippines

Date	Events
01-81	10% Capital gain tax on share transactions to discourage speculation in the Manila Stock market.[d]
12-81	Export of foreign currency was forbidden without prior approval.[d]
10-82	Introduced a regulation specifying that the commercial banks' net foreign exchange position should not exceed the sum of 20 percent of their outstanding letters of credit and 30 percent of foreign exchange receipts negotiated through the commercial banks.[f]
10-83	Commercial banks instructed to surrender 80% of foreign exchange earnings to the Central Bank and a ban was placed on nonresident imports.[d]
11-83	Commercial banks must surrender all their foreign exchange receipts to the Central Bank. Foreigners were permitted to own up to 100% of certain Philippines enterprises to attract hard currency.[d]
10-84	Introduced the effective exchange rate determined by market forces with periodic Central Bank interventions. 1% tax on all purchase and sales on foreign exchange.[d]
01-86	Amended, following the Circular of October 1984, establishes that all foreign investments in equity or in Central Bank-approved securities and reinvestments must be registered with the Central Bank. These investments must be placed by the foreign investors in government securities, shares of BOI-registered industries, or shares of stock in Central Bank-certificated export-oriented industries.[f]
05-86	Country fund liberalisation. First country fund, "The Thornton Philippines Redevelopment Fund Limited", launch of 1980's. The first larger scale country fund followed in May 1997.[b]
00-87	Few restrictions left the governing repatriation of capital income by foreigners. Introduction of "The Omnibus Investment Code" of 1987 (E.O. No.226), which guarantees all investors in enterprises registered with the BOI the right to repatriate their investments and to remit earnings thereon as well as sums needed to meet payments of principal and interest on foreign loans.[f]
05-87	Philippines Long Term Equity Fund Ltd launched (unlisted).[b]
06-89	A Circular Letter provided that sales proceeds of central bank-registered foreign investments in a domestic company whose stocks were not listed could be traded in the local stock exchanges when investments were made, and that company shares that were subsequently listed/traded in the local stock exchanges at time of their sale could be repatriated in full, net of taxes and fees, subject to prior approval by the Central Bank through the Foreign Exchange Operations and Investments Department.[f]
10-89	IFC Official liberalisation date.
03-91	First ADR introduced.[b]
06-91	Bekaer and Harvey Official liberalisation date.
06-91	A foreign investment act is signed into laws. Under the provisions, foreign investors are required only to register with the securities and exchange commission, and most sectors of the economy are opened to 100% foreign ownership. Foreign firms would be allowed to invest in all sectors, expect for those on three negative lists: List A, which restricts foreign investment as provided for in the constitution and nationalization laws; List` B, which restricts foreign investments in defence-related activities, in activities detrimental to public morals and health, and in small businesses; and List C, which includes sectors that are adequately served by Philippines interests. List C is to be suspended for a three-year transitory period, with the exception that foreign investment will be restricted in certain sectors (such as retail trade, mass media, import and wholesale trade, and insurance) and for firms where foreign investors are currently involved in joint ventures as licensing arrangements.

Continue Philippines

01-92	The Central Bank liberalised rules governing foreign exchange transactions. Authorised banks were permitted to sell foreign exchange for repatriation of all types of investment without prior approval from the Central Bank. (Exchange rate arrangements, IMF). Full and immediate repatriation of profits and dividends were allowed without obtaining prior approval from the Central Bank.[f]
06-92	Foreign exchange payments for principal, fees, and related charges on foreign credit approved by and registered with the Central Bank and not subject to or covered by rescheduling with foreign creditors were allowed to be remitted through authorized banks without prior approval from Central Bank.[f]
08-92	The government lifted all foreign exchange restrictions allowing foreign investors to freely repatriate their capital.
04-93	Central Bank Circular No. 1389 setting forth the status of the Central Bank's rules regulations on current accounts, capital accounts, foreign currency deposit u offshore banking units, and representative offices of foreign banks was issued. Circular also included that foreign investors can repatriate cash dividends, profits capital without central bank's approval. The move follows the more general relaxa of foreign ownership restrictions in 1992.[f]
06-94	Elimination of restrictions on repayment and repatriation of foreign investments funded by debt-to-equity conversion transactions. Also repealed were the limitations on the remittance of dividends, profits, and earnings on such transactions.[f]
02-95	Circular from the Central bank, which allows the reduction of the maximum allowed overbought foreign exchange position of commercial banks from 25 percent to 20 percent of unimpaired capital, and the maximum oversold position was raised to 10 percent from 5 percent.[f]
06-97	Central Bank announced that the currency could trade in a wider range.
02-99	Standard and Poor's raised Phillipines' country outlook to stable from negative, owing to the country's improved access to foreign capital.

Taiwan

Date	Events
02-79	Effective Rate was placed on a controlled basis with its exchange determined against a "basket" of currencies.
00-82	Ministry of Finance began policy of gradual liberalisation. The plan has three phases. The first phase will allow indirect investment through trust funds established in the Republic of China. The second phase will allow direct investment by foreign institutions. The third phase will allow free access to foreign capital.[l]
09-82	Taipei announced the gradual opening of local stock market to foreign investors via "beneficial certificates" issued by local investment companies. Foreign investors were to be allowed to buy shares in companies in Taiwan.[d]
08-83	Implementation data of phase one of the liberalisation plans. The International Trust Company Limited is established.
10-83	Taiwan (Roc) Fund launched by the International Investment Trust Co Ltd. The Trust Fund was launched with an initial capital value of U.S.$81 million.[e]
00-86	Taiwan continues to dismantle its foreign exchange control system. Allowed foreign-invested firms to return capital gains as well as of their investment after one year instead of several; reduced tariffs on 1841 items; permitted residents to hold or export up to US$5 million in foreign exchange and allowed residents to buy foreign exchange certificates of deposit at minimums of US$10,000.[d]
05-86	Taipei Fund, Formosa Fund and Taiwan Fund launched and managed by National Investment Trust Co Ltd., Kwang Hwa Securities Investment Trust Co Ltd. and China Securities Investment Trust Corporation, respectively. All three countries funds were launched with an initial capital value of U.S.$25 million.[e]
07-89	Complete deregulation of interest rates with advent of a new Banking Law. Relaxed the requirement for entry into the banking system and the establishment of new branches including international offices. Government allows foreign investment in the stock market in local companies.[m]
11-89	Central Bank lifted the US$5 million annual limit to financial institutions making remittances and overseas investments with specified trust funds. Taiwan recognizes the Government on the Mainland and sectioned indirect investment in China through affiliates or subsidiaries.[d]
01-91	Official liberalisation date.
01-91	Implementation data of phase two of liberalisation plan. Eligible foreign institutional investors may now invest directly in Taiwan securities if they have applied for and received SEC approval as an after initial investment. Each foreign institution is limited to holding a maximum of 5% of any listed stock and total foreign holdings in any listed companies may not exceed 10% plus an overall ceiling. The initial ceiling was US$2.5 billion.
12-91	First ADR introduced.[b]
07-95	Elimination of the maximum initial ceiling and raised the maximum of foreign holdings in any listed companies from 10% percent to 12% percent.[f]
09-95	Raised the limit of foreign investment from 12% to 15% percent.[f]
03-96	Executive Yuan increased the ceiling on foreign ownership of total market capitalisation from 15% to 20% raised to 25% in December.[h]
05-96	Increased the limit of foreign investors participation from 15% to 20%.[f]
05-97	Government took steps to give greater access to foreign banks in domestic markets.
03-99	Ministry of Finance announced that foreign ownership limits in listed companies would be raised to 50% from 30%.

Thailand

Date	Events
04-77	Foreign Promotion Act guarantees that no private business will be nationalized. Free repatriation of profits and dividends.
11-84	Thailand abandons fixed rate vis-à-vis the dollar.[f]
07-85	Bangkok Fund Ltd jointly launched by Merrill Lynch and Cazenove. The country fund was managed by the Bank of NT Butterfield & Son Ltd. The initial capital value was of U.S.$10 million.[e]
12-86	Thailand Fund launched by Vickers da Costa and managed by Mutual Fund Co & Morgan Stanley Asset Management. The initial capital value was of U.S.$30 million.[e]
09-87	Inauguration of the Alien Board on Thailand's Stock Exchange. The Alien Board allows foreigners to trade stocks of those companies, which have reached their foreign investment limits. Thais continue to trade stocks on the Main Board.[a,e]
12-88	IFC Official liberalisation date.
01-90	Domestic firms no longer need to get approval to pay dividends to foreigners.[a]
05-90	Thais citizens gain access to foreign bank accounts.[a]
01-91	First ADR introduced.[b]
04-91	Announcement of the loosening of foreign exchange controls and the introduction of the value added tax system in January 1992. Controls and reporting requirements for the repatriation of dividend, capital gains, foreign currencies and share certificates are partially removed.
05-92	Controls and reporting requirements for the repatriation of dividends, capital gains, foreign currencies, and share certificates continue to be partially removed.[a]
02-94	The ceiling on the amount authorized banks are permitted to lend to nonresidents in foreign currency was eliminated. The maximum amount of foreign direct investments or loans that domestic residents nay provide to their affiliates without authorization from the Bank of Thailand was increased to $10 million a year from $5 million a year.
08-95	The Bank of Thailand imposed a reserve requirement of 7 percent on nonresident baht accounts with maturities of less than one year.[f]
06-97	The foreign ownership limit of 25% of financial institution was lifted on a case-by -case basis.[f]
06-97	The Bank of Thailand introduced a series of measures to limit capital inflows.[f]
07-97	The exchange rate of the Thai baht was allowed to float freely, and a two-tier currency market was introduced.[f]
10-97	Foreign investors were allowed full ownership of local financial institutions for up to 10 years.[f]
01-98	The two-tier currency market, in effect since July 1997, was unified[f]. The 49% foreign ownership limit for securities companies was scrapped. Decision to dismantle currency controls was made on January 30.
04-99	Moody's raised big bank's credit rating.

Notes: Unless otherwise noted all information is taken for Bekaert, G. and C.R. Havey, 1998, Capital flows and the behavior of emerging equity market returns; working paper N. 6669, National Bureau of Economic Research.

[a]Bailey, W. and J. Jagtiani, 1994, Foreign ownership restrictions and stock prices in the Thai capital market, Journal of Financial Economics, 36, 1, 57- 87.

[b]Bekaert, G. and C.R. Harvey, 2000, Foreign speculators and emerging equity markets, Journal of Finance, 55, 2, 565-613.

[c]Bentley, P. ed., 1986, World Guide to Exchange Control Regulations, Euromoney Series, Longwood Publishing Group, Wolfeboro, NH.

[d]Cowitt, P.P ed., World Currency Yearbook, Currency Data and Intelligence, Inc. Brooklyn, New York, varies issues 1984, 1985, 1989, and 1991.

[e]Euromoney annual report, The World stock exchange, various issues for the period 1987 to 2000.

[f]Exchange arrangements and restrictions, IMF publications, varies issues for the period 1973 to 2000.
[g]George, R.L., 1989, A Guide to Asian Stock Markets, Longman, Hong Kong.
[h]International Finance Corporation, Emering Stock Markets Factbook, 1997.
[i]Park, K.K.H. and Van Agtamel, A.W., 1993, The World's Emerging Stock Markets: Structure, Development, Regulations, and Opportunities.
[l]Private Market Financing for Development Countries, International Monetary Funds, various issues form 1991 to 1996.
[m]World Bank, 1993, The Asian miracle, Oxford University Press.

CHAPTER THREE

A REVIEW OF THE APPLIED ECONOMETRIC METHODS

SECTION ONE: COINTEGRATION ANALYSIS

3.1 Introduction

The identification of the characteristics of the dynamic path of a time series is essential to estimate its potential relationships with other variables. The application of incorrect econometric methodology in estimating links between two or more variables produces results that are only meaningless information about the analysed links. In particular, when modelling economic and financial phenomena is quite common to operate with time series that do not satisfy the basic assumption of stationarity, which is required to avoid spurious inferences based on regression analysis (Nelson and Plosser, 1982). Therefore, a preliminary analysis has to be performed to identify the characteristics of the time series under research, and based on the findings, select the appropriated econometric technique to apply.

3.2 Stationary and nonstationary time series

3.2.1 Decomposition of time series into permanent and transitory components

Beveridge and Nelson (1981) affirm that any time series can be decomposed into permanent and transitory components. Considering the process y_t generated by an ARIMA(0,1,1) model, including a drift, as the following

(3.2.1) $$y_t = \alpha + y_{t-1} + \varepsilon_t + \gamma\varepsilon_{t-1},$$

where ε_t is assumed to be identically, independent distributed *(iid)* errors and letting the initial value of y_t, indicated with y_0, be equal to zero, by successive substitution we can explain y_t as follows

(3.2.2) $$y_t = \alpha + (\alpha + y_{t-2} + \varepsilon_{t-1} + \gamma\varepsilon_{t-2}) + \varepsilon_t + \gamma\varepsilon_{t-1}$$

$$= \alpha t + \sum_{i=1}^{t} \varepsilon_i + \gamma \sum_{j=1}^{t-1} \varepsilon_j$$

$$= \alpha t + (1+\gamma) \sum_{i=1}^{t} \varepsilon_i - \gamma\varepsilon_t.$$

Defining

(3.2.3) $$DT_t = \alpha t,$$

$$ST_t = (1+\gamma) \sum_{i=1}^{t} \varepsilon_i,$$

$$C_t = \gamma\varepsilon_t,$$

where DT_t represents the deterministic trend, ST_t represents the stochastic trend, and it includes all random shocks from ε_1 to ε_t, and C_t represents the cyclical component of the process y_t; we are able to rewrite y_t as follows

(3.2.4) $y_t = DT_t + ST_t + C_t$.

As noted by Beveridge and Nelson (1981) the process of equation (3.2.4) is composed by a permanent component, which is represented by the sum of the deterministic and stochastic trends, and a cyclical component. It is important to underline that not necessary all components are present in the time path of variables. In same cases the behaviour of a series over time can be driven by both stochastic trend and cycle, while in other cases only by one of them. Of course, the presence of the stochastic component induces the researcher to apply more sophisticated econometric techniques than the classic regression analysis.

3.2.2 Characteristics of stationary and nonstationary time series

Given a very simple data generating process (*d.g.p*) y_t defined as

(3.2.5) $y_t = \rho\, y_{t-1} + \varepsilon_t$,

if ρ is in absolute value smaller than one and ε_t is distributed as a white noise with mean equal to zero and with constant variance equal to σ^2, the time series is defined as stationary. In this case, it is possible to rearrange and accumulate y_t for different periods of time to obtain

(3.2.5) $$y_t = \rho^n y_{t-n} + \sum_{i=t-n+1}^{t} \rho^i \varepsilon_i,$$

where y_{t-n} is the initial value of y_{t-n}. Since the absolute value of ρ is smaller than one, as n goes to infinity, y_t will be solely determined by a finite moving average. Its mean is constant and equal to zero and also its variance is constant and equal to

(3.2.6) $\mathrm{Var}\{y_t\} = \sigma^2/(1-\rho^2)$.

If the coefficient ρ is equal to one, y_t can be explained as in the following equation:

(3.2.7) $$y_t = y_{t-n} + \sum_{i=t-n+1}^{t} \varepsilon_i.$$

where y_t is defined as the sum of its initial value and all disturbances accounting between t-n+1 and t. In this case the variance of y_t is equal to

(3.2.8) $\mathrm{Var}\{y_t\} = t\sigma^2$

and it becomes infinitely large as t increases. In this case the time series is nonstationary. Thus, it is possible to conclude that while a stochastic process is stationary if its mean, its variance, and its covariance are constant for all t; a nonstationary process has its mean, variance and autocovariance time varying.

Graphically, a stationary time series exhibits mean reversion and it fluctuates around a constant long-run mean that could be a level, named deterministic trend. It presents finite variance, which is also time-invariant and its correlogram diminishes as lag length increases. A nonstationary time series does not present any long-run mean to which the series returns, its variance is time dependent and it goes to infinity and its autocorrelation decay out slowly. Consequently, a shock to a stationary series has only a temporary effect. It will dissipate as the time goes and the time series will revert to its long-run mean level. Opposite, a shock to a nonstationary time series will never decay, and it will cause a permanent deviation of the series from its previous level.

A nonstationary process is also named difference stationary process. This is because a difference stationary process is stationary only in its differences. However, a difference stationary process should not be confused with a deterministic stationary process, which is a process stationary in its level as well. A difference stationary process can include a determinist trend in its path, but is still stationary only in its differences. The d.g.p of a deterministic process is as follows

(3.2.9) $$Y_t = \alpha + \beta t + \varepsilon_t,$$

where $\alpha + \beta t$ is the deterministic trend and ε_t is a stationary residual component. Since the disturbance is assumed to be stationary, the time series is trend-stationary. In contrast, the d.g.p of a difference stationary process inclusive of a deterministic trend is given as

(3.2.10) $$y_t = y_o + \beta t + \sum_{i=t-n+1}^{t} \varepsilon_i,$$

where $y_o + \beta t$ represents the determinist component and $\sum_{i=t-n+1}^{t} \varepsilon_i$ is the stochastic component of the time series y_t. We can face time series that present a determinist trend, but that are stationary (trend stationary processes) as well as time series that include deterministic trends, but that are nonstationary (difference stationary process).

Both series present determinist trends, but they required different econometric technique of analysis.

The concept of nonstationarity is associated with the presence of unit roots in d.g.p. of a time series. Considering the general pth order autoregressive process (AR(p)) defined as follows

(3.2.11) $y_t = \psi_1 y_{t-1} + \psi_2 y_{t-2} + \ldots\ldots\ldots + \psi_p y_{t-p} + \varepsilon_t,$

where ε_t is distributed as a white noise, and reformulating it as

(3.2.12) $\Psi(L) y_t = \varepsilon_t,$

where $\Psi(L)$ is the polynomial lag operator $1 - \psi_1 L - \psi_2 L^2 + \ldots\ldots\ldots + \psi_p L^p$; if the roots of its characteristic equation, $(1 - \psi_1 L - \psi_2 L^2 + \ldots\ldots\ldots + \psi_p L^p)$, are greater than unity, then y_t is stationary. In contrast, if at least one of the parameter $\tilde{\psi}_i$ is equal to one, then the process is nonstationary. Therefore, an AR(1) is stationary only if the parameter ψ_1 assumes an absolute value smaller than one.

Concluding, a nonstationary time series presents unit roots. The number of unit roots, indicated with d, denotes how many times the variable has to be differentiated to become stationary. A nonstationary variable is also called integrated of order d, which is indicated as I(d).

3.3 Unit root tests

3.3.1 Dickey and Fuller (1979) and Augmented Dickey and Fuller (1981) tests

Econometric literature provides a variety of unit root tests to verify the stationarity of time series. In particular, the widest used was introduced by Dickey and Fuller (1979). Given the following d.g.p.

(3.3.1) $y_t = a_1 y_{t-1} + \varepsilon_t,$

where ε_t is a white noise process, if the parameter a_1 is equal to one, the time series y_t is nonstationary. Subtracting y_{t-1} from the left and right side of the above equation, we obtain

(3.3.2) $\Delta y_t = (a_1 - 1) y_{t-1} + \varepsilon_t,$

or equivalent

(3.3.3) $\Delta y_t = \gamma y_{t-1} + \varepsilon_t,$

where γ is equal to $a_1 - 1$. Test the null hypothesis of $\gamma = 0$ is equivalent to test for the presence of a unit root in the time series y_t. Dickey and Fuller (1979) propose three different regression equations in testing for the presence of unit roots. The first one represents a pure random walk model, the second one includes a drift term and the third one includes both a drift and a deterministic trend. Following, we report the three models for the different cases

Model I: $\Delta y_t = \gamma y_{t-1} + \varepsilon_t$,

Model II: $\Delta y_t = a_o + \gamma y_{t-1} + \varepsilon_t$,

Model III: $\Delta y_t = a_o + a_2 t + \gamma y_{t-1} + \varepsilon_t$.

The test simply consists in fitting one of the reported models on the sample data of the variable y_t and in comparing the t statistic of the estimated parameter γ with the critical values provided by Dickey and Fuller (1979). If for instance, the obtained t-statistic is -1.4530, which is smaller of the Dickey and Fuller's critical values at the 10, 5, 1 percent of significant level, then the null hypothesis that the time series it is nonstationary is accepted.

Dickey and Fuller (1981) extended this statistic test to allow the inclusion of autoregressive components in the distribution of the analysed variable y_t. Also in this scenario, three alternative models are proposed

Model I: $\Delta y_t = \gamma y_{t-1} + \sum_{i=1}^{p} A_i \Delta y_{t-i} + \varepsilon_t$,

Model II: $\Delta y_t = a_o + \gamma y_{t-1} + \sum_{i=1}^{p} A_i \Delta y_{t-i} + \varepsilon_t$,

Model III: $\Delta y_t = a_o + a_2 t + \gamma y_{t-1} + \sum_{i=1}^{p} A_i \Delta y_{t-i} + \varepsilon_t$.

However, Dickey and Fuller's unit root test present some limitations. First, the test requires the error ε_t to be independent and to have a constant variance. Secondly, the test does not cover the case of time series with moving average components. Thirdly, the true order of the autoregressive process it is unknown; therefore one has also to estimate the order p of the autoregressive component in testing for unit roots. Finally, this test considers only the case of a single unit root, and a pth-order autoregressive component could present p unit roots.

As previously reported, Dickey and Fuller (1981) introduced a unit root test to be applied in presence of autoregressive components. On the other hand, Said and

Dickey (1984) support that an ARIMA(p, 1, q) process can be well approximated by an ARIMA(n,1,0) with the autoregressive n order smaller or equal to $T^{1/3}$, where T is the number of available observations. Therefore, the presence of a moving average components can be also covered by performing the Augmented Dickey Fuller test on the inverse autoregressive representation. In addition, Dickey and Pantula (1987) suggest to perform the Dickey and Fuller test on successive differences of y_t to detect the presence of more than one unit roots when the time series is an autoregressive process of order p. In all the cases the critical values of Dickey and Fuller (1979) are still valid.

3.3.2 *Phillips-Perron Tests*

The most important innovation with respect to the Dickey-Fuller and the Augmented Dickey and Fuller unit root tests is the Phillips and Perron (1988) nonparametric unit root test. Its innovation consists in allowing presence of autocorrelated and heteroscedastic disturbances.

The Phillips and Perron (1988) unit root test presents a non-parametric correction to the t-test statistic in order to account for any bias due to autocorrelation in the error term of the Dickey-Fuller regression model. This bias results when the variance of the 'true' population, which is given as follows

(3.3.4) $\sigma^2 = \lim E(T^1 S^2_T)$,

differs from the variance of the residuals in the regression equation, which can be represented as

(3.3.5) $\sigma^2_\varepsilon = \lim T^{-1} \Sigma E(\varepsilon^2_t)$.

Phillips and Perron (1988) show that consistent estimators of σ^2_ε and σ^2 are

(3.3.6) $S^2_\varepsilon = T^{-1} \Sigma (\varepsilon^2_t)$; $S^2_{T\tau} = T^{-1} \Sigma (\varepsilon^2_t) + 2T^{-1} \Sigma\Sigma \varepsilon_t \varepsilon_{t-j}$, $t=1, .., \tau$ $t=j+1, .., T$

where τ is the lad truncation parameter used to ensure that the autocorrelation of the residuals is fully captured. In case there is not autocorrelation the last term in the formula defining $S^2_{T\tau}$ is zero and $\sigma^2_\varepsilon = \sigma^2$.

Having a d.g.p. defined as follows

(3.3.7) $y_t = y_{t-1} + \varepsilon_t$,

the Phillips and Perron (1988) test investigates for the presence of unit root considering the following regression equations

(3.3.8) $y_t = a^*_0 + a^*_1 y_{t-1} + \varepsilon_t$,

and

(3.3.9) $y_t = b^*_o + b^*_1 y_{t-1} + b^*_2 (t - T/2) + \varepsilon_t$,

where T is the number of observations and ε_t represents the disturbance error, which is only required to have zero mean. Even if this procedure involves a different statistic[14] test that the basic Dickey and Fuller unit root test, it has been shown that the critical value for the Phillips-Perron unit root test are the same of the Dickey-Fuller unit root test.

Concluding, the proposed unit root tests present advantages and disadvantages. None has been shown to perform generally better than the other does. On the one hand, the Augmented Dickey-Fuller (ADF) unit root test can be used when the error process is a moving average (Said and Dickey (1987). On the other hand, the Phillips-Perron test allows for a weaker set of assumptions concerning the error process. Monte Carlo studies (for instance, Schwert, 1989) suggest that Phillips-Perron test is more powerful to reject a false null hypothesis of unit roots, than augmented Dickey-Fuller test. But Phillips-Perron test tends to reject the presence of unit roots in the case of negative moving average term in the *d.g.p.* Therefore, it is up to the researcher to choice the one that fits better the specific characteristics of the variables under study.

3.4 Cointegration analysis

Many economic and financial variables present stochastic trends in their dynamic path. In fact, when examining economic and financial links is common to face the problem of operating with nonstationary time series. Even if only in the last two decades the nonstationarity of time series has been seriously taken in consideration, the concept of cointegration is quite old. In fact, Yule (1926) argues that regressions based on trending time series data could be spurious. A similar argument has been supported much later by Granger and Newbold (1974). However, the original concept of cointegration was introduced by Granger (1981) and it was developed only five years later by Engle and Granger (1987) under the name of cointegration analysis.

This econometric method permits to solve the problem of estimating relationship among nonstationary time series without losing any relevant information

[14] The statistic test in the Phillips-Perron approach is:

regarding the analysed linkage. Campbell and Shiller (1987) supported that cointegration analysis represents a more powerful method to estimate links between nonstationary variables. Applying the alternative methodology of differencing all nonstationary variables in order to estimate relationships between stationary time series will obscure potentially important long-run relationship between the variables. Therefore, the main advantage of applying the cointegration technique is in the simultaneous estimation of both long-run as well as short-run dynamics between the analysed variables.

As described in the previous paragraph, a nonstationary variable presents a stochastic trend in its dynamic path over time. If two or more integrated variables are cointegrated, their stochastic trends are related in their long-term movement. According to Stock and Watson (1988), the number of common stochastic trends of a cointegrated system is equal to the dimension of the system minus the number of linear independent cointegrating vectors shared by the variables of the process. The economic system converges over time to the equilibrium represented by the cointegrating vectors. This long run equilibrium is the steady state growth path where the economic forces are in balance. Any deviation of the system, due to economic shocks, will revert in a certain amount of time to its steady state growth path. Misalignment will also affect the variables on their short-run dynamics. The error correction model (ECM) captures short-run dynamics due to both misalignment from the equilibrium and short-run links between the integrated variables.

Concluding, cointegration analysis avoids spurious regression and loss of information when operating with nonstationary variables. This method of estimation captures in a single model both the long-run and short-run dynamics amongst the integrated variables under research. Therefore, the application of this approach gives the advantage of evaluating and comparing links between the behaviour of the economic and financial phenomena in two different types of markets, the short and long term market.

3.5 *Vector error correction model and the Johansen approach*

The first method to test for cointegraton was introduced by is Engle and Granger (1987). The author proposed a technique, known as the Engle and Granger

---

$Z(a^*_1=1) = (S_\varepsilon/S_{T\tau})\,\tau_\varepsilon - ½\,(S^2_{T\tau} - S^2_\varepsilon)\,\{ S_{T\tau}\,[T^2\,\Sigma\,(y_{t-1} - y'_{t-1})]^{1/2}\}^{-1}.\quad t = 2, .., T$

coitnegration analysis, that develops in two steps. In the first step, a possible long-run stationary relationship between nonstationary time series is estimated applying a static Ordinary Least Squares (OLS) regression. In the second step, the results of the first phase are included through the error correction term in evaluating the error correction model, which captures the short-run dynamics of the series due to their short-term changes and to long-term disequilibria. Even if this procedure was and still widely used, it presents several limits. First, the method cannot be applied in testing for more than one cointegrating vector. Secondly, Engle-Granger is a two-steps procedure, therefore errors introduced in the first step will also be carried into the second step. Thirdly, this procedure imposes a normalisation on the dependent variable a priori, which could affect the final results. More recently, several others methods have been developed[15] in order to improve the Engle and Granger approach's limits. Amongst the alternative methods, the widest applied are the Johansen (1988) and Stock and Watson (1988) maximum likelihood estimators. Both approaches present the advantage to circumvent the use of two-steps estimator allowing the possibility of testing for the presence of more than one cointegrating vector.

In the empirical part of the thesis we use the cointegration technique developed by Johansen (1988, 1991) and extended by Johansen and Juselius (1990, 1992), which is the Full Information Maximum Likelihood (FIML) estimation method. This procedure uses all the information incorporated in the dynamic structure and it also estimates the entire space of the long-run relationship among a set of variables without imposing a prior normalisation on the dependent variable. The choice of this method is based on Gonzalo' s (1994) empirical study. Gonzalo (1994) applying a Monte Carlo simulation compares the performance of five methods (ordinary least squares, non-linear least squares, maximum likelihood in an error correction model, principal component and canonical correlations) of estimating cointegrating vectors. He found that the Johansen's approach has clearly better properties than the other estimators do. The results also show that this method performs better than others, even when the errors are nonnormally distributed or when the number of lags in the ECM is unknown.

[15] Chronologically they are: ordinary least squares (OlS) by Engle and Granger (1987); nonlinear least squares (NLS) by Stock (1987), principal components (PC) by Stock and Watson (1988), canonical correlations (CC) by Bossaerts (1988), maximum likelihood in a fully specified error correction model (MLECM) by Jonhansen (1988), instrumental variables (IV) by Hansen and Phillips (1990) and spectral regression (SR) by Phillips (1991).

Considering a vector Y_t that contains p variables. If all p variables are integrated of order one, I(1), then the VAR(k) model can be written in the error-correction form as

(3.5.1) $$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{k-1}\Gamma_i \Delta Y_{t-i} + \mu + \theta D_t + \varepsilon_t,$$

where k is the order of the VAR system; μ is a vector of constants; D_t is a vector of seasonal dummies orthogonal to the constant; and ε_t is *i.i.d.* errors. The matrix Π, in equation (3.5.1), is defined as $\alpha\beta'$, where α and β are (p $\times$ r) matrices; it has rank equal to r; and it can be written as $\Pi = -(I - A_1 - .... - A_k)$; and the matrix $\Gamma_i = -(I - A_1 - .... - A_i)$, with i = 1, .., k.

As shown in Johansen and Juselius (1990), the estimation procedure is simplified by reformulating model (3.5.1) as

(3.5.2) $$R_{0t} = \alpha\beta' R_{1t} + \text{error}, \quad t = 1, \ldots, T.$$

The vector R_{0t} and R_{1t} obtained as residuals from the auxiliary regressions

(3.5.3) $$\Delta Y_t = \hat{B}_1 \Delta z_{t-1} + \hat{B}_2 D_t + R_{0t}$$

and

(3.5.4) $$Y_{t-1} = \hat{B}_3 \Delta z_{t-1} + \hat{B}_4 D_t + R_{1t},$$

where B_1, B_2, B_3 and B_4 are estimated by ordinary least squares regressions (cf. Johansen and Juselius, 1990). The maximum likelihood estimator of β is found by solving the equation

(3.5.5) $$\left|\lambda S_{11} - S_{10} S_{00}^{-1} S_{01}\right| = 0,$$

which gives the eigenvalues $\hat{\lambda}_1 \succ \ldots \succ \hat{\lambda}_p$ and the corresponding eigenvectors $\hat{V} = (\hat{v}_1, \ldots, \hat{v}_p)$ normalized such that $\hat{V}' S_{11} \hat{V} = I$. The matrices S_{11}, S_{10} and S_{00} are appropriately defined covariance matrices (for further details, see Johansen and Juselius (1990)). The eigenvalues $\hat{\lambda}_i$ correspond to the squared canonical correlations between the "levels" residuals and the "difference" residuals, as above defined. The eigenvectors $\hat{v}_i$ determine the linear combinations $\hat{v}_i' z_t$, i= 1, k-1. Thus, the magnitude of $\hat{\lambda}_i$ is a measure of how strongly the cointegrating relation $\hat{v}_i' z_t$ is correlated with the stationary part of the process. The last (p-r) combinations $\hat{v}_i' z_t$, i=r+1, .., p, give the directions in which the process is found to be nonstationary.

Theoretically these latter combinations are uncorrelated with the stationary part of the process and consequently the population value of λ_i is 0 for i = r+1, ..., p. The statistical problem is to discriminate between nonzero and zero eigenvalues and the maximum likelihood solution are given by the likelihood ratio test procedure described below. The maximum likelihood estimate of β is given by $\hat{\beta} = (\hat{v}_1,...,\hat{v}_r)$, that is the matrix of eigenvectors corresponding to the first r ordered eigenvalues. To each vector v_i, i=1, .., r, there is a corresponding vector α_i of dimension p × 1 for which at least one element is nonzero. The elements of α_i can be interpreted as the weights with which the cointegrating relation $v_i'z_{t-1}$enters each of the p equations in the systems. The matrix α is estimated as

(3.5.6) $$\hat{\alpha} = S_{01}\hat{\beta}(\hat{\beta}'S_{11}\hat{\beta})^{-1}.$$

The maximised likelihood function used in the estimation is given as follows

(3.5.7) $$L_{max}^{-2/T} = |S_{00}|\prod_{i=1}^{r}\left(1-\hat{\lambda}_i\right).$$

3.6 *Statistic tests for cointegration*

Two statistic tests have been introduced by Johansen and Juselius (1990) to investigate for presence of cointegration among a group of integrated variables: the Trace and the maximum likelihood statistics. Both statistics test for the null hypothesis of the existence of at most r cointegrating vectors in the system

(3.6.1) $$H_0: \lambda_i = 0, \qquad i = r+1, ..., n$$

where the first r eigenvalues are non-zero.

The Trace statistic, which is also called likelihood ratio test, tests that there are at most r cointegrating vectors $0 \le r \le p$, and (p-r) common stochastic trends. The statistic is

(3.6.2) $$\text{trace} = -T\sum_{i=r+1}^{p}\ln(1-\hat{\lambda}_i),$$

where $\hat{\lambda}_i$'s are the p-r smallest squared canonical correlations as described in section 3.5.

The maximum likelihood statistic test, which is based on the assumption of the comparison of H_0 (r) given H_0(r+1), is given by

(3.6.3) $-2 \ln Q(H_0(r) \mid H_0(r+1)) = -T \ln(1-\lambda_{r+1})$[16].

Regarding, which of the two statistic tests is the more accurate, Cheung and Lai (1993) show that in presence of skewness and kurtosis on the distribution of the disturbance errors, the Trace statistic is more robust than the maximum likelihood test.

3.7 Determination of the cointegration rank

The determination of the cointegration rank is the most crucial part of the analysis. Errors introduced in this step will be carried on to the following steps and will affect the final results. Four alternative approaches can be applied in testing for the cointegration rank. Their results could be compared in order to support the researcher's decision regarding the choice of r.

The previous introduced maximum likelihood and trace statistics are the most common tests when estimating the cointegration rank. However, one has to have in mind that both statistics present some limitations. First, the goodness of their distribution is affected in case of small sample and in presence of deterministic components such intervention dummies and exogenous variables. Secondly, the two tests might give ambiguous results. Finally, none of the tests can be applied in case of I(2) variables. Even if some of the limits have been solved, for instance by correcting for small sample biases as recommended by Reimers (1992), and empirical studies based on Monte Carlo simulation have showed the strong power of the trace test in presence of nonnormal distributed errors (see, Cheung and Lai (1993)), alternative approaches should be considered in the choice the cointegration rank.

Juselius (1995) suggests to examine the eigenvalues of the companion matrix as an additional information in selecting the rank r. According to the author, eigenvalues provide information regarding the number of (n-r) unit roots that are on the unit cycle, which represents the number of r linear combinations. Giving the following p-dimensional vector autoregressive model

(3.7.1) $y_t = A_1 y_{t-1} + \ldots\ldots + A_k y_{t-k} + \mu + \Psi D_t + \varepsilon_t, \qquad t = 1, \ldots, T,$

where y_t is a $p \times 1$ vector of stochastic variables and D_t is a vector of non-stochastic variables as dummies or intervention dummies, its comparison matrix is given by

[16] Johansen and Juselius (1990) and Osterwald-Lenum (1992) report the tables representing the critical values when respectively the dimension of the system is less than 5 or less than 11.

(3.7.2) $$A = \begin{bmatrix} A_1 & A_2 & \dots & A_{k-1} & A_k \\ I_n & 0 & \dots & 0 & 0 \\ 0 & I_n & \dots & 0 & 0 \\ \dots & \dots & \dots & \dots & \dots \\ 0 & 0 & \dots & I_n & 0 \end{bmatrix}$$

where I_p is the p-dimensional identity matrix.

The eigenvalues of A are the reciprocal values of the roots of the characteristic polynomial, and hence, they should be inside the unit disc or equal to unity under the assumption of the cointegrated VAR-model. The number of common stochastic trends in the model corresponds to the number of roots of the companion matrix close to unity. The test gives $p \times k$ eigenvalues, where p represents the number of variables and k is the dimension of the VAR model. For example, considering the case of three variables and founding that the first three real values of the eigenvalues are 1.0000, 1.0000 and 0.8794, this indicates that the system share two common stochastic trends and one stationary linear combination. Therefore, the rank r is equal to one.

Finally, another relevant method to use in the estimation of the number r of cointegrating vectors is the recursive analysis. Specifically, recursively restimating the Trace statistic over the sample period, one can identify the number r of cointegrating vectors by looking at the time path of the trace statistics (see paragraph 3.9.3 for details regarding the distribution of this statistics). More important with this technique one is able to individuate if the number r of cointegrating vectors is constant over time, or if the variables of the system share a different number of cointegrating vectors in different subperiods.

3.8 Deterministic components

In testing for presence of cointegration amongst a group of variables, it is extremely important to decide a priori, if and which deterministic components to include in the system. This is because the inclusion of deterministic components affects the asymptotic distribution of the rank test statistics. A general form of the VECM introduced in equation (3.5.2), which excludes dummy variables D_t, and it includes the complete variety of determinist components can be written as follows

$$(3.8.1) \qquad \Delta y_t = \Gamma_1 \Delta y_{t-1} + \alpha \begin{bmatrix} \beta \\ \mu_1 \\ \delta_1 \end{bmatrix} \tilde{y}_{t-k} + \alpha_\perp \mu_2 \, \delta + \alpha_\perp \, \delta_2 \, t + \varepsilon_t,$$

where $\tilde{y}_{t-k} = (y'_{t-k}, 1, t)$, μ_1 represents the restricted intercept component, δ_1 represents the restricted trend component, μ_2 represents the unrestricted intercept, and δ_2 represents the unrestricted trend component. Osterwalt-Lenum (1992) provides critical values for each kind of determinist component included in the VECM of equation (3.5.2).

Another important fact is the inclusion of dummy and exogenous variables in the studied process. This is because adding dummy and exogenous variables to the system affects the asymptotic distribution of the rank statistic tests. Therefore, new tables have to be calculated every time a dummy and/or exogenous variables are included in the model. The only exception is the inclusion of centered seasonal dummies, which are constructed to sum to zero over time. Johansen and Nielsen (1993) derive the asymptotic distribution for some models with dummy variables. The authors also provide a program called DisCo, which is designed to simulate the asymptotic distribution of the rank statistics. In our case we exploit the program DiSco to re-compute the table of critical values in case of inclusion on the analysed system of dummy variables, by performing a Monte Carlo Simulation, which is repeated 10,000 times for a number of 400 observations.

3.9 *Recursive analysis*

The main objective of the recursive analysis is to provide statistical tests for the evaluation of parameter constancy in cointegrated VAR models. The term recursive estimation is used to indicate that the parameters estimated for the full period of observations (X_0, ..., X_T), are compared with the parameters estimated successively on the basis of observations X_0, ..., X_t for $t = T_0$, ..., T.

In our empirical study, we conduct the recursive analysis for two major reasons. First, to avoid possible biases applying the Johansen's test because of sample dependency (see Stepthon and Larsen (1991)). Secondly, this analysis is also a relevant instrument to detect potential changes in the relationship amongst the analysed variables due to important events such as the liberalisation of the financial markets of the Pacific Rim and the recent Asian financial crisis, which represents two of the major interests of this doctoral thesis.

In case of testing for the constancy of the parameter θ_1, of a statistical model with many parameters $\theta = (\theta_1, \theta_2)$, one can conduct the recursive analysis in three different ways. First, one can simultaneously recursively estimate all the parameters of the model with likelihood function as

(3.9.1) $$L(t, \theta_1, \theta_2) = \prod_{s=1}^{t} t f(X_s / X_{s-1}, \ldots, X_1, \theta_1, \theta_2).$$

Secondly, one can use the full sample likelihood function to first estimate only the parameter θ_2 by solving

(3.9.2) $$\delta ln\, L(T, \theta_1, \theta_2) \,/\, \delta\theta_2 = 0,$$

which determines $\theta_2 = \hat{\theta}_2(T, \theta_1)$, and then derive the recursive estimates of θ_1 from the concentrated likelihood function

(3.9.3) $$Lconc\,(t, \theta_1) = L(t, \theta_1, \hat{\theta}_2\,(T, \theta_1).$$

Finally, one can calculate the full sample estimator of $\theta_2 = \hat{\theta}_2(T)$ and consider the conditional likelihood function

(3.9.4) $$F_{fix}\,(t, \theta_1) = L(t, \theta_1, \hat{\theta}_2\,(T)).$$

to evaluate θ_1.

In a cointegrated VAR model, the vector of parameters θ_1 represents the cointegrating relations, the adjustment parameters, the error covariance and θ_2 represents the short-term dynamics. As in Hansen and Johansen (1998), we consider only the first two of the methods above introduced. Applying the first approach, we recursively re-estimate all the parameters of the cointegrated VAR obtaining the "*Z-representation*". When, applying the second approach we recursively re-estimate only θ_1, which represents the cointegrating relations, the adjustment parameters and the error covariance. At the same time, we concentrated out the short-run parameters θ_2 obtaining the "*R-representation*".

3.9.1 The non-zero eigenvalues tests

One of our major interests is to look at the behaviour of the cointegrating relations over time. In particular, the intent is to verify if the estimated relations are constant over time. As recommended by Hansen and Johansen (1998), one way of assessing the constancy of the parameters, representing the speed of adjustments and the cointegrating relations, is to plot the time path of the r largest eigenvalues. The authors support the use of eigenvalues by showing that if the estimated eigenvectors are normalised such that $\beta' S_{11} \beta = I$, there exists a unique relationship between the eigenvalues, the adjustment coefficients, and the cointegrating vectors given as

(3.9.5) $$\Lambda' = \hat{\alpha}' S^{-1}_{00} \hat{\alpha} = \hat{\beta}' S_{10} S^{-1}_{00} S_{01} \hat{\beta},$$

where S_{00}, S_{10} and S_{01} are the variance and the covariance of the residual defined in the equation (3.5.4).

Thus, evaluation of the time path of $\hat{\lambda}_i$ (i = 1, ..., r) can be seen as an evaluation of the i'th column of $\hat{\alpha}$, speed of adjustments, or the i'th column of $\hat{\beta}$, cointegrating vectors, and changes in α or β will be reflected in the estimated eigenvalues.

Hansen and Johansen (1998) define a distribution for the eigenvalues. The authors in the same study also indicated asymptotic proprieties of eigenvalues, trace statistic and the estimator (betas). Hansen and Johansen (1998) show that the asymptotic distribution of the r largest eigenvalues $\lambda'_+ = (\lambda'_1, ..., \lambda'_r)$ is given by

(3.9.7) $T^{1/2} (\lambda'_+, ..., \lambda_+) \rightarrow N_r (0, \Sigma)$,

where Σ is given by

(3.9.8) $$\Sigma_{ii} = 4(1 - \lambda_i)^2 \left(\sum_{m=1}^{\infty} \left(\gamma_{ii}^{uu}(m)^2 - \gamma_{ii}^{uv}(m)^2\right) + \lambda_i\right),$$

(3.9.9) $$\Sigma_{ij} = 2(1 - \lambda_i)(1 - \lambda_j) \left(\sum_{m=1}^{\infty} \left(\gamma_{ij}^{uu}(m)^2 + \gamma_{ji}^{uu}(m)^2 - \gamma_{ij}^{uv}(m)^2 - \gamma_{ji}^{uv}(m)^2\right), \; i \neq j.\right.$$

Here

(3.9.10) $$\gamma^{uu}(m) = \Lambda^{1/2}(I, -\tilde{\Sigma}_{12}\tilde{\Sigma}_{22}^{-1})A^{m-1}(\alpha'\beta + \Lambda, \alpha', 0, .., 0)' \Lambda^{-1/2},$$

(3.9.11) $$\gamma^{uv}(m) = \Lambda^{1/2}(I, -\tilde{\Sigma}_{12}\tilde{\Sigma}_{22}^{-1})A^{m-1}(\alpha'\beta, \alpha', 0, .., 0)'(I - \Lambda)^{-1/2} \Lambda^{-1/2}.$$

In the infinite sums only terms with $m \geq 1$ enter, so that if the process u_t is *i.i.d.* the variance matrix Σ reduces to the result in Anderson (1984), section 12.4.2.

To obtain a better approximation of the limit distribution and to ensure that confidence bounds for λ_i stay in the interval [0, 1], we can transform the parameter into $\xi_i = - \ln(1 - \lambda_i)$. Consequently, the asymptotic variance for ξ_i is given by the following expression in (3.9.9) without the factors $(1 - \lambda_i)$ and $(1 - \lambda_j)$. Thus, we obtain

$$\Sigma_{ii}^{0} = 4\left(\sum_{m=1}^{\infty} (\gamma_{ii}^{uu}(m)^2 - \gamma_{ii}^{uv}(m)^2) + \lambda_i\right), \quad (3.9.12)$$

$$\Sigma_{ij}^{0} = 2\left(\sum_{m=1}^{\infty} (\gamma_{ij}^{uu}(m)^2 + \gamma_{ji}^{uu}(m)^2 - \gamma_{ij}^{uv}(m)^2 - \gamma_{ji}^{uv}(m)^2\right), \; i \neq j. \quad (3.9.13)$$

a 95% confidence interval for λ_i can be constructed as

$$1 - (1 - \lambda_i)\exp(1.96(T^{1}\Sigma_{ii}^{0})^{1/2} < \lambda_i < 1 - (1 - \lambda_i)\exp(-1.96)(T^{1}\Sigma_{ii}^{0})^{1/2}). \quad (3.9.14)$$

Concluding, in analysing the graph of the time path of the non-zero eigenvalues and their bounds any presence of substantial changes of these statistics is an indication of changes of the extent of links amongst the variables of the cointegrated system.

3.9.2 *Constancy of the cointegration space*

An alternative method to test for the constancy of the long-run parameters, which in this explanation we name betas, is to compare the parameters estimated for the full period with the parameters recursively estimated by adding a new sample at any point of time and graph the sequence. With this test is possible to investigate the null hypothesis that the betas estimated considering the full sample period are within the space spanned by the beta in each sub-sample. The major advantage of this test is that it does not require a prior estimation of the cointegration space. The test is distributed as a chi-square with $(p-r)r$ degree of freedom, where p is the dimension of beta and r is the number of cointegrating vectors. This statistic test is scaled. The level of significance is 5%.

3.9.3 *The rank test*

The selection of the cointegration rank is one of the most sensitive steps in cointegration analysis. This is because the identification of the number of cointegrating vectors, which is conducted as one of the first statistic tests, is determining the results of the following phases. Therefore, although a structural break in the number of cointegrating relations is unlikely (Hansen and Johansen, 1998), in case of presence of period of turbulences in the sample period, it is important to get an idea of the degree of sample dependence on the estimated cointegration rank.

Recall, from (3.6.2), that the Trace test is calculated as

(3.9.6) $$\text{Trace}_j = T\sum_{i=j}^{p}\ln(1-\hat{\lambda}_i), j = 1,\ldots,p-1.$$

In recursive analysis the rank test statistic is expressed as a function of time, in particular it is expected the time path of Trace_j to be upward sloping for $j \leq r$, where r is the number of cointegrating vectors, with a slope approximately equal to $\sum_{i=j+1}^{r}\hat{\lambda}_i$, whereas the test statistics are approximately constant for $j > r$. Plotting the test statistics against time is therefore an auxiliary tool in the evaluation of the cointegration rank. The trace statistics recursive test can be computed recursively restimating both short-run and long-run parameters of the VECM or alternative by recursively restimating only the long-run parameters and concentrating out the short-run parameters. Comparing the time paths of the recursive trace tests obtained from the two different recursions is possible to identify if the system was cointegrated for the full sample period or if short-run effects affects the final results. All test statistics are scaled by the 90% quantile of the trace distribution derived for the select model. For a specific t, we identify the rank r as the number of Trace_j statistics presenting and upward slope and above the critical value of one, which indicates the 10 percent statistical significance.

3.10 The moving average representation of a cointegrated system

Modelling potential relationships amongst integrated variables one can focus on two aspects. Either the "stable" economic relations between the variables that show less variability than the original variables, or the cumulated disturbances, which create the nonstationarity. For integrated process, the ideas of cointegration (see Engle and Granger, 1987) and of common trends (Stock and Watson, 1988) are dual concepts, which are related to the rank of the autoregressive (AR) and of the moving average (MA) impact matrices, respectively. Important is that these two representations are complementary to each other and not an alternative. While the AR formulation provides information of linear long-run equilibrium as well as short-run dynamics amongst the considered variables; the MA representation focuses on the identification and evaluation of the innovations and common trends.

Having an integrated process of order one, I(1), as follows

(3.10.1) $A(L)Y_t = \mu + \theta D_t + \varepsilon_t$,

where $A(L) = I - A_1L - \dots - A_kL^K$ is a finite matrix polynomial of order k, L is the backward shift operator, μ is a vector of constants, D_t is a vector of seasonal dummies orthogonal to the constant, and ε_t is *iid* errors. The error correction form of the process reported in equation (3.10.1) is given as follows

(3.10.2) $$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-i} + \mu + \theta D_t + \varepsilon_t,$$

where $\Pi = \alpha\beta$ and $\Gamma_I = -(I - A_1 - \dots - A_i)$, (I=1, .., k) and $\Pi = -(I - A_1 - \dots - A_k)$.

Considering the matrix $\alpha_\perp$ of full rank and dimension p × (p-r) such that $\alpha'\alpha_\perp=0$. The rank of $(\alpha, \alpha_\perp)$ is equal to p. In the same manner, taking the matrix $\beta_\perp$ of full rank and dimension p × (p-r) such that $\beta'\beta_\perp=0$. The rank of $(\beta,\beta_\perp)$ is again equal to p.

If the matrix Π, which is given by multiplying the vector of loading factors α by the cointegrating vector β, has reduced rank r, and if $\alpha_\perp'\Gamma\beta_\perp$ has a full rank p-r, then the process in equation (3.10.1) is I(1) and its moving average representation is given by:

(3.10.3) $\Delta Y_t = C(L)(\varepsilon_t + \mu + \phi D_t)$,

where C(L) can be developed as $C(L) = C(1) + (1-L)\tilde{C}(L)$, (see Engle and Granger (1987)). In integrated form (3.10.3) is given by

(3.10.4) $$Y_t = Y_0 + C\sum_{i=1}^{t} \varepsilon_i + C\mu t + C\sum_{i=1}^{t} \phi D_i + \tilde{C}(L)(\varepsilon_t + \phi D_t),$$

where $C = C(1)$ and $\tilde{C}(L) = (1-L)^{-1}[C(L)-C(1)]$.

As shown in Johansen (1991) the link to the AR form of the model is given by

(3.10.5) $C = \beta_\perp(\alpha_\perp'(-I + \Gamma_1)\beta_\perp)^{-1}\alpha_\perp'$,

where $\alpha_\perp$ and $\beta_\perp$ are the orthogonal complements of α and β, respectively. The matrix $\alpha_\perp$, of order p × (p-r), reports the coefficients of the common trends indicating the contribution of each component to the stochastic vector; and the matrix $\beta_\perp$, of order p × (p-r), includes the loading factors indicating the effect of each common trend on each variable. The matrix C determines how the non-stationary part of the process Y_t is generated from the underlying stochastic and deterministic trends.[17]

Gonzalo and Granger (1995) show that the matrix C also identifies the permanent component of a system. A simple decomposition of Y_t into its transitory and common trend components based on the estimators from the cointegration tests, is

(3.10.6) $$Y_t = \alpha(\beta'\alpha)^{-1}X_t + \beta_\perp(\alpha_\perp'\beta_\perp)^{-1}Z_t,$$

where $X_t = \beta'Y_t$ is defined as the stationary or transitory process (which is actually the deviation from the cointegration relationship), $Z_t = \alpha_\perp'Y_t$ is defined as the non-stationary permanent component.[18] Gonzalo and Granger (1995) demonstrated that this nonstationary permanent component in the decomposition (3.10.6) corresponds to the common trend of the Stock-Watson decomposition through the Wald representation of ΔY_t,

(3.10.7) $$\Delta Y_t = C(L)\varepsilon_t = C(1)\,\varepsilon_t + \Delta\tilde{C}(L)\varepsilon_t,$$

where C(1) is defined as in equation (3.10.5) for the model (1) and $\tilde{C}(L)$ is defined as in equation (3.10.4).[19]

In our analysis, we estimate the moving average representation of the cointegrated system in order to investigate the nonstationary or permanent component, which drives the set of capital markets in the long-run.

3.11 Wald tests for cointegrated systems

Wald tests are standard tools used to test restrictions on the coefficients of vector autoregressive (VAR) processes. Their simplicity as well as their easy applicability makes them attractive in conducting statistical inference on hypotheses of interest. For instance, a typical example is the test of Granger-causality in the VAR framework where the null hypothesis is formulated as zero restrictions on the coefficients of the lags of a subset of the variables. However, these tests may not have nonstandard asymptotic proprieties if the variables considered in the VAR

[17] From equation (3.10.1) it is easy to verify that the choice of variables in D_t can affect the statistical description of the trend component in Y_t. To make sure that there are no seasonal trend effects in the model, in case there are fixed seasonal effects in the data, we use centered seasonal dummies.

[18] See also Park (1990) for a similar decomposition of Y_t.

[19] It should be noted that this correspondence applies by imposing the condition that the permanent component is a linear combination of the variables and that the transitory component does not have any permanent effect on the variables.

system are integrated or cointegrated. To avoid to condition the testing procedure on the estimation of unit roots, cointegration rank and cointegrating vectors, Dolado and Lutkepohl (1996) propose a modified Wald test with standard asymptotic χ^2 distribution and which avoids possible pre-test biases. The Wald statistic test recommended by Dolado and Lutkepohl (1996) is performed directly on the least squares estimators of the coefficient of the VAR process specified in the levels of the variables. It is important to note that although the variables are allowed to be potentially cointegrated it is not assumed that the cointegration structure of the system under investigation is known. Hence, the preliminary unit root tests are not necessary and, therefore, the testing procedure is robust to the integration and cointegration proprieties of the process.

The procedure is based on the argument that the non-standard asymptotic proprieties of the Wald test on the coefficient of cointegrated VAR systems are due to the singularity of the asymptotic distribution of the least square estimators. Dolado and Luktepohl (1996) suggest a method, which gets rid of the singularity by fitting a VAR process whose order exceeds the true order. In their work they show that the proposed modify test leads to a non-singular distribution of the relevant coefficients.

Considering the k-dimensional multiple time series generated by a VAR(p) process

(3.11.1) $$y_t = A_1 y_{t-1} + \ldots\ldots + A_p y_{t-p} + \varepsilon_t,$$

where $\varepsilon = (\varepsilon_{1t}, \ldots.., \varepsilon_{kt})'$ is a zero mean independent white noise process with nonsingular covariance matrix Σ_ε and, for $j = 1, \ldots, k$, $E|\varepsilon_{jt}|^{2+\tau} < \infty$ for some $\tau > 0$. It is assumed that the order p of the process to be known or eventually to be estimated by consistent model selection criterion.

Let $a_p = \text{vec}[A_1 \ldots.. A_p]$ where vec denotes the vectorization operator that stacks the columns of the argument matrix and suppose that we are interested in testing q independent linear restrictions

(3.11.2) $$H_0 : Ra_p = s \text{ vs } H_1 : Ra_p \neq s$$

where R is a know $(q \times k^2p)$ matrix of rank (rk) q and s is a know $(q \times 1)$ vector. For instance, if y_t is partitioned in m and (k - m) - dimensional subvectors y_t^1 and y_t^2 and the A_i matrices are partitioned conformably, then y_t^2 does not Granger-cause y_t^1 if the hypothesis H_0: $A_{12,I} = 0$ for $I = 1\ldots p$ is true. The standard Wald test is as follows. Get an asymptotically normal estimator $\hat{a}_p$ satisfying

(3.11.3) $$T^{1/2}(\hat{a}_p - a_p) \Rightarrow N(0,\Sigma_p)$$

and use the statistic

(3.11.4) $$\lambda_w = T(R\hat{a}_p - s)'(R\hat{\Sigma}_p R)^{-1}(R\hat{a}_p - s)$$

where $\hat{\Sigma}_p$ is some consistent estimator of Σ_p. The Wald statistic λ_w has asymptotic χ^2 - distribution with q degrees of freedom if Σ_p is nonsingular. If the VAR(p) process $\{y_t\}$ is I(0), invertibility holds for the usual estimators (LS or ML) and Wald tests may be applied in the usual manner. However, this is not true if $\{y_t\}$ is I(d), d > 0. In this case the results are following explained.

Consider the error correction (EC) representation of equation (3.11.1)

(3.11.5) $$\Delta y_t = D_1\Delta y_{t-1} + \ldots + D_{p-1}\Delta y_{t-p+1} - \Pi y_{t-p} + \varepsilon_t,$$

where $D_i = -(I_k - A_1 - \ldots - A_i)$, i = 1, ..., p-1, and $\Pi = (I_k - A_i - \ldots - A_p)$ with $rk(\Pi) = r$. Therefore, Π can be written as the product $\Pi = BC$ where B is $(k \times r)$ and C is $(r \times k)$ with rk(B) = rk(C) = r.

Defining

(3.11.6) $$\Delta Y = [\Delta y_1 \ldots \Delta y_T], \quad \Delta X_t = \begin{bmatrix} \Delta y_t \\ .. \\ \Delta y_{t-p+2} \end{bmatrix}, \quad \Delta X = [\Delta X_0 \ldots \Delta X_{T-1}]$$

$$D = [D_1 \ldots D_{p-1}], \quad Y_{-p} = [Y_{1-p}, \ldots, Y_{T-p}], \quad E = [\varepsilon_1, \ldots, \varepsilon_T].$$

Denoting as $\hat{D}$ and $\hat{B}\hat{C}$ the ML estimators of D and BC, we obtain

(3.11.7) $$T^{1/2}\mathrm{vec}(\lfloor \hat{D}, -\hat{B}\hat{C} \rfloor - [D, -BC]) \Rightarrow N(0, \Sigma_{co})$$

With

(3.11.8) $$\Sigma_{co} = \begin{pmatrix} I_{k(p-1)} & 0 \\ 0 & C' \end{pmatrix} \Omega^{-1} \begin{pmatrix} I_{k(p-1)} & 0 \\ 0 & C \end{pmatrix} \otimes \Sigma_\varepsilon$$

and

(3.11.9) $$\Omega = \mathrm{plim}\, T^{-1} \begin{pmatrix} \Delta X \Delta X' & \Delta X Y'_{-p} C' \\ C Y_{-p} \Delta X' & C Y_{-p} Y'_{-p} C' \end{pmatrix}.$$

Note that the dimension of Σ_{co} is $(k^2p \times k^2p)$, whereas the dimension of Ω is $[(k(p-1) + r(k(p-1) + r)]$. Thus, the rank of Σ_{co} cannot be greater than $k(k(p-1) + r)$ which is smaller than k^2p unless r = k (stationary case). Hence, if $\{y_t\}$ is I(1), then the matrix Σ_{co} is singular.

Previous studies[20] have shown that the ML estimators of $\hat{A}_i$ of A_i obtained via EC representation and the unrestricted LS estimators of A_i have the same asymptotic distribution. Assuming that C is known and that $\hat{B}$ and $\hat{D}_i$ are the ML estimators of the remaining parameters, then if follows that

(3.11.10) $$T^{1/2}\text{vec}\left[(\hat{D},-\hat{B})-(D,-B)\right] \Rightarrow N(0,\Sigma_{EC})$$

where Σ_{EC} is a nonsingular [k(k(p-1) + r)] covariance matrix. Note that $\hat{B}$ and B disappear for r = 0.

From equation (3.11.4) we obtain that the parameters of the VAR representation (3.11.1) as

(3.11.11) $$A_1 = I_k + D_1$$

$$A_i = D_i - D_{i-1} \qquad (i = 2, .., p-1)$$

$$A_p = - D_{p-1} - \Pi$$

Hence,

(3.11.12) $$[A_1, ..., A_p] = [B, D_1, ..., D_{p-1}]\ W + [I_k, 0....0]$$

where

(3.11.13) $$W = \begin{bmatrix} 0 & 0 & 0 & \dots & 0 & -C \\ I_k & -I_k & 0 & \dots & 0 & 0 \\ 0 & I_k & -I_k & \dots & 0 & 0 \\ \dots & \dots & \dots & \dots & \dots & \dots \\ 0 & 0 & 0 & \dots & -I_k & 0 \\ 0 & 0 & 0 & \dots & I_k & -I_k \end{bmatrix} \quad [(r + k(p-1)) \times kp]$$

Since rk(W) = r + k(p-1) and

(3.11.14) $$T^{1/2}(\hat{a}_p - a_p) \Rightarrow N(0,\Sigma_p)$$

it follows that the $[k^2p \times k^2p]$ covariance matrix $\Sigma_p = (W'\otimes I_k)\ \Sigma_{EC}\ (W\otimes I_k)$ has obviously rank k[k(p-1) + r]. Thus, it is singular for r < k. However, if A_i is omitted from equation (3.11.12), k columns of W are deleted which results in a [(r + k(p-1) × k(p-1)] matrix W* with rank k(p-1).

Denoting by $\hat{a}_p^{p-1}$ the estimator of the remaining $[k^2(p-1)]$ elements of a_p from $\hat{a}_p$, we get

(3.11.15) $$T^{1/2}(\hat{a}_p^{p-1} - a_p^{p-1}) \Rightarrow N[0, W^*\otimes I_k)\Sigma_{EC}(W^*\otimes I_k)] \equiv N[0,\Sigma_p^{p-1}],$$

[20] For instance, Park and Phillips (1989) and Sims, Stock and Watson (1990).

where the $[k^2(p\text{-}1) \times (k^2(p\text{-}1)]$ covariance matrix Σ_p^{p-1} has now full rank and the Wald test can be implemented in the usual way.

From above, the following theorem holds

Let the k-dimensional I(1) process $\{y_t\}$ process be generated by the VAR(p) process in (3.11.1) and let $\hat{A}_i$ (I = 1, ..., p) be the LS estimators and $\hat{a}_p^{p-1}$ the $[k^2(p\text{-}1)]$-dimensional vector consisting of the $k^2(p\text{-}1)$ elements of $\hat{a}_p = \text{vec}\lfloor \hat{A}_{1p},\ldots, \hat{A}_p \rfloor$ that are obtained by deleting one of the $\hat{A}_i$ matrices. Then

(3.11.16) $\quad T^{1/2}(\hat{a}_p - a_p) \Rightarrow N(0,\Sigma_p)$

where the $[k^2(p\text{-}1) \times (k^2(p\text{-}1)]$ covariance matrix Σ_p^{p-1} is nonsingular. Moreover, given a consistent estimator $\hat{\Sigma}_p^{p-1}$, the Wald test of the null hypothesis $H_0 : R\hat{a}_p^{p-1} = s$,

(3.11.17) $\quad \lambda_w = T(R\hat{a}_p^{p-1} - s)'(R\hat{\Sigma}_p^{p-1}R')^{-1}(R\hat{a}_p^{p-1} - s)$

has an asymptotic $\chi^2(q)$ - distribution.

The theorem affirms that if elements from all A_i, I = 1, ..., p, are involved in the restrictions as in noncausality hypotheses, we may just add an extra lag in estimating the parameters of the process and thereby ensure the standard asymptotic for the Wald test. Dolado and Luktepohl (1996) also report a Monte Carlo simulation indicating the robustness of the modified Wald test even if a more lag of the required is added in the estimation of the VAR system. In fact, the authors argue that the problem could be more severe for high dimensional VARs with a small true lag length.

SECTION TWO: VARIANCE DECOMPOSITION

3.12 *Decomposition of stock returns and their variances*

3.12.1 The components of stock returns

Campbell and Shiller (1988) introduced a framework that allows the logarithm of the dividend-price ratio of a stock to be decomposed as the discounted sum of all future returns minus the discounted sum of all future dividend growth rates less a constant term. This decomposition affirms that when dividends are expected to decrease or to grow really slowly, the dividend-price ratio is higher. In addition, remembering that the dividend-price ratio can be defined as the rate at which future dividends are discounted in today's price, if the discount rate is high, also the dividend-price ratio is high. The Campbell and Shiller's (1988) framework can be written as follows

(3.12.1) $$\delta_t \cong \sum_{j=0}^{\infty} \rho^j (h_{t+j} - \Delta d_{t+j}) - \frac{k}{1-\rho},$$

where δ_t represents the log of the dividend-price ratio; d_t indicates the logarithmic of the real dividends, h_t indicates the log of the holding period returns; $\frac{k}{1-\rho}$ is a constant; and the parameter ρ is a constant of linearization defined as $1/(1+\exp(d - p))$, where $(d - p)$ represents the sample mean of the log dividend-price ratio.

Campbell and Shiller (1988) show that equation (3.12.1) holds almost exactly for actual data. However, it can also be treated as an ex-ante relationship by taking expectation of both sides of equation (3.12.1) conditional on information available at the end of period t

(3.12.2) $$\delta_t \cong \sum_{j=0}^{\infty} \rho^j [E_t(h_{t+j+1}) - E_t(\Delta d_{t+j+1})] - \frac{k}{1-\rho},$$

where δ_t is known at the end of t and therefore $E_t[\delta_t]$ is equal to δ_t.

In the same manner, the dividend-price ratio for the period t+1 is defined as

(3.12.3) $$\delta_{t+1} \cong \sum_{j=0}^{\infty} \rho^j [E_{t+1}(h_{t+j+2}) - E_{t+1}(\Delta d_{t+j+2})] - \frac{k}{1-\rho}.$$

Campbell and Shiller (1988) also show that

(3.12.4) $$h_{t+1} - \Delta d_{t+1} - k = \delta_t - \rho\delta_{t+1}.$$

Considering equations (3.12.2) and (3.12.1), equation (3.12.4) can be rearranged as

(3.12.5) $$h_{t+1} - \Delta d_{t+1} - k = E_t h_{t+1} + \sum_{j=0}^{\infty} \rho^j E_t(h_{t+j+1}) - \sum_{j=0}^{\infty} \rho^j E_t(\Delta d_{t+j+1}) - \frac{k}{1-\rho} - \sum_{j=0}^{\infty} \rho^{j+1} E_{t+1}(h_{t+j+2}) + \sum_{j=0}^{\infty} \rho^{j+1} E_{t+1}(\Delta d_{t+j+2}) + \frac{k}{1-\rho},$$

which can also be written as

(3.12.6) $$h_{t+1} - E_t h_{t+1} = \sum_{j=0}^{\infty} \rho^j E_t(h_{t+j+1}) - \sum_{j=0}^{\infty} \rho^j E_t(\Delta d_{t+j+1}) - \sum_{j=0}^{\infty} \rho^j E_{t+1}(h_{t+j+1}) + \sum_{j=0}^{\infty} \rho^j E_{t+1}(\Delta d_{t+j+1}) + \Delta d_{t+1}$$

and

(3.12.7) $$h_{t+1} - E_t h_{t+1} = (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j(\Delta d_{t+j+1}) - (E_{t+1} - E_t) \sum_{j=0}^{\infty} \rho^j(h_{t+j+1}),$$

where h_{t+1} represents the log real return on a stock held from the end of the period t to the end of the period t+1; and d_{t+1} indicates the log real dividend paid during period t+1. Equation (3.12.7) affirms that the unexpected returns of a stock are given by the revision of investors' expectation of future dividend growth and future expected stock returns.

3.12.2 The decomposition of the variance of stock returns

Considering equation (3.12.7) and defining u^h_{t+1} as the unexpected stock returns during the period t+1, η^d_{t+1} as the component representing news about future dividend growth and η^h_{t+1} as the element indicating news about future expected returns, we obtain

(3.12.8) $$u^h_{t+1} = \eta^d_{t+1} - \eta^h_{t+1}.$$

Using the decomposition of equation (3.12.8), the variance of the unexpected stock returns can be defined as

(3.12.9) $$var(u^h_{t+1}) = var(\eta^d_{t+1}) + var(\eta^h_{t+1}) - 2\,cov(\eta^d_{t+1}, \eta^h_{t+1}).$$

The decomposition of equation (3.12.9) shows that the variance of unexpected stock returns is composed by three elements. The variance of news about future growth; the variance of news about future returns and the covariance between these two elements.

3.13 The decomposition of excess stock returns and the variances

Using the log-linear approximate asset-pricing framework of Campbell (1991) and Campbell and Ammer (1993), which is based on the decomposition proposed by Campbell and Shiller (1988), the domestic unexpected excess stock return is expressed as a linear function of news about future dividend growth rates, real interest rates, and excess stock returns. Writing e_{t+1} for the log excess return on a stock held from the end of period t to the end of period $t+1$, relative on the one-period interest rate, d_{t+1} for the real dividend paid during period $t+1$, and r_{t+1} for the log real interest rate from t to $t+1$, the unexpected excess stock return is defined as in the equation[21]

(3.13.1) $$e_{t+1} - \mathrm{E}_t e_{t+1} = (\mathrm{E}_{t+1} - \mathrm{E}_t)\left\{ \sum_{j=0}^{\infty} \rho^j \Delta d_{t+1+j} - \sum_{j=0}^{\infty} \rho^j r_{t+1+j} - \sum_{j=1}^{\infty} \rho^j e_{t+1+j} \right\}.$$

Here E_t denotes an expectation formed at the end of period t, conditional on an information set, which includes at least the history of stock prices and dividends, while Δ denotes a one-period backward difference. All variables are measured in real terms and in logs. The parameter ρ is a constant of linearization; it assumes a value a little smaller than one.[22, 23]

To simplify the notation in equation (3.13.1), we define $\tilde{e}_{t+1}$ to be the unexpected component of the excess stock return e_{t+1}, $\tilde{e}_{d,t+1}$ to be the term that represents innovations in dividends, $\tilde{e}_{r,t+1}$ to be the term that represents innovations in real interest rates, and $\tilde{e}_{e,t+1}$ to be the term that represents innovations in future excess returns. Hence, we use a tilde to denote a surprise in a variable, and we use subscripts to denote the innovation components making up that news. Then equation (3.13.1) can be rewritten as follows if the subscript $t+1$ is dropped

(3.13.2) $$\tilde{e} = \tilde{e}_d - \tilde{e}_r - \tilde{e}_e.$$

Equation (3.13.2) shows that unexpected stock returns must be associated with changes in expectations of future dividends or real returns. News of an increase of

[21] Equation (3.13.1) is derived by taking a first-order Taylor approximation of the equation relating the log stock returns to log stock prices and dividends. The approximate equation is based on the condition that the log dividend-price ratio does not follow an explosive process (see Campbell and Shiller, (1988)).

[22] The parameter ρ is defined as 1/(1 + exp(d - p)), where (d - p) represents the sample mean of the log dividend-price ratio.

[23] In our empirical work the coefficient ρ assumes a range of values from 0.9584 to 0.9921, for the analysed countries. Campbell and Ammer (1993) testing for the accuracy of equation (1), found that the approximation holds quite well for a wide range of possible values of ρ.

future dividends are associated with a capital gain today, while an increase in expected future returns is associated with a capital loss today. The reason is that with no information about future dividend or interest rates, higher future returns can only be generated by future price appreciation from a lower current price.

As suggested by Ammer and Mei (1996), the unexpected foreign excess stock return is expressed by a similar version of the stock equation (3.13.1), where the asterisk (*) is used to denote foreign variables. Then the equation is

(3.13.3) $e^*_{t+1} - E_t e^*_{t+1} =$

$$(E_{t+1} - E_t)\left\{\sum_{j=0}^{\infty}(\rho^*)^j \Delta d^*_{t+1+j} - \sum_{j=0}^{\infty}(\rho^*)^j r^*_{t+1+j} - \sum_{j=1}^{\infty}(\rho^*)^j e^*_{t+1+j}\right\}.$$

Considering the excess of the foreign stock return expressed in dollars and over the domestic interest rate as in the equation

(3.13.4) $f_{t+1} = e^*_{t+1} - \Delta q_{t+1} + r^*_{t+1} - r_{t+1}$,

the unexpected foreign excess stock return can be rewritten as

(3.13.5) $f_{t+1} - E_t f_{t+1} =$

$$(E_{t+1}-E_t)\left\{\sum_{j=0}^{\infty}(\rho^*)^j \Delta d^*_{t+1+j} - \sum_{j=0}^{\infty}(\rho^*)^j r_{t+1+j} - \sum_{j=0}^{\infty}(\rho^*)^j \Delta q_{t+1+j} - \sum_{j=1}^{\infty}(\rho^*)^j f^*_{t+1+j}\right\},$$

where f is the foreign excess return and q denotes the real exchange value of the domestic currency. Equation (3.13.5) can be rearranged, using the same notation applied in the definition of equation (3.13.2), as

(3.13.6) $\tilde{f} = \tilde{f}_d - \tilde{f}_r - \tilde{f}_q - \tilde{f}_f$.

In equation (3.13.6) the intuition for the signs on the components of foreign excess stock returns is the same as that previously explained for the signs on the corresponding components of domestic excess stock returns. There is additionally the exchange rate component, $\tilde{f}_q$, which has a negative sign. The arrival of information that the dollar will appreciate sometime in the future will reduce expected dollar returns on foreign assets at some point in time. The loss will occur today in the absence of information regarding future expected excess returns.

3.14 *Variance decomposition and covariances between components of domestic and foreign excess stock returns*

Using the decomposition of equation (3.14.2), the variance of the domestic excess returns can be decomposed as follows

$$\text{(3.14.1)} \qquad \text{Var}(\tilde{e}) = \text{Var}(\tilde{e}_d) - 2\,\text{Cov}(\tilde{e}_d, \tilde{e}_r) + \text{Var}(\tilde{e}_r) - 2\,\text{Cov}(\tilde{e}_d, \hat{e}_e) + \text{Var}(\tilde{e}_e) + 2\,\text{Cov}(\tilde{e}_r, \tilde{e}_e)$$

In addition, by using the decomposition of equation (3.14.6), the variance of the foreign excess return can be written as follows

$$\text{(3.14.2)} \qquad \text{Var}(\tilde{f}) = \text{Var}(\tilde{f}_d) - 2\,\text{Cov}(\tilde{f}_d, \tilde{f}_r) - 2\,\text{Cov}(\tilde{f}_d, \tilde{f}_q) - 2\,\text{Cov}(\tilde{f}_d, \tilde{f}_f) + \text{Var}(\tilde{f}_f) + 2\,\text{Cov}(\tilde{f}_r, \tilde{f}_q) + 2\,\text{Cov}(\tilde{f}_r, \tilde{f}_f) + \text{Var}(\tilde{f}_q) + 2\,\text{Cov}(\tilde{f}_q, \tilde{f}_f) + \text{Var}(\tilde{f}_f).$$

Finally, considering equations (3.14.2) and (3.14.6), the covariance of domestic and foreign excess stock returns is decomposed as follows

$$\text{(3.14.3)} \qquad \text{Cov}(\tilde{e}, \tilde{f}) = \text{Cov}(\tilde{e}_d, \tilde{f}_d) - \text{Cov}(\tilde{e}_d, \tilde{f}_r) - \text{Cov}(\tilde{e}_d, \tilde{f}_q) - \text{Cov}(\tilde{e}_d, \tilde{f}_f) - \text{Cov}(\tilde{e}_r, \tilde{f}_d) + \text{Cov}(\tilde{e}_r, \tilde{f}_r) + \text{Cov}(\tilde{e}_r, \tilde{f}_q) + \text{Cov}(\tilde{e}_r, \hat{f}_f) - \text{Cov}(\tilde{e}_e, \tilde{f}_d) + \text{Cov}(\tilde{e}_e, \tilde{f}_r) + \text{Cov}(\tilde{e}_e, \tilde{f}_q) + \text{Cov}(\tilde{e}_e, \tilde{f}_f).$$

3.15 *Estimation procedure*

To estimate multiperiod expectations composing domestic and foreign excess stock returns, we combine the asset-pricing framework, described in paragraph 3.13, with a vector autoregression system (VAR) in long-term asset returns, interest rates, real exchange rates and other information that helps to forecast these variables.

The application of this technique permits one to write the unobserved components of returns as linear combinations of innovations to observable variables. The coefficients in these linear combinations are identified by using a time-series model to construct forecasts of the discounted value of future dividends, real interest rates, excess returns and real exchange rates. Revisions in these forecasts are then used as proxies for revisions in investors' expectations.[24] In order to improve the

[24] Monte Carlo simulations of Hodrick (1992) and Campbell (1991) show that VAR systems have better finite-sample proprieties than direct regression methods with long-horizon variables. Moreover, this procedure has been widely used in financial literature (see, for

forecasting power of multiperiod expectations of components of excess stock returns, we include instrumental variables in the estimation of the VAR system, such as, dividend yields for each stock market and the change of nominal domestic interest rate (see e.g. Ferson and Harvey (1991), Fama and French (1988) and Keim and Stambaugh (1986)).

We begin the procedure by defining a vector of state of variables, z_t, of which the first four elements are domestic excess stock return, e, foreign excess stock returns, f, domestic real interest rate, r, and changes of real exchange rate, q. These variables are chosen to be stationary and for notational convenience we treat them as having zero means[25]. We assume that the state vector follows a first-order VAR process

(3.15.1) $z_{t+1} = Az_t + w_{t+1}$

where the matrix A is the coefficient matrix of the VAR, and w_{t+1} is the error vector. The assumption that the VAR is first-order is not restrictive. Higher-order VAR models are handled by augmenting the state vector and reinterpreting the matrix A as the companion matrix of a system (see e.g. Campbell and Shiller (1988)). Using the fact that

(3.15.2) $(E_{t+1} - E_t)\, z_{t+j+1} = A^j\, w_{t+1}$

we estimate each component of stock returns as a linear combination of the elements of the error vector w_{t+1} as following described. Defining e1, e2, e3, and e4 as vectors whose first, second, third, and fourth element respectively is one, and whose other zero, these vectors can be used to pick e, f, r, and q out of z. Based in the previous notation, the components of the domestic and foreign stock returns can be written as

(3.15.3) $e_{e,t+1} = e1'\rho A(I - \rho A)^{-1} w_{t+1} = \lambda' w_{t+1}$, with $\lambda' = e1'\rho A(I - \rho A)^{-1}$

$f_{f,t+1} = e2'\rho^* A(I - \rho^* A)^{-1} w_{t+1} = \theta' w_{t+1}$, with $\theta' = e2'\rho^* A(I - \rho^* A)^{-1}$

$e_{r,t+1} = e3'(I - \rho A)^{-1} w_{t+1} = \gamma' w_{t+1}$, with $\gamma' = e3'(I - \rho A)^{-1}$

$f_{r,t+1} = e3'(I - \rho^* A)^{-1} w_{t+1} = \phi' w_{t+1}$, with $\phi' = e3'(I - \rho^* A)^{-1}$

$f_{q,t+1} = e4'(1 - \rho^*)(I - \rho^* A)^{-1} w_{t+1} = \mu' w_{t+1}$, with $\mu' = e4'(1-\rho^*)(I-\rho^* A)^{-1}$

$e_{t+1} = e1' w_{t+1}$,

$f_{t+1} = e2' w_{t+1}$,

---

instance, Campbell and Shiller, (1987, 1988); Campbell, (1991) and Campbell and Ammer, 1993)).

[25] In this empirical work sample means are removed from all variables before estimating the VAR process.

and consequently the components regarding the discount value of future domestic and foreign dividends are

(3.15.4) $e_{d,t+1} = e_{t+1} + e_{e,t+1} + e_{r,t+1} = (e1' + \lambda' + \gamma')w_{t+1}$

$f_{d,t+1} = f_{t+1} + f_{f,t+1} + f_{r,t+1} + f_{q,t+1} = (e2' + \theta' + \phi' + \mu')w_{t+1}$.

Defining Ψ as the variance of the disturbance w_t, the variances of the elements defined in equations (3.15.3) and (3.15.4) are defined as follows

(3.15.5) $var(e_e) = \lambda'\Psi\lambda$

$var(f_f) = \theta'\Psi\theta$

$var(e_r) = \gamma'\Psi\gamma$

$var(f_r) = \phi'\Psi\phi$

$var(f_q) = \mu'\Psi\mu$

$var(e) = e1'\Psi e1$

$var(f) = e2'\Psi e2$

and considering equation (3.15.4), the variance of the future domestic dividend growth is derived as follows

(3.15.6) $var(e_d) = var(e) + 2cov(e,e_e) + var(e_e) + 2cov(e_e,e_r) + var(e_r) + 2cov(e,e_r)$

or

$var(e_d) = (e1 + \lambda + \gamma)'\Psi(e1 + \lambda + \gamma)$.

In the same manner, the variance of the future foreign dividend growth is given as

$var(f_d) = var(f) + 2cov(f, f_f) + var(f_f) + 2cov(f_f, f_r) + var(f_r) + 2cov(f, f_r)$

or

$var(f_d) = (e2 + \theta + \phi + \mu)'\Psi(e2 + \theta + \phi + \mu)$.

The covariance components of equation (3.15.6) are computed as

(3.15.7) $cov(e, e_e) = e1'\Psi\lambda$

$cov(e_e,e_r) = \lambda'\Psi\gamma$

$cov(e,e_r) = e1'\Psi\gamma$

$cov(f,f_f) = e2'\Psi\theta$

$cov(f_f,f_r) = \theta'\Psi\phi$

$cov(f_r,f_q) = \phi'\Psi\mu$

$cov(f,f_q) = e2'\Psi\mu$.

Substituting (3.15.7) in (3.15.6) we have

(3.15.8) $$\mathrm{var}(e_d) = e1'\Psi e1 + 2(e1'\Psi\lambda) + \lambda'\Psi\lambda + 2(\lambda'\Psi\gamma) + \gamma'\Psi\gamma + 2(e1'\Psi\gamma),$$
$$\mathrm{var}(f_d) = e2'\Psi e2 + 2(e2'\Psi\theta) + \theta'\Psi\theta + 2(\theta'\Psi\phi) + \phi'\Psi\phi + 2(\phi'\Psi\mu) + \mu'\Psi\mu + 2(e2'\Psi\mu).$$

Thus, the covariance between e_d and f_d is

(3.15.9) $$\mathrm{cov}(e_d, f_d) = \mathrm{cov}[(e + e_e + e_r)(f + f_f + f_r + f_q)].$$

Equation (3.15.9) can also be written as follows

(3.15.10) $$\mathrm{cov}(e_d,f_d) = \mathrm{cov}(e, f) + \mathrm{cov}(e,f_f) + \mathrm{cov}(e, f_r) + \mathrm{cov}(e,f_q) + \mathrm{cov}(e_e,f) + \mathrm{cov}(e_e,f_f) + \mathrm{cov}(e_e,f_r) + \mathrm{cov}(e_e,f_q) + \mathrm{cov}(e_r,f) + \mathrm{cov}(e_r,f_f) + \mathrm{cov}(e_r,f_r) + \mathrm{cov}(e_e,f_q).$$

The covariances of equation (3.15.10) are computed as following

(3.15.11) $$\mathrm{cov}(e,f) = e1'\Psi e2$$
$$\mathrm{cov}(e,f_f) = e1'\Psi\theta$$
$$\mathrm{cov}(e,f_r) = e1'\Psi\phi$$
$$\mathrm{cov}(e,f_q) = e1'\Psi\mu$$
$$\mathrm{cov}(e_e,f) = \lambda'\Psi e2$$
$$\mathrm{cov}(e_e,f_f) = \lambda'\Psi\theta$$
$$\mathrm{cov}(e_e,f_r) = \lambda'\Psi\phi$$
$$\mathrm{cov}(e_e,f_q) = \lambda'\Psi\mu$$
$$\mathrm{cov}(e_r,f) = \gamma'\Psi e2$$
$$\mathrm{cov}(e_r,f_f) = \gamma'\Psi\theta$$
$$\mathrm{cov}(e_r,f_r) = \gamma'\Psi\phi$$
$$\mathrm{cov}(e_r,f_q) = \gamma'\Psi\mu,$$

and therefore the covariance between e_d and f_d is given by

(3.15.12) $$\mathrm{cov}(e_d,f_d) = e1'\Psi e2 + e1'\Psi\theta + e1'\Psi\phi + e1'\Psi\mu + \lambda'\Psi e2 + \lambda'\Psi\theta + \lambda'\Psi\phi + \lambda'\Psi\mu + \gamma'\Psi e2 + \gamma'\Psi\theta + \gamma'\Psi\phi + \gamma'\Psi\mu.$$

From equation (3.15.4) we can simpler define $\mathrm{cov}(e_d\ f_d)$ as

(3.15.13) $$\mathrm{cov}(e_d,f_d) = \mathrm{cov}[(e1 + \lambda + \gamma)'w_{t+1}w_{t+1}(e2 + \theta + \phi + \mu)],$$

obtaining

(3.15.14) $$\mathrm{cov}(e_d,f_d) = (e1 + \lambda + \gamma)'\Psi(e2 + \theta + \phi + \mu).$$

Finally, the variance of the domestic excess stock returns is composed as follows

(3.15.15) $$\mathrm{Var}(e) = \mathrm{Var}(e_d) - 2\mathrm{Cov}(e_d, e_r) + \mathrm{Var}(e_r) - 2\mathrm{Cov}(e_d, e_e)$$

$$+ Var(e_e) + 2Cov(e_r, e_e)$$
$$= (e1+\lambda+\gamma)'\Psi(e1+\lambda+\gamma) - 2[(e1+\lambda+\gamma)'\Psi\gamma] + \gamma'\Psi\gamma$$
$$- 2[(e1+\lambda+\gamma)'\Psi\lambda] + \lambda'\Psi\lambda + 2[\gamma'\Psi\lambda],$$

and the one for the foreign excess returns is given as

(3.15.16) $$Var(f) = Var(f_d) - 2Cov(f_d, f_r) + Var(f_r) - 2Cov(f_d, f_f) + Var(f_f)$$
$$+2Cov(f_r, f_f) + Var(f_q) + 2Cov(f_r, f_q) + 2Cov(f_q, f_f) - 2Cov(f_d, f_q)$$
$$= (e2+\theta+\phi+\mu)'\Psi(\theta+\phi+\mu) - 2[(e2+\theta+\phi+\mu)'\Psi\phi] + \phi'\Psi\phi$$
$$-2[(e2+\theta+\phi+\mu)'\Psi\theta] + \theta'\Psi\theta + 2[\phi'\Psi\theta] + \mu'\Psi\mu + 2[\phi'\Psi\mu]$$
$$+ 2[\mu'\Psi\lambda] - 2[(e2+\theta+\phi+\mu)'\Psi\mu.$$

Consequently, the covariance between the domestic and foreign excess stock returns can be decomposed as follows

(3.15.17) $$Cov(e,f) = Cov(e_d,f_d) - cov(e_d,f_r) - cov(e_d,f_q) - cov(e_d,f_r) - cov(e_r,f_d) +$$
$$cov(e_r,f_r) + cov(e_r, f_d) + cov(e_r, f_q) + cov(e_r, f_f) -$$
$$cov(e_e,f_d) + cov(e_e,f_r) + cov(e_e,f_q) + cov(e_e,f_f).$$
$$= (e1+\lambda+\gamma)'\Psi(e2+\theta+\phi+\mu) - (e1+\lambda+\gamma)'\Psi\phi$$
$$-(e1+\lambda+\gamma)'\Psi\mu - (e1+\lambda+\gamma)'\Psi\phi - \gamma'\Psi(e2+\theta+\phi+\mu) + \gamma'\Psi\phi$$
$$+ \gamma'\Psi\theta + \gamma'\Psi(e2+\theta+\phi+\mu) + \gamma'\Psi\mu + \gamma'\Psi\theta - \lambda'\Psi(e2+\theta+\phi+\mu)$$
$$+ \lambda'\Psi\phi + \lambda'\Psi\mu + \lambda'\Psi\theta.$$ [26]

In accordance with Campbell (1991), the coefficients of the VAR system and the elements of the variance-covariance matrix of VAR innovations are jointly estimated using the Generalised Method of Moments (GMM)[27] estimator of Hansen (1982). This is to correct for any heteroscedasticity that may be present in the error terms.[28] The GMM parameter estimates are numerically identical to standard OLS estimates, but GMM delivers a heteroskedasticity-consistent variance-covariance matrix for the entire set of parameters (see White, 1984).

We evaluate the statistical significance of variances of the components of excess stock returns, their covariances and correlations, estimating the standard errors of these statistics. Denote the vector of the entire set of estimated parameters as θ and the heteroscedasticity adjusted variance-covariance matrix of the estimate of these parameters V. Any statistic such as the correlation between the components

[26] The decomposition of the correlation between domestic and foreign excess stock returns includes the same components.
[27] See Appendix 3.A for a complete explanation of this econometric technique of estimation.

attributed to news about future domestic and foreign dividend growth can be written as a non-linear function $f(\theta)$ of the vector of parameters θ. The standard error for the statistic is then estimated as $\sqrt[2]{f_\theta' V f_\theta}$, where f_θ is the gradient of the statistic with respect to the vector of parameters θ.

[28] The Newey-West type adjustments for heteroscedasticity and serial correlation tend to inflate the VCV, and bias tests against finding significant coefficients. This is particularly true in small samples.

SECTION THREE: GARCH PROCESS

3.16 Volatility of financial time series

When looking at the time path of variables representing financial phenomena, one can note that periods of stability are alternate by periods of persistent volatility. Therefore, econometric literature developed new procedures to capture time varying variances when modelling financial variables.

3.16.1 Conditional and unconditional variances

Before introducing the analysis of variables with time varying variance, we discuss the concepts of unconditional and conditional variances.

Having the variable y_t, generated by a data generating process (d.g.p.) distributed as the following ARMA(1, 0)

(3.16.1) $$y_t = a_0 + a_1 y_{t-1} + \varepsilon_t,$$

where ε_t is an error iid, with zero mean and σ^2 variance, its unconditional mean is given by $a_0 / (1 - a_1)$. The unconditional variance of the error ε_t is given by

(3.16.2) $$E_{t-1}\{[y_t - a_0 / (1 - a_1)]^2\} = E[(\varepsilon_t + a_1\varepsilon_{t-1} + a_1^2\varepsilon_{t-2} + a_1^3\varepsilon_{t-3})^2] = \sigma^2 / (1 - a_1^2).$$

On the other hand, the conditional mean of y_t is as follows

(3.16.3) $$E_t\{y_t\} = a_0 + a_1 y_{t-1},$$

and the conditional variance is defined as in the following equation

(3.16.4) $$E_t\{[y_t - (a_0 + a_1 y_{t-1})]^2\} = E_t\varepsilon_t^2 = \sigma^2.$$

While the unconditional variance is considered in the long-run analysis and unconditional forecasts; the conditional variance is examined in the short-run analysis and conditional forecasts.

3.16.2 Autoregressive Conditional Heteroskedastic Processes

The conditional variance of the error ε_t, can be constant or varying over time. In case the conditional variance is not constant over time, a simple strategy is to model the conditional variance as AR(q) as follows

(3.16.5) $$\varepsilon_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \alpha_2\varepsilon_{t-2}^2 + ... + \alpha_{t-q}\varepsilon_{t-q}^2 + u_t$$

where u_t = a white noise process.

If the parameters α_1, α_2, ..., α_{t-q}, of the equation (3.16.5) are all equal to zero, then the estimated variance is simply the constant α_0. In contrast, if at least one of the parameters is different from zero, then equation (3.16.1) indicates an Autoregressive Conditional Heteroskedastic (ARCH) process.

Econometric literature provides a variety of ARCH models. These models differ from each other by how residuals of equation (3.16.5) are explained. The first class of multiplicative conditionally heteroskedastic models was introduced by Engle (1982). The author explained residuals using the following autoregressive representation

(3.16.6) $\varepsilon_t = v_t\,(\alpha_0 + \alpha_1\,\varepsilon_{t-1}^2)^{1/2}$,

where v_t is a white noise process with variance equal to one, and where v_t and ε_{t-1} are independent variables.

The inclusion of the element v_t in (3.16.6) does not affect the unconditional mean and variance of ε_t. This is because if $Ev_t = 0$, consequently, $E[v_t(\alpha_0+\alpha_1\varepsilon_{t-1}^2)^{1/2}]$ is equal to $Ev_t\,E(\alpha_0 + \alpha_1\,\varepsilon_{t-1}^2)^{1/2} = 0$. At the same time, the variance of v_t is equal to one and as a consequence $E\varepsilon_t^2$, that is equal to $Ev_t^2E(\alpha_0 + \alpha_1\,\varepsilon_{t-1}^2)$, is the same that $E\varepsilon_{t-1}^2$.

Similarly, it is easy to show that the conditional mean of ε_t is equal to zero. Given that v_t and ε_{t-1} are independent and $Ev_t = 0$, the conditional mean of ε_t is

(3.16.7) $E(\varepsilon_t\,|\,\varepsilon_{t-1}, \varepsilon_{t-2}, ...) = Ev_tE(\alpha_0 + \alpha_1\,\varepsilon_{t-1}^2)^{1/2} = 0$.

From the previous analysis, it is rational to think that the term v_t does not affect the distribution of the error ε_t since both means are zero and the unconditional variance is constant. However, the influence of the term v_t, in the error ε_t falls entirely on the conditional variance. Since $\sigma_v^2 = 1$, the variance of ε_t is dependent on the realized value of ε_{t-1}^2. Therefore, if the conditional variance of ε_{t-1}^2 is large, the conditional variance of t will be large as well.

The conditional variance is always positive and its minimum value is α_0. The value assumes by the parameter α_1 is important in determining the persistence of a shock in v_t. The larger is the value of α_1, the more persistent is any change in y_t. The stronger the tendency for y_t to remain away from its mean, the greater is the variance. In fact, a condition for the stationarity of the conditional variance is that the parameter

α_1 assumes a value in absolute term smaller than one. The described ARCH(1) model can be generalized to the entire class of higher-order ARCH(q) processes as follows

(3.16.8) $$\varepsilon_t = v_t \left(\alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 \Sigma_i\right)^{1/2}.$$

From equation (3.16.8) we can see that all shocks from ε_{t-1} to ε_{t-q} have a direct effect on ε_t. Also in this case, to satisfy the condition of stationary conditional variance the sum of the estimated parameters $\alpha_1, \dots, \alpha_p$ has to be in absolute value smaller than the unity.

3.16.3 Generalized Autoregressive Conditional Heteroskedastic Processes

Bollerslev (1986) extended Engle's original work by developing a technique that allows the conditional variance to be an ARMA process. In this case, the error process is given by the following equation

(3.16.9) $$\varepsilon_t = v_t (h_t)^{1/2},$$

where $\sigma_v^2 = 1$, and

(3.16.10) $$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \beta_j h_{t-j}.$$

Equation (3.16.10) shows that the Generalized ARCH(p,q) model – called GARCH(p, q) allows for both autoregressive and moving average components in the heteroskedastic variance. The sum of the parameters α_i and β_j indicates the persistence of the conditional variance process. In case the sum of these parameters is in absolute value equal or bigger than the unity, we have an Integrated GARCH model.

3.16.4 Asymmetric GARCH structure: Exponential and Threshold GARCH models.

Alternative functional GARCH forms have been introducted to model the conditional variance of time series. In particular, Nelson (1991) suggested that a symmetric conditional variance function may be inappropriate for modelling the volatility of returns on stocks because it cannot represent a phenomena known as the "leverage effect", which is the negative correlation between volatility and past returns. In a symmetric ARCH model, σ_t^2 is not affected by the sign of ε_{t-i}, and therefore σ_t^2 is uncorrelated with past errors. To rectify this, Nelson began by defining $\varepsilon_t = \eta_t(\sigma_t^2)^{0.5}$, where η_t is independent and identically distributed with $E(\eta_t)=0$ and $Var(\eta_t)=1$. He suggested that in the general ARCH formulation σ_t^2 can be viewed as a stochastic process in which η_t serves as the forcing variable for both the conditional variance and the error. He then chose the conditional variance σ_t^2 to produce the desired dependence. To avoid nonnegativity restrictions on parameters, Nelson used the logarithmic specification and proposed

(3.16.11) $$\log(\sigma_t^2) = \alpha_o + \Sigma_i \alpha_i\, g(\eta_{t-i}) + \Sigma_i\, \beta_i \log(\sigma_{t-i}^2),$$

where

(3.16.12) $$g((\eta_t) = \theta\eta_t + \gamma\, [|\eta_t| - E\, |\eta_t|\,].$$

The conditional variance in (3.16.11) and (3.16.12) is known as exponential GARCH (EGARCH). It is easy to see that the sequence $g(\eta_t)$ is independent with mean zero and constant, if finite, variance. Therefore, (3.16.11) represents a linear ARMA model for the conditional variance, with innovation $g(\eta_t)$. The properties of the EGARCH model are determined by the careful construction of the function (3.16.12). In particular, the innovation to the conditional variance is piecewise linear in η_t, with slopes $\alpha_i\ (\theta + \gamma)$ when η_t is positive and $\alpha_i\ (\theta - \gamma)$ when η_t is negative. This produces the asymmetry in the conditional variance.

Building on the success of the EGARCH model to represent asymmetric responses in the conditional variance to positive and negative errors, a series of papers have proposed other ARCH models which allow a very general shape in the conditional variance function. Although these models are parametric, and estimated by maximum likelihood, they are nonparametric in spirit because the shape of the conditional variance function is largely determined by the data itself. Glosten, Jagannathan, and Runkle (1991) and Zakoian (1994) independently suggested a conditional standard deviation of the form

(3.16.13) $$\sigma_t = \alpha_o + \Sigma_i \alpha_i^{+} \varepsilon_{t-i}^{+} - \Sigma_i\, \alpha_i^{-} \varepsilon_{t-i}^{-},$$

where $\varepsilon_{t-i}^{+} = \max\, [\varepsilon_t, 0]$ and $\varepsilon_{t-I}^{-} = \min\, [\varepsilon_t, 0]$. The parameters are constrained by $\alpha_o > 0$, $\alpha_i^{+} \geq 0$, and $\alpha_i^{-} \geq 0$ for $I=1, \ldots, q$, to ensure that the conditional standard deviation is positive. Zakoian (1994) referred this formulation as a threshold ARCH(TARCH) model because the coefficient of ε_{t-i} changes when ε_{t-I} crosses the *threshold of zero*. In fact, when $\varepsilon_{t-i} > 0$, the conditional standard deviation is linear in ε_{t-i} with slope α_i^{+} and when $\varepsilon_{t-i} < 0$, the conditional standard deviation is linear in ε_{t-i} with slope α_i^-. This allows for asymmetry in the conditional variance in the fashion of EGARCH.[29]

3.16.5 Test for Heteroscedasticity and Autocorrelation in the disturbances

Preliminary analysis has to be conducted in order to investigate for presence of hederoscedasticity and autocorrelation in the residual of the analysed time series. Only in presence of heteroscedasticity ARCH(GARCH) models are appropriate in modelling the financial variables. However, the same test statistics are applied when verifying the goodness of fit of estimated models.

3.16.5.1 Statistic tests for Autocorrelation and Heteroscedasticity

To test for lack of autocorrelation on the disturbances one can perform the Box-Pierce-Ljung Statistic test. This statistic was originally introduced by Box and Pierce (1970) with the name of Box-Pierce Q statistic. Using the first k sample autocorrelations, this statistic test is defined as follows

(3.16.14) $$Q(k) = N\sum_{s=1}^{k}\rho_s,$$

where ρ_s indicates the autocorrelation of order s, and N is the number of observations. If the data are generated from a stationary ARMA process, Q(k) is an asymptotic χ^2 distribution, with degrees of freedom equal to k. The intuition behind the use of the statistic is that high sample correlations lead to large values of Q. Certainly, a white noise process would have a Q value of zero. If the calculated value of Q exceeds the appropriate value of χ^2 table, we can reject the null of no significant autocorrelations. Therefore, the alternative hypothesis of at least one autocorrelation is not zero is accepted.

A problem with the Box-Pierce Q-statistic is that it works poorly even in moderately large samples. Ljung and Box (1978) report superior small sample performance for the modified Q-statistic calculated as

(3.16.15) $$Q'(k) = N(N+2)\sum_{s=1}^{k}\frac{\rho_s}{N-k}.$$

The Ljung-Box (LB) statistic test of equation (3.16.15) works as the Box-Pierce statistic Q introduced in equation (3.16.14).

---

[29] In our framework, we did not include asymmetric effects for the main reason that the applied framework is already highly parameterised and complex.

The Ljung-Box test is also performed on the standardized residuals, where the standardized residuals are obtained by dividing each residual by its variance. The same test is applied on the squared standardized residuals to identify presence of heteroscedasticity on this time series.

3.16.5.2 Normality of the Residual

The normality of the disturbances of an estimated process is related to the behaviour of the third and fourth moments of the errors. In particular, it depends on their skewness and kurtosis. These moments describe some aspects of the shape of the density function of the errors. In presence of skewness the distribution of the errors presents asymmetry, which can be left or right. The skewness coefficient is given by

$$\text{(3.16.16)} \qquad S = \frac{E[(\sum_{t=1}^{n} \varepsilon_i)^3]}{\sigma_e^3} \quad ,$$

and in case of symmetry is equal to zero. On the other hand, the presence of kurtosis indicates concentration of values around the mean or a peakedness of the distribution. A standard measure of the kurtosis is given by

$$\text{(3.16.17)} \qquad K = \frac{E[(\sum_{t=1}^{n} \varepsilon_i)^4]}{\sigma_e^4}$$

and in case of normality is equal to 3. To jointly test is the residuals preset skewness and kurtosis, or in other words is they are normally distributed, one can perform the Jarque Bera statistic test, which is given as

$$\text{(3.16.18)} \qquad JB = \frac{T-k}{6}(S^2 + \frac{1}{4}(K-3)^2),$$

where T is the number of observations, k represents the number of parameters that have been estimated, and S and K are the estimated of the skewness and kurtosis.

3.17 Multivariate generalised autoregressive heteroscedastic process

3.1.7.1 Multivariate GARCH with constant correlations

The simple univariate GARCH models have been widely used in describing the statistical behaviour of economic and financial time series. More recently, a number of multivariate GARCH processes have been proposed when analysing more that one variable. In the multivariate GARCH model, the M-element residual vector ε_t is specified as follows

(3.17.1) $$\varepsilon_t | \Omega_{t-1} \sim D(0, H_t)$$

where H_t : (M × M) is the time-varying conditional covariance matrix, with a D distribution. In the multivariate case, a major problem is the specification of the matrix H_t. In fact, several specifications of H_t have been discussed in econometric literature.

One of the first proposed specification consists in explaining the matrix H_t in a vector form. According to this approach, a somewhat general form of H_t can be written as follows

(3.17.2) $$\text{vech}(H_t) = \text{vech}(\Sigma) + \sum_{i=1}^{q} C_i vech(\varepsilon_{t-i}\varepsilon_{t-i}') + \sum_{i=1}^{p} \beta_i vech(H_{t-i}),$$

where $\varepsilon_t = (\varepsilon_{1t}, \ldots, \varepsilon_{Nt})'$, Σ is an N× N positive definite matrix, A_i and B_i are $N(N+1)/2 \times N(N+1)/2$ matrices, and the vech notation stacks the lower triangular elements of a symmetric matrix in a column. This represents a generalisation to the multivariate case of the earlier introduced univariate GARCH(p,q) model given by equation (3.16.10). Representation (3.17.2) is called the "vech representation" of a multivariate ARCH model. For N=2 and p=q=1, equation (3.17.2) takes the form

(3.17.3) $$\text{vech}(H_t) = \begin{bmatrix} h_{11,t} \\ h_{12,t} \\ h_{22,t} \end{bmatrix} = \begin{bmatrix} \sigma_{11} \\ \sigma_{12} \\ \sigma_{22} \end{bmatrix} + \begin{bmatrix} c_{11} & c_{12} & c_{13} \\ c_{21} & c_{22} & c_{23} \\ c_{31} & c_{32} & c_{33} \end{bmatrix} \begin{bmatrix} \varepsilon_{1,t-1}^2 \\ \varepsilon_{1,t-1}\varepsilon_{2,t-1} \\ \varepsilon_{2,t-1} \end{bmatrix}$$
$$+ \begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{bmatrix} \begin{bmatrix} h_{11,t-1} \\ h_{12,t-1} \\ h_{22,t-1} \end{bmatrix}.$$

However, this specification presents two problems concerning the specification of H_t. First, the matrix H_t should be positive definite for all possible realisations. Secondly, the formulation of equation (3.17.2) might present a too large number of parameters to be estimated. Therefore, some restrictions have to be imposed. In fact, Engle, Granger and Kraft (1984), which represents the first paper on multivariate ARCH models, considering a bivariate ARCH model with a similar specification of equation (3.17.3), reported that they had to impose a considerable number of restrictions to obtain a matrix H_t positive defined.

An alternative approach to reduce the number of parameters is to explain the conditional variances only as a function of they own lagged squared residuals and lagged values. The assumption amounts to taking C_i and B_i to be diagonal matrices. From equation (3.17.2), the "diagonal representation", in case of p=q=1, is given as follows:

(3.17.4) $$h_{ij,t} = \sigma_{ij} + c_{ij}\varepsilon_{i,t-1}\varepsilon'_{j,t-1} + b_{ij}h_{ij,t-1} \qquad i,j = 1,2, \ldots, N.$$

This form was used by Bollerslev, Engle and Wooldridge (1988) in their analysis of returns on bills, bonds and stocks, and by Baillie and Myers (1991) and Bera, Garcia and Roh (1991) for hedge ratio estimation in commodity markets.

However, also the diagonal representation appears to be too restrictive, and at the same time, positive definiteness of the resulting H_t is not easy to check and also difficult to impose at the estimation stage. To overcome this problem, Baba, Engle, Kraft and Kroner (1990) suggested an alternative parameterisation, which is well known as the "BEKK representation" and where the matrix H_t is almost guaranteed to be positive definite. In this case, the parameterisation of H_t is given as follows

(3.17.5) $$H_t = \Sigma + \sum_{i=1}^{q} C_i'\varepsilon_{t-i}\varepsilon_{t-i}'C_i + \sum_{i=1}^{p} B_i'H_{t-i}B_i,$$

where C_i and B_i are N× N matrices. If Σ is positive definite, then so is H_t. For N =2 and p=q=1, equation (3.17.5) have only 11 parameters compared to the 21 parameters of the vech representation in equation (3.17.3), as equation (3.17.5) now takes the form

(3.17.6) $$\begin{bmatrix} h_{11,t} & h_{12,t} \\ h_{21,t} & h_{22,t} \end{bmatrix} = \begin{bmatrix} \sigma_{11} & \sigma_{12} \\ \sigma_{21} & \sigma_{22} \end{bmatrix} + \begin{bmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{bmatrix}' \begin{bmatrix} \varepsilon_{1,t-1}^2 & \varepsilon_{1,t-1}\varepsilon_{2,t-1} \\ \varepsilon_{1,t-1}\varepsilon_{2,t-1} & \varepsilon_{2,t-1}^2 \end{bmatrix} \begin{bmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{bmatrix}$$
$$+ \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix}' \begin{bmatrix} h_{11,t-1} & h_{12,t-1} \\ h_{21,t-1} & h_{22,t-1} \end{bmatrix} \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix}.$$

By taking the vech of (3.17.5), it can be shown that under certain nonlinear restrictions equations (3.17.2) and (3.17.5) are equivalent (see Baba, Engle, Kraft and Kroner (1990)].

Bollerslev (1990) introduced an attractive way to simplify H_t. He assumed that the conditional correlation matrix of $\varepsilon_t = (\varepsilon_{1t}, \ldots, \varepsilon_{Nt})'$ is constant and expressed H_t as follows

(3.17.7) $$H_t = \mathrm{diag}(\sqrt{h_{11,t}}, \ldots, \sqrt{h_{NN,t}})R\ \mathrm{diag}(\sqrt{h_{11,t}}, \ldots, \sqrt{h_{NN,t}}),$$

where R is the time invariant correlation matrix. When N=2, this representation takes the form

$$\text{(3.17.8)} \qquad H_t = \begin{bmatrix} \sqrt{h_{11,t}} & 0 \\ 0 & \sqrt{h_{22,t}} \end{bmatrix} \begin{bmatrix} 1 & \rho \\ \rho & 1 \end{bmatrix} \begin{bmatrix} \sqrt{h_{11,t}} & 0 \\ 0 & \sqrt{h_{22,t}} \end{bmatrix},$$

where $|\rho| < 1$ is the correlation coefficient between $\varepsilon_{1,t}$ and $\varepsilon_{2,t}$, and the individual variances $h_{11,t}$ and $h_{22,t}$ are assumed to be standard univariate ARCH(p,q) processes, for example

$$\text{(3.17.9)} \qquad h_{11,t} = \sigma_{11} + \sum_{i=1}^{q} c_{1i}\varepsilon_{1,t-i}^2 + \sum_{i=1}^{p} \beta_{1i} h_{11,t-i} .$$

For positive definiteness of H_t in this constant correlation representation, the followings restrictions are necessary, $\sigma_{ij} > 0$, $\alpha_{ij} \geq 0$, and $\beta_{ik} \geq 0$, i=1, …, N, j =1, …, q, and k = 1, …, p.

To avoid that the positive definiteness H_t be conditioned on the positiveness of σ_{ij}, Engle and Kroner (1995) introduced an alternative model to equation (3.17.5) where the conditional covariance matrix is specified as

$$\text{(3.17.10)} \qquad H_t = A'A + \sum_{k=1}^{K}\sum_{i=1}^{p} B_{ik}' H_{t-i} B_{ik} + \sum_{k=1}^{K}\sum_{i=1}^{q} C_{ik}' \varepsilon_{t-1} \varepsilon_{t-i}' C_{ik} ,$$

where the only difference is in substituting the matrix Σ with the matrix A'A where A is defined as follows

$$\text{(3.176.11)} \qquad A = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}.$$

3.17.2 Multivariate GARCH with time-varying correlations

Many of the recent applications of bivariate ARCH use the representation of Engle and Kroner (1995) with constant correlations (see, for example, Baillie and Bollerslev (1990); Baillie and Myers (1991); Bera, Garcia and Roh (1990); Bollerslev (1990); Kroner and Claessens (1991) and Kroner and Sultan (1991)). However, it is quite obvious that constant correlation is a strong assumption. In fact, Bera and Roh (1991) tested for the constant correlation hypothesis and found the null hypothesis is rejected for many financial data series. More recently, the evidence in Login and Solnik (1995), amongst others, suggests that the conditional correlation between asset returns is time-varying.

In addition, King, Sentana and Wadhwani (1994) support the presence of a considerable increased of the international correlations during the October 1987 crash. In looking at the relationships between stock and foreign exchange returns for a group of Pacific Basin countries, their correlation could have been increased following signal of openness to foreign investors and during the Asian financial crisis of mid 1997. The application of a multivariate GARCH process with constant correlations could represent a misspecificatied model and so any evidence and test based on that specification. Therefore, to avoid misspecification errors, it is preferable to use a multivariate GARCH process allowing for conditional covariances and correlations.

In our case the conditional correlation trivariate GARCH model is used. Specifically, we consider a diagonal BEKK representation, that for a GARCH(1,1) process is given as follows

(3.17.12) $$R_t = \mu + \sum_{i=1}^{k} R_{t-i} + \varepsilon_t \qquad \varepsilon_t | \Omega_{t-1} \sim D(0, H_t)$$

$$H_t = AA' + BH_{t-1}B' + C\varepsilon_{t-1}\varepsilon'_{t-1}C',$$

where

$$H_t = \begin{bmatrix} h_{11} & 0 & 0 \\ h_{21} & h_{22} & 0 \\ h_{31} & h_{32} & h_{33} \end{bmatrix}, \qquad A = \begin{bmatrix} a_{11} & 0 & 0 \\ a_{21} & a_{22} & 0 \\ a_{31} & a_{32} & a_{33} \end{bmatrix}, \qquad B = \begin{bmatrix} b_{11} & 0 & 0 \\ 0 & b_{22} & 0 \\ 0 & 0 & b_{33} \end{bmatrix},$$

$$C = \begin{bmatrix} c_{11} & 0 & 0 \\ 0 & c_{22} & 0 \\ 0 & 0 & c_{33} \end{bmatrix}, \qquad \varepsilon_t = \begin{bmatrix} \varepsilon_1 & 0 & 0 \\ 0 & \varepsilon_2 & 0 \\ 0 & 0 & \varepsilon_3 \end{bmatrix}.$$

Equation (3.17.12) can also be written as

(3.17.13)
$$h_{11,t} = a_{11}^2 + b_{11}^2 h_{11,t-1} + c_{11}^2 \varepsilon_{1,t-1}^2$$

$$h_{22,t} = a_{21}^2 + a_{22}^2 + b_{22}^2 h_{22,t-1} + c_{22}^2 \varepsilon_{2,t-1}^2$$

$$h_{33,t} = a_{31}^2 + a_{32}^2 + a_{33}^2 + b_{33}^2 h_{33,t-1} + c_{33}^2 \varepsilon_{3,t-1}^2$$

$$h_{21,t} = a_{11}a_{21} + b_{11}b_{22}h_{21,t-1} + c_{11}c_{22}\varepsilon_{1,t-1}\varepsilon_{2,t-1},$$

$$h_{31,t} = a_{11}a_{31} + b_{11}b_{33}h_{31,t-1} + c_{11}c_{33}\varepsilon_{1,t-1}\varepsilon_{3,t-1}$$

$$h_{23,t} = a_{21}a_{31} + a_{22}a_{32} + b_{22}b_{33}h_{23,t-1} + c_{22}c_{33}\varepsilon_{21,t-1}\varepsilon_{3,t-1}$$

Engle and Kroner (1995) have shown that the necessary and sufficient conditions for covariance stationarity of the trivariate GARCH model of equation

(3.17.13) are given as $b_{11}^2 + c_{11}^2 < 1$, $b_{22}^2 + c_{22}^2 < 1$, and $b_{33}^2 + c_{33}^2 < 1$. Another important factor is that the sum of b_{11}^2 and c_{11}^2, of b_{22}^2 and c_{22}^2, and of b_{33}^2 and c_{33}^2, denote the degree of persistence in the conditional variance given a shock to the system[30]. The assumption of conditional correlation of the trivariate GARCH process of equation (3.17.13) is achieved by remembering that the correlation is given by dividing the covariance by the squared root of the product of the variances of the two variables in consideration. Modelling variances and covariances as time-varying for definition we also obtained conditional correlations.

In estimating the multivariate GARCH process of equation (3.17.12) and (3.17.13) one can assumed that the vector of errors ε_t to follow a multivariate normal distribution so the conditional log likelihood for each observation is given by

$$(3.17.14) \qquad l_t(\theta) = -\log(2\pi) - \frac{1}{2}\log|H_t(\theta)| - \frac{1}{2}\varepsilon_t'(\theta)H_t^{-1}(\theta)\varepsilon_t(\theta),$$

where θ is the vector of all parameters. The log likelihood to be maximized is

$$(3.17.15) \qquad l(\theta) = \sum_{t=1}^{T} l_t(\theta).$$

In our case non linear optimation techniques are used to calculate the maximum likelihood estimates based on the Broyden, Fletcher, Goldfarb and Shanno (BFGS) algorithm. White's (1984) standard errors are computed, which are robust to misspecification of the distribution of the error term. This method, in case of non-normal errors, yields quasi-maximum likelihood estimates (QMLE). Under suitable regularity conditions, QMLE parameters are consistent and asymptotically normal (Gourieroux, Monfort and Trognon, 1984).

Based on the fact that the unconditional distribution of many financial time series seems to have fatter tails than allowed by the Gaussian family, which in part could be explained by the presence of ARCH, Engle and Bollerslev (1986) and Bollerslev (1987) recommend adopting a t distribution for the vector of errors ε_t, with v degrees of freedom. However, Bera and Higgins (1993) argue that conditional t or other nonnormal distributions do not of course solve all the problems, since the degree of freedom v is not time invariant. The conditional t distribution although it allows

[30] As the sum tends to 1, the higher becomes the instability in the variance, and shocks tend to persist instead of dying out. This special case is known as integrated GARCH (IGARCH); See Engle and Bollerslev (1986).

kurtosis to exceed 3, it assumes constant conditional kurtosis. Therefore, in same cases is more appropriate to focus the analysis on the QMLE parameters.

Appendix 3.A: Generalized Method of Moments

3.A. 1 The GMM estimator

The Generalized Method of Moments (GMM) is a technique of estimation applied to evaluate the parameters of an equation or of a system of equations. Since its introduction in the past decade, in particular subsequently Hansen's seminal paper in 1982[31], there has been an explosion of macroeconomic and microeconomic researches using this estimator. Two are the fundamental reasons of its popularity. First, GMM nests many common estimators and provides a useful framework for their comparison and evaluation. Secondly, GMM estimators require specification only of certain moment conditions rather than the full density. However, these advantages come at a price. The GMM estimator is a large-sample estimator and therefore, it can be used only in cases of a large number of observations availability.

The GMM represents a generalisation of the method of the moments (MM) estimator. The MM is an estimator of parameters, which using population moments definition, calculates the sample moments and it employs these relations and restrictions to estimate the parameters of the data generating process. In the same manner, the GMM is an estimation that simply satisfies a general function of moments, which is represented by the orthogonal condition between the set of explanatory variables and the error vector.

If (y, X) are the data and Θ is a set of parameters of the statistic model

(A.1) $y = \alpha + X\beta + \varepsilon$,

where $\theta = [\alpha\ \beta]$ and ε is the error vector; the orthogonal condition for the population is satisfied if

(A.2) $E[g(y, X, \Theta)] = 0$.

For a given sample, the GMM estimator of the set Θ, is the value of Θ, defined as Θ_{GMM} that minimizes

(A.3) $m(y, X, \Theta_{GMM})' (W_n)^{-1} m(y, X, \Theta_{GMM})$,

where, $m(y, X, \Theta) = (1/n) \Sigma\ g(y_i, X_i, \Theta)$, and W_n is a function of the data that converges in probability to some matrix W that is symmetric and positive definite.

[31] Hansen, L. 1982, "Large sample properties of generalized method of moments estimators", Econometrica, 50, 646-660.

Analytically the matrix W_n is an estimate of W, where this matrix is calculated as following

(A.4) $W=\lim (1/n) \Sigma_t\Sigma_i E\{[g(y_t, X_t, \Theta)][g(y_{t-i}, X_{t-i}, \Theta)]$ with $t=1, .., n$ and $i=(-\infty, \infty)$, and it is a Newey-West covariance matrix.[32] Econometric theory (see Johnson and Di Nardo, 1997) shows that the GMM estimator is asymptotically distributed as following

(A.5) $\Theta_{GMM} \sim N(\Theta, (G'\Omega G)^{-1}$,

where $G = \partial m/\partial\Theta$ and $\Omega = E[g(\theta) g(\theta)']$, which is the variance of the moment condition. GMM estimator is always consistent and asymptotically unbiased. When the correct weighting matrix is used, GMM is also asymptotically efficient in the class of estimators defined by the orthogonal conditions.

3.A.2 Special cases of generalized method of moments estimators

3.A.2.1 OLS and Instrumental variables as a moment problem

A special case of GMM estimator is the OLS method. If (y, X) are the data and Θ is the set of parameters of the analysed statistic model, one of the conditions to be satisfied to apply the OLS method is the absence of correlation between the set of explanatory variables and the error vector. This condition can be represented as

(A.6) $E(X'\varepsilon) = 0$,

where ε is the error vector and the operator $E(\cdot)$ indicates expectations. In case condition (A.6) is satisfy, the OLS estimator is a special case of the GMM method, where the function $g(y, X, \Theta) = X'(y - Xb)$. If equation (A.6) is not verified, the OLS estimators are inconsistent. In this particular case, an alternative is to use instrumental variables, which have to be correlated with the original explanatory variables, but that have to be orthogonal to innovations, to estimate the set of parameters Θ.

Considering the following model

(A.7) $y = \alpha + x_1\beta_1 + \varepsilon$

where (y, X) are the data, $\Theta = [\alpha\ \beta]$ is the set of parameters and ε is the error vector. In the case the orthogonality condition of equation (A.6) is not verified, we define a

[32] The Newey-West estimator provides a way to calculate consistent matrices in the presence of both serial correlation and heteroscedasticity (see Davidson and MacKinnon, 1995).

set of instrumental variables $Z = [\ 1\ Z_1\ Z_2]$ that is correlated with X, $X=[1\ x_1]$ and satisfies the condition

(A.8) $E[Z'\varepsilon] = 0.$

If $\beta = [\alpha\ \beta_1]$, and $\varepsilon = y - Xb$, for the orthogonal condition we have

(A.9) $1/n\ Z'(y - Xb) = 0,$

and consequently,

(A.10) $b = (Z'X)^{-1}Z'y.$

Because $(Z'X)^{-1}$ is a 3×2 matrix, it is not invertible. Therefore, to estimate the set of parameters Θ, it is possible to use the expectation condition in equation (A.3), which is always satisfied in the population.

Equation (A.3) gives a number of conditions (in this case three) that is bigger than the number of parameters to be estimated (two). Three approaches can be applied to estimate Θ. First, one equation can be eliminated. Secondly, every deviation from each condition could be weighted equally in the calculation and the sum of squared deviation minimized. Thirdly, each equation could be weighted according to how precisely (measure of the variance) each equation is estimated.

As suggested by Hansen (1982), the optimal estimator to apply to satisfy the orthogonal condition is the third type. This estimator is a following

(A.11) $\min(b)\ \{(1/n)[Z'(\ y - Xb)']\ V'^{-1}(1/n)[Z'(y - Xb)],$

where V'^{-1} is a consistent estimate of $\{var[(1/n)(Z'\varepsilon)]\}^{-1}$. However, the set of parameters b, estimated as in equation (A.3) represents only a special case of GMM. The estimated b is the 2SLS estimators, which in case of absence of correlation between the set of explanatory variables X and the error vector ε, or $E(X'\varepsilon)=0$, b_{2sls} is an OLS estimator of β. Therefore, we can conclude that the OLS and 2SLS estimators are two special cases of GMM estimators.

3.A.2.2 Maximum likelihood

Maximum likelihood estimators are also a specific case of GMM estimator. Econometric theory shows that to maximize the likelihood function, the parameters of the statistic model under analysis are estimated by equalising the first derivative of the log-likelihood $\partial \ln[L(X, \Theta)]/\partial\Theta$ (the score) to zero

(B.12) $m(y, X, \Theta) = \partial \ln L/\partial\Theta = 0.$

The condition (B.12) is a simply moment condition. If we estimate the same parameters using the GMM method, the "GMM way" to write this problem is as a solution to

(A.13) $\min(\Theta_{GMM})\ \{m(y, X, \Theta)'\ H^{-1}m(y, X, \Theta)\}$,

where the *weighting matrix* H is the variance of the moment condition. That is, $H = -E(\partial^2 \ln L / \partial\Theta\ \partial\Theta')$. The GMM estimator of the set of parameters Θ must satisfy

(B.14) $(\partial^2 \ln L / \partial\Theta\ \partial\Theta)\ H^{-1}\ (\partial \ln L / \partial\Theta\ ) = 0$.

However, the solution of equation (A.12) is the maximum likelihood estimator (MLE) that can view as a GMM estimator.

Some researchers prefer GMM to MLE. This is for two reasons. Firstly, GMM is easier to compute than MLE and it is a consistent estimator, even if is less asymptotically efficient that the ML estimator. Secondly, GMM needs only the speciation of moment conditions and it does not require information regarding the data generation process as the ML estimator.

Concluding, because the GMM estimator, requires only some moment conditions, it is consistent, it is asymptotically efficient as well as unbiased and it does not require any information regarding the d.g.p., it represents a valid alternative to more used methods of estimation. However, it is important to remember that it is a large sample estimator. So far, the GMM estimator has been quite applied in financial empirical studies because of the above described characteristics and because it permits to correct the variance-covariance matrix of all the parameters in the statistic model for the presence of heteroskedasticity (White, 1984).

PAGE

NUMBERING

AS ORIGINAL

CHAPTER FOUR

STOCK PRICES AND EXCHANGE RATE DYNAMICS

4.1 Introduction

The recent emergence of new capital markets, the relaxation of foreign capital controls and the adoption of more flexible exchange rate regimes have increased the interest of academics and practitioners in studying the interactions between the stock and foreign exchange markets. The gradual abolition of foreign exchange controls in emerging economies has opened the possibility of international investment and portfolio diversification. At the same time, the adoption of more flexible exchange rate regimes by these countries in the late 1980's and early 1990's has increased the volatility of foreign exchange markets and the risk associated with such investments. The choice of currency denomination has added an important dimension to the overall portfolio decision.

Classical economic theory suggests a relationship between the stock market performance and the exchange rate behaviour. For example, "flow oriented" models of exchange rate determination, (see e.g. Dornbusch and Fisher (1980)), affirm that currency movements affect international competitiveness and the balance of trade position, and consequently the real output of the country, which in turn affects current and future cash flows of companies and their stock prices. Movements in the stock market may also affect exchange rates. Equities, being part of wealth, may affect the behaviour of exchange rates through the demand for money according to the monetarist models of exchange rate determination (see Gavin, (1989)). Similar links can be traced through the portfolio-balance models as well (see Branson (1983) and Frankel (1983)).

Previous studies, which have examined the relationship between stock and foreign exchange markets mainly for U.S. (see e.g. Aggarwal (1981), Soenen and Hennigar (1988), Ma and Kao, (1990), Roll (1992) and Chow et al. (1997)), found different results concerning the links between the two markets. For example, Aggarwal (1981) finds that revaluation of the US dollar is positively related to stock market returns. In contrast, when Soenen and Hennigar (1988) considered a different period, 1980-1986, found a significantly negative relationship. Roll (1992), who used daily data over the period 1988-1991 found also a positive relationship between the two markets. On the other hand, Chow et al (1997) using monthly data for the period 1977-1989 found no relationship for monthly excess stock returns and real exchange rate returns. When repeating the exercise, however, with longer than six months horizons they found a positive relationship between a strong dollar and stock returns.

At the micro level other works have focused on evaluating the exposure of domestic firms to foreign currency risk. Apart from the economic exposure, which arises from variations in firm's discounted cash flows when exchange rates fluctuate, firms also face transaction exposure due to gains or losses arising from settlement of investment transactions stated in foreign currency terms. Empirical work using an unconditional pricing multi-factor asset-pricing model generally reports that the exchange risk is not priced either in the U.S. or in the Japanese markets (see e.g. Jorion (1991), Hamao (1988) and Brown and Otsuki (1990)). More recent studies, however, using a conditional international asset-pricing model with exchange risk find that the conditional model outperforms the unconditional model used by prior work, and report that the exchange risk is priced for the four largest countries, U.S., UK, Japan and Germany (see e.g. Dumas and Solnik (1995) and Choi et al. (1998)).

Our study concentrates on the macro level issues and contributes to the literature in the following ways. First, the paper clarifies the theoretical issues of the relationship between stock and foreign exchange markets. It discusses the channels through which exogenous shocks impact on these markets and link them together. Secondly, it considers simultaneously both the short-run and the long-run dynamics of the financial markets. Earlier empirical work focused their analysis on the linkage between the returns in the two markets and did not consider the relationship between the *levels* of the series. One of the reasons for concentrating on returns is the fact that financial time series do not satisfy the basic assumption of stationarity required to avoid spurious inferences based on regression analysis. By differencing the variables, however, some information regarding a possible linear combination between the levels of the variables may be lost. It should be noted that economic theory does not preclude a relationship of exchange rates and stock prices in terms of *levels*. The use of cointegration technique, developed initially by Granger (1981) to explore the long-run relationship between two series, overcomes the problem of nonstationarity and allows an investigation into both, the levels and differences, of exchange rates and stock prices.

Thirdly, it is shown that the lack of causal relationship between the stock and foreign exchange markets in a country might be due to the omission of an important variable from the system, which acts as a conduit through which the real exchange rate affects the stock market, invalidating the results of some of the previous studies. Caporale and Pittis (1997) have shown that inferences about the long-run relationship of variables and the causality structure are invalid in an incomplete system. The important variable omitted from the system is the US stock market, which can be thought of as representing the influence of world markets. As foreign capital restrictions are lifted in the Pacific Basin Stock markets and the link between the foreign exchange market and the stock market increases, there will also be an increase in the degree of correlation between the local market and other financial markets around the world, as well as an increase in the link between the foreign exchange and stock markets.[33]

Finally, previous studies have concentrated almost exclusively on U.S. Our study examines the relationship between stock and foreign exchange markets for a group of Pacific Basin countries providing another insight into the issue.

The paper tries to answer the following questions. What is the long-run relationship between the stock markets and foreign exchange markets? Has the relationship changed in recent years following the relaxation of foreign exchange controls and especially those applying to foreign ownership? What has been the effect of the financial crisis of July 1997 on this relationship? What is the direction of causality between these markets and what are the implications for the transmission mechanism of shocks? Can domestic stock markets be isolated from world markets? Answers to these questions have policy implications for the implementation of exchange rate and foreign exchange control policies. Understanding the dynamic links between stock and foreign exchange markets should also assist multinational corporations in managing their foreign exchange exposure.

The paper is structured as follows. Section 4.2 explains methodological issues. It discusses the theoretical links between the stock and foreign exchange markets within the cointegration methodology. It examines the application of

[33] Many studies have found supportive evidence on the internationalisation of stock markets following the abolition of foreign exchange controls, see e.g. Taylor and Tonks (1989) for the case of UK based on a bivariate analysis, and Kasa (1992) for a multivariate framework on US, Japan, England, Germany and Canada. With regard to emerging capital markets, see e.g. Bekaert and Harvey (1995), who have used a regime switching framework to model changes in market integration based on one factor asset-pricing model; Bekaert and Harvey (2000) who conditioned mean and variance on both local and world information to capture changes in the degree of market integration; and the empirical work of chapter 6, which has been focused in measuring financial integration by analysing the covariance of excess returns of national stock markets.

multivariate Granger Causality tests suggested by Dolado and Lutkerpohl (1996). Testing for the direction of causality is associated with some interesting hypotheses regarding the type of channel that links the stock and foreign exchange markets. It finally explains the recursive-based method to test for constancy of the long-run relationship developed by Hansen and Johansen (1998). Section 4.3 discusses the data and presents the empirical results. Section 4.4 summarises the main findings and the policy implications.

4.2 Methodological issues

4.2.1 Bivariate and Trivariate cointegration

The relationship between domestic and foreign stock markets can be represented by

(4.1) $P_t^{PBC} = \alpha_0 + \alpha_1 S_t^{PBC} + \varepsilon_t$,

where P_t^{PBC} is the domestic stock price, S_t^{PBC} is the real exchange rate defined as domestic prices relative to foreign prices multiplied by the nominal exchange rate and ε_t is a disturbance term.[34] All data are transformed by natural logarithms. The real exchange rate has been used instead of the nominal because it reflects better the competitive position of an economy with the rest of the world.[35]

On the basis of economic theory the coefficient α_1 can either take a positive or a negative value. One of the explanations of the comovement between foreign exchange and stock markets relates to the relationship of these markets and economic activity. The behaviour of the real exchange rate is one of the major determinants of economic activity. A fall in the real exchange affects the the competitiveness of domestic goods versus foreign goods and the balance of trade of a country. This increases the level of domestic aggregate demand and the level of output. The long-run relationship between exchange rates and economic activity has been well documented in several studies (see e.g. Cornell (1983) and Wolff (1988)).

On the other hand, economic activity also affects the level of stock prices. The stock price of a firm reflects the expected future cash-flows, which are influenced

[34] The nominal exchange rate is expressed in domestic currency per unit of foreign currency.
[35] Furthermore, the nominal exchange rate of these countries has not varied substantially during this period.

by the future internal and external aggregate demand. Consequently, stock prices will incorporate present and expected economic activity as measured by industrial production, real economic growth, employment rate or corporate profits (see Fama (1981), Geske and Roll (1983)). Empirical studies have confirmed the long-run positive relationship between stock prices and economic activity (see e.g. Schwert (1990), Roll (1992) and Canova and DeNicole (1995)).[36] Thus, a fall in real exchange rate may increase stock prices through its effect on economic activity implying that $\alpha_1 < 0$. This scenario is based on the "flow" approach to exchange rate determination and will referred to as the "flow" approach scenario.

There is, however, another scenario concerning the link between the stock market and the foreign exchange market, which is based on the portfolio approach to exchange rate determination and will give rise to $\alpha_1 > 0$. According to the model, agents allocate their wealth amongst alternative assets including domestic money, and domestic and foreign securities. The role of the exchange rate is to balance the asset demands and supplies. Thus, any change in the demand for and supply of assets will change the equilibrium exchange rate. For example, an increase in domestic stock prices will increase wealth and the demand for money and consequently interest rates will go up. High interest rates in turn, will attract foreign capital, resulting in an appreciation of the domestic currency and a rise in the real exchange rate. This scenario will be referred to as the "stock" approach.[37]

Previous studies have estimated equation (4.1) in difference form and some of them found evidence to support the "flow" approach, some the "stock" approach and others neither. The model described above, however, could be an incomplete system because of the omission of an "important variable". If that is the case inferences about the long-run relationship of variables and the causality structure are invalid. Lutkepohl (1982) and more recently Caporale and Pittis (1997) have shown that the omitted variable in the extended system is the only determining factor for the sensitivity of causality inference between the variables of the incomplete system.

[36] There is the possibility of a J-effect. The deterioration in the terms of trade will increase the costs of imports, domestic inflation and may reduce domestic demand and stock prices. This effect is, however, short-term.

[37] For an individual firm, however, the economic currency exposure will depend on the currency structure of its exports, imports and financing. Thus, devaluation can either raise or lower a firm's stock prices depending whether the firm is an exporting firm or it is a user of

Caporale and Pittis (1997) take a first order bivariate VAR and derive the condition for which both eigenvalues are equal to one, which is equivalent to no cointegration and no causality between the two variables of the system.[38] They go on to show how these inferences are affected if the bivariate VAR is part of a trivariate system and the omitted variable causes a) none, b) one, and c) both variables in the bivariate system.

Thus, non-cointegrability in our system might arise because of the omission of an important "causing" variable. In the present context, the U.S. stock market, representing the world capital markets, could be a conduit through which the foreign exchange and the local stock markets are linked. In the "flow" approach, an increase in the U.S. stock market conveys information about the performance of the U.S. economy since there is a long-run relationship between the stock market and the real activity in a country. That implies an increase in U.S. imports and an increase in Pacific Basin countries' exports since there are substantial trade links between these countries and U.S. That leads on the one hand, to an appreciation of their currency and a rise in the real exchange rate, and on the other hand, to an increase in the domestic economic activity, which causes the local stock market to rise.[39,40]

Within the "stock" approach, an increase in the U.S. stock market will cause the local stock market to rise as a result of the greater integration between Pacific Basin countries markets and world markets. The resulting increase in wealth will trigger a series of events as explained earlier, which will lead to a rise in the real exchange rate.

The complete system can thus be represented by equation (4.2)

$$(4.2) \quad P_t^{PBC} = \alpha_0 + \alpha_1 S_t^{PBC} + \alpha_2 P_t^{US} + \varepsilon_t ,$$

where P_t^{US} is the U.S. stock price. The coefficients α_1 and α_2 are expected to be positive under both scenario, "stock" and "flow". We will be distinguishing between the two scenarios and their implied channels of transmission of shocks, also called

---

imported inputs. If it is involved in both activities, stock prices could move in either direction.

[38] They reaffirm in another way Engle and Granger's (1987) result that at least one-way Granger causality is necessary for cointegration.

[39] See Mundell (1963) and Fleming (1962) for an explanation of how an exogenous increase in exports leads to an increase in real output and an appreciation of the nominal exchange rate.

[40] In a recent paper, Canova and DeNicole (1995) have shown theoretically and empirically that the relationship between stock returns and domestic output is enhanced when foreign influences are considered.

"stock" and "flow" channels respectively, through the application of multivariate Granger causality tests for cointegrating systems.

In implementing the tests for cointegration we use the likelihood ratio test due to Johansen (1988) and Johansen and Juselius (1990). In the bivariate case $Y_t \equiv (P_{PBC}, S_{PBC})$ where P_{PBC} is the stock price index in the Pacific Basin country and S_{PBC} the real exchange rate for each Pacific Basin country versus the U.S.; n the number of variables in the system, two in this case. If Y_t is cointegrated, it can be generated by a vector error correction model (VECM)

$$(4.3)\quad \Delta Y_t = \mu + \sum_{i=1}^{k-1} G_i \Delta Y_{t-i} + G_k Y_{t-1} + \varepsilon_t,$$

where μ is a 2 x 1 vector of drift, G's are 2 x 2 matrices of parameters, and ε_t is a 2 x 1 white noise vector. The Johansen trace test statistic of the null hypothesis that there are at most r cointegrating vectors $0 \leq r \leq n$, and thus *(n-r)* common stochastic trends is

$$(4.4)\quad trace = -T \sum_{i=r+1}^{n} \ln(1-\hat{\lambda}_i),$$

where $\hat{\lambda}_i$'s are the *n-r* smallest squared canonical correlations of Y_{t-1} with respect to ΔY_t corrected for lagged differences and T is the sample size actually used for estimation.

In the case of the trivariate system $Y_t \equiv (P_{PBC}, S_{PBC}, P_{US})$ and in equation (4.3) μ is a 3 x 1 vector of drift, G's are 3 x 3 matrices of parameters, and ε_t is a 3 x 1 white noise vector.

4.2.2 *Multivariate Granger causality tests*

Apart from the examination of the long-run co-movements of foreign exchange and stock markets, we explore the short-run dynamics by performing Granger-causality tests for cointegrating systems. Such an exercise will provide an understanding of the interactions amongst the variables in the system and will shed light on the type of channel, "stock" and/or "flow", that has linked the various markets.

In exploring the causality issue between stock markets and the real exchange rate we apply the methodology for multivariate Granger Causality tests for cointegrating systems suggested by Dolado and Lutkepohl (1996).[41] Dolado and Lutkepohl (1996) propose a method which leads to Wald tests with standard asymptotic χ^2- distributions and which avoids possible pretest biases associated with the usual procedure of estimating a first order differenced VAR if variables are known to be I(1) with no cointegration, and an error correction model if they are known to be cointegrated.

Their method is performed directly on the least squares estimators of the coefficients of the VAR process specified in levels of the variables.[42] The procedure is based on the argument that the non-standard asymptotic properties of the Wald test on the coefficients of cointegrated VAR systems are due to the singularity of the asymptotic distribution of the least square estimators. Their suggested method gets rid of the singularity by fitting a VAR process whose order exceeds the true order. They show that this device leads to a non-singular distribution of the relevant coefficients.

The method involves the following steps. First, one finds the lag structure of the VAR by testing a VAR(k) against a VAR(k+1), k ≥ 1 using the standard Wald test. Secondly, if the true data generating process is a VAR(k), a VAR(k+1) is fitted and standard Wald tests are applied on the first k VAR coefficient matrix.

In the context of our paper, the above method implies estimating the undifferenced VAR of VECM of equation (4.3),

(4.5) $$Y_t = \mu + A_1 Y_{t-1} + \dots + A_p Y_{t-k} + \varepsilon_t,$$

where A_i are 3 x 3 coefficient matrices in our case. The expanded version of the VAR for each Pacific Basin country is

(4.6) $$\begin{bmatrix} P_{PBC} \\ S_{PBC} \\ P_{US} \end{bmatrix} = \begin{bmatrix} A_{10} \\ A_{20} \\ A_{30} \end{bmatrix} + \begin{bmatrix} A_{11}(L) & A_{12}(L) & A_{13}(L) \\ A_{21}(L) & A_{22}(L) & A_{23}(L) \\ A_{31}(L) & A_{32}(L) & A_{33}(L) \end{bmatrix} \begin{bmatrix} P_{PBC,t-1} \\ S_{PBC,t-1} \\ P_{US,t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{PBC} \\ \varepsilon_{SPBC} \\ \varepsilon_{US} \end{bmatrix},$$

where A_{i0} are the parameters representing intercept terms and A_{ij} the polynomials in the lag operator L. We select the lag structure using the Wald test, and then re-estimate the VAR adding one extra lag. Since each equation has the same lag length,

[41] The discussion below is presented in terms of the trivariate system.

[42] It should be noted that although the variables are allowed to be potentially cointegrated, it is not assumed that the cointegration structure of the system under investigation is known. Therefore, preliminary unit root tests are not necessary and, the testing procedure is robust to the integration and cointegration properties of the process.

we estimate the three equations using OLS as the estimates are consistent and asymptotically efficient.[43] We test various hypotheses concerning the two channels of links between stock and foreign exchange markets.

(i) "Flow" channel: $A_{13}(L) \neq 0$, $A_{23}(L) \neq 0$, $A_{12}(L) \neq 0$.

(ii) "Stock" channel: $A_{13}(L) \neq 0$, $A_{21}(L) \neq 0$.

(iii) "Flow" and "Stock" channels: $A_{13}(L) \neq 0$, $A_{23}(L) \neq 0$, $A_{12}(L) \neq 0$, $A_{21}(L) \neq 0$.

4.2.3 Tests for parameter constancy in cointegrated VAR-models

An important issue relating to a cointegrating VAR model is that of parameter constancy. Stepthon and Larsen (1991) have shown that Johansen's test may be characterised by sample dependency. This is specifically relevant to our study because the Asian financial crisis in mid 1997 might have affected the links between the stock and the foreign exchange markets. The currency collapse might have made domestic assets less attractive, forcing a stock market collapse and thus, a possible increase in the links between the two markets. Previous work on the 1987 stock market crash and the Mexican crisis has shown that correlations between stock markets increase during a crisis (see e.g. Roll, (1989), Calvo and Reinhart, (1996)).

We apply the recursive estimation suggested by Hansen and Johansen (1998) for the evaluation of parameter constancy in cointegrated VAR models, using estimates from the Johansen FIML technique under two VAR representations. In the "Z-representation" all the parameters of VECM are reestimated during the recursions, while under the "R-representation" the short-run parameters are kept fixed to their full sample values and only the long-run parameters are reestimated.

We perform two tests. The first examines the null hypothesis of constancy of the cointegration space for a given cointegrating rank. Hansen and Johansen (1998) propose a likelihood ratio test, which is constructed by comparing the likelihood function from each recursive sub-sample with the likelihood function under the restriction that the cointegrating vector estimated from the full sample falls within the space spanned by the estimated vectors of each individual sample. The test statistic is

[43] See e.g. Enders (1995).

distributed as a chi-square with *(n-r)r* degrees of freedom, where *n* is the dimension of the cointegrating space.

The second test concerns the non-zero eigenvalues, which have a unique relationship to the cointegrating vectors. Thus, when the cointegrating vectors have undergone a structural change, this will be reflected in the estimated eigenvalues. Hansen and Johansen (1998) have derived the asymptotic distribution of the estimated eigenvalues.

4.3 Empirical results

4.3.1 Data

Six Pacific Basin countries were selected for the empirical analysis: Hong Kong, Indonesia, Malaysia, Singapore, Thailand and Philippines. The sample period varies for each country depending on the availability of data. For Malaysia and Thailand the sample period is 1980.01 to 1998.12; for Hong Kong 1981.01 to 1998.12; for Indonesia 1983.05 to 1998.12; and for Philippines and Singapore 1990.01 to 1998.12. The data consist of monthly stock market index prices (1990=100) expressed in local currency, local bilateral spot exchange rates expressed as domestic currency per U.S. dollar, and consumer price index (1990=100). All the observations were obtained from the *International Financial Statistics* data base in *Datastream*[44] and are end-of-the month observations. All the series are expressed in logarithmic form. The stock market index prices used are as follows: the Hang Seng Price Index for Hong Kong; the Jakarta SE Composite Price Index for Indonesia; the Kuala Lumpur Composite Price Index for Malaysia; the Philippines SE Composite Price Index for the Philippines; the Singapore Straits Times Price Index for Singapore; the Bangkok S.E.T. Price Index for Thailand; and the Standard & Poors' Composition Index for the U.S.

The real exchange rate is defined as

$$\ln S_t^{PBC} = \ln CPI_t^{PBC} - \ln ex_t^{PBC} - \ln CPI_t^{US},$$

[44] The only exception is for Hong Kong, where the CPI series was obtained from the Monthly Statistical Bulletin published by the Hong Kong Monetary Authority.

where CPI_t^{PBC} is the consumer price index for the Pacific Basin country, ex_t^{PBC} is the nominal exchange rate and CPI_t^{US} is the consumer price index for U.S.

One of the objectives of the study is to examine the impact of stock markets liberalisation on foreign exchange and stock markets. For this purpose we divided the sample period into pre and post liberalisation sub-periods. In doing so we were faced with two problems. First, liberalisation can take many forms, such as relaxing currency restrictions, reducing foreign ownership restrictions, allowing capital and dividends to be repatriated e.t.c. In addition, these reforms might not take place at the same time. This made the choice of the liberalisation date difficult. Second, in some countries foreigners had been allowed to participate in local markets through indirect means, such as Country Funds and American Depositary Receipts (ADRs), prior to the lifting of various restrictions on foreign investors. Theoretical and empirical studies support the view that such means increase the integration of local markets with global markets (see e.g. Errunza, Senbet and Hogan (1998), Tandon (1997) and Urias (1994)).

In Table 4.1.1, we summarize three different signals of liberalisation for each country: the official liberalisation date (OLD), which is based on information obtained from a variety of sources reported in the table, the First Country Fund (FCF) and the First ADR. In our analysis we have used both the OLD liberalisation date and the date for the introduction of FCF to divide the sample period into pre and post liberalisation sub-periods. The introduction of first ADR has in all cases followed the introduction of FCF. Furthermore, in order to show the extent of liberalisation in these countries we present in Table 4.1.2 various indicators of direct and indirect barriers for institutional investors at the end of 1989. [45] As it can be seen our six countries differ in the degree of foreign exchange restrictions. We have on the one hand, Hong Kong, and Singapore, which have virtually no foreign exchange controls and foreign ownership regulations throughout the period i.e. they have open markets, and on the other hand, Philippines, Thailand and Indonesia, which have significant controls. We can refer to these markets as semi-open. Malaysia was a closed market until 1989 and completely open until September 1998.

Thus, our investigation will explore the effects of foreign exchange restrictions on the links between stock and foreign exchange markets through the

[45] We chose that date because many liberalisation clustered in the late 1980's.

division of the sample into pre and post liberalisation sub-periods and through any differences in the results between open and semi-open markets.[46]

4.3.2 *Bivariate and Trivariate cointegration results*

Before testing for cointegration we tested for unit roots in all the stock market indices and the real exchange rates for the two sub-periods, whenever that was possible. The results are not presented but can be made available by the authors. We used the Augmented Dickey Fuller test with and without trend as recommended by Engle and Granger (1987) and the Phillips and Perron (1988) test again with and without trend. We found that the null hypothesis of a unit root for the first difference can be rejected for all series. On the other hand, the null hypothesis of a unit root in levels was accepted in all cases.[47] Thus, like most financial series, the stock market and exchange rates are I(1), which means that first differencing is required to achieve stationarity.

We proceeded to test for cointegration for each Pacific Basin country. The results for the bivariate case are shown in Table 4.2. We use the Johansen trace statistic which has been corrected for small sample bias (see Reimers (1992)).[48] Thus, we use $(T-nk)$ in equation (4.4) instead of T. The lag length is chosen by applying the Schwarz information criterion (SIC) on the undifferenced VAR developed by Schwarz (1978). Reimers (1992) finds that the SIC does well in selecting the lag length.

Using a 5 percent significance level, we cannot reject the null hypothesis that there are zero cointegrating vectors, either for the first or the second sub-period, for all the countries except Hong Kong in the second sub-period. In the latter case the long-run cointegrating parameter α_1 in equation (4.1) is 5.488 providing support for the link between the markets based on the monetary approach to exchange rate determination. The test for excluding S_t^{PBC} from the cointegrating relationship

[46] In the case of Hong Kong the sample period has been divided into the 1980's and 1990's in order to compare possible changes in the links between the markets, which could be due to other factors, such as company information and liquidity.

[47] Lags were added in order to induce whiteness of the residuals.

[48] The trace test appears to be more robust to nonnormality of errors compared to the maximal eigenvalue (see Cheung and Lai (1993) for Monte Carlo results on this issue).

indicates that the restriction is rejected and the coefficient is statistically significant $\left[\chi^2(1)=5.34\right]$.

In order to identify the direction of causality we have performed a Wald test on the G matrix in equation (4.3). The hypothesis that the real exchange rate causes the Hong Kong stock market is rejected $\left[\chi^2(1)=2.41\right]$, whereas the hypothesis for reverse causality is strongly accepted $\left[\chi^2(1)=59.88\right]$. This finding is to be expected because of the fixed parity between the Hong Kong dollar and the U.S. dollar. Under this regime, the real exchange rate can only change due to variations in the price levels, which can be triggered, by a change in the stock market.[49] For example, considering an increase in the Hong Kong stock market and using the monetary framework that will increase wealth and the demand for real money balances, creating an excess demand for money and a fall in prices (in a full-employment economy) as agents refrain from spending to build up their balances. There is a fall in the real exchange rate, which will reverse itself in the long-run as demand for exports rises and puts pressures on domestic prices.

As explained in section 4.3.1 non-cointegrability in the previous system can arise because of the omission of an important "causing" variable, which, in the present context, is the US stock market. The results for the trivariate case for all the countries apart from Hong Kong in the second sub-period are shown in Table 4.3. Using a 5 percent significance level, we cannot reject the null hypothesis that there are zero cointegrating vectors in the first sub-period for any of the countries, both open and semi-open ones. On the other hand, the results for the second sub-period show that the hypothesis that there is one cointegrating vector in the full three-dimensional system cannot be rejected in every case. Furthermore, the null hypothesis that there is one cointegrating vector cannot be rejected for the post liberalisation period when that starts from the introduction of FCF. This confirms the results of other studies that country funds render local markets at least partially integrated. In order to save space in the rest of the analysis, we present the results for the post liberalisation sub-period when FCF is used.

[49] Under fixed exchange rates the price level differential between the domestic and foreign country should be zero if Purchasing Power Parity holds all the time. Since price convergence takes time, however, there can still be variations in the real exchange rate.

In Table 4.4, we present the long-run cointegrating vectors for the second sub-period. In every case the results show that the real exchange rate is positively related to the domestic stock market confirming the stock oriented models of exchange rate determination. The U.S. stock market is also positively related to the stock market of each Pacific Basin country providing supporting evidence for the integration of these markets with the U.S. market. In Table 4.5, we perform the test of excluding S_t^{PBC} and P_t^{US} from the cointegrating relationship. In each case the restriction is rejected, which implies that all estimated coefficients of the accepted cointegrating vectors are statistically significant.

The results from the above analysis have highlighted an interesting point. The lack of foreign exchange restrictions might be neither a necessary nor a sufficient condition for a link between foreign exchange markets and stock markets. It is not a sufficient condition because no such links were found in the first sub-period for both the bivariate and trivariate systems and for both types of markets, open and semi-open. As Bekaert and Harvey (2000) point out liberalisation may not be enough to induce foreign investors to actually invest in the country. Home bias or other concerns such as lack of information on company stocks may impede international investment (see Bekaert (1995) and Levine and Zervos (1996)). For example, Levine and Zervos (1996) have found that countries where information about firms, such as price-earnings ratios, is comprehensive and published internationally, have larger, more liquid, and more internationally integrated stock markets than countries that do not publish firm information as comprehensively and widely.

In order to examine whether this explanation bears support in our particular case, we compared the institutional features of the emerging stock markets in the two periods as presented by the indicators constructed by the International Finance Corporation (IFC). These indicators are available on an annual basis from 1986-1993 for 23 developling countries. The information is given for four of our countries: Indonesia, Malaysia, Philippines and Thailand. Comparing the indicators for 1986 and 1990, one can observe a substantial improvement in accessing market information. For example, the Securities Exchange Bulletin was only available annually or monthly for all the countries in 1986, while since 1990, this information has been made available daily. A similar picture is obtained by looking at whether local brokers or international managers prepare market commentaries in English. In

1986, only in Malaysia, international managers prepared the commentaries. By 1990, this was the case for the other three countries as well. Finally, there was no regular publication of the price-earnings ratio in Indonesia in 1986. This has been, however, available since 1990.

In general, the above evidence lends support to the proposition that access to market information is important to international investors in addition to having access to the capital market itself. The technological advances also facilitated the accessibility of information during the 1990's.[50]

The lack of differences in the results between open and semi-open markets in the second sub-period indicate that the relaxation of foreign exchange restrictions might not be a necessary condition for a link between foreign exchange and stock markets. This could be the case because substantial trade between the Pacific Basin countries and US provides a link between the economies, the cash flow of companies and thus, the stock markets. Chen and Zhang (1997) have studied the relationship between cross-country stock returns correlations and trades for Pacific Basin countries and found that countries with strong economic ties tend to have financial markets that move together.

4.3.3 *Multivariate Granger causality tests*

We examine the short-run dynamics of the system by performing multivariate Granger-causality tests. Our objective in this exercise is to test hypotheses concerning the two channels of links between stock and foreign exchange markets. Applying the methodology suggested by Dolado and Lutkepohl (1996) and outlined in section 4.2.2, we examine the "flow" channel by testing the restrictions $A_{12}(L)=0$, $A_{13}(L)=0$ and $A_{23}(L)=0$, and the "stock" channel by testing the restrictions $A_{13}(L)=0$ and $A_{21}(L)=0$ using the Wald test. In addition, we test the restriction $A_{31}(L)=0$ to examine whether there is a feedback from the Pacific Basin stock market to the US stock market.

The results are shown in Table 4.6 and cover the second sub-period. It is interesting to note that the restriction $A_{13}(L)=0$ is strongly rejected in all the cases, while the restriction $A_{31}(L)=0$ is accepted for every country. Thus, there is overwhelming evidence that the U.S. stock market is driving the Pacific Basin stock markets confirming on the one hand, the links between these economies and U.S., and on the other hand, the price leadership of the U.S. market (see Lin et al, (1994)). The U.S. market, with its dominance in the world market place, is the most influential producer of information.

The results further show the channel through which the foreign exchange and the local stock markets are linked. In Indonesia and Singapore, the markets are connected through the "flow" channel since the restrictions $A_{12}(L) = 0$, $A_{13}(L) = 0$ and $A_{23}(L) = 0$ are rejected, and in Thailand and Philippines the markets are connected through the "stock" channel since the restrictions $A_{13}(L) = 0$ and $A_{21}(L) = 0$ are rejected. For Malaysia the markets are connected through both channels since all of the above restrictions are rejected. These results imply that the type of channel is not connected to the degree of stock market openness. For example, in Indonesia, which has a semi-open stock market, the markets are connected through the "flow" channel, while in the other two semi-open economies, Thailand and Philippines, the markets are connected through the "stock" channel.

4.3.4 Tests for parameter constancy

In the last set of tests we subject our cointegrated VAR to parameter constancy tests to examine whether the financial crisis, which started with the flotation of the Thai Bhat in July 1997, had an effect on the relationship between the stock and foreign exchange markets. We applied the recursive estimation suggested by Hansen and Johansen (1998) and examined first the null hypothesis of constancy of the cointegrating space for a given rank. The base period varies for each country, depending on the introduction of FCF, but ends in 1994.12 and the extension is done by adding the succeeding observations one by one until the end of the sample, which is 1998.12. The likelihood ratio test, which compares the likelihood function from each recursive sub-sample with the likelihood function under the restriction that the cointegrating vector estimated from the full sample falls within the space spanned by the estimated vectors of each individual sample, has been scaled by the 95 percent

[50] See e.g. US Brady Commission (1988).

quantile in the χ^2- distribution such that unity corresponds to a test with a 5 percent significance level.

Figures 4.1a to 4.6a show the path of the test statistics for each of the countries. For Hong Kong and Philippines the null hypothesis of parameter constancy cannot be rejected.[51] There is some instability around the time of the crisis, but the statistic remains well below one. For the rest of the countries the increase in the statistic is such that passes unity substantially and that is more so in the case of Thailand and Indonesia.[52,53] For all the countries, apart from Indonesia, the statistic falls below one by February 1998, while in the case of Indonesia that takes place in February and then it rises again for the month of June before settling down. This brief increase is noticed in the other countries as well but the statistic remains below one. This increase could be due to the Russian crisis, which shook confidence again in emerging markets.

Figures 4.1b to 4.6b show the time path of the eigenvalues with 95 percent confidence bands. Apart from Hong Kong and Philippines there is a change during the period of the crisis. It is also observed that the point estimates increase resulting in bigger parameter estimates compared to the rest of the period.

The above results confirm that the hardest hit countries by the crisis were Indonesia and Thailand. The effect did not last for long and the long-run relationships between stock and foreign exchange markets was soon reestablished. That confirms the return of foreign funds to these countries. Net private capital flows to Asia were $102 billion in 1996, 38.5 in 1997, and an estimated 1.5 in 1998 and 58.8 in 1999.[54] Finally, the results show the increase in links between stock and foreign exchange currency returns during a crisis and confirm the results of studies, which examine intermarket relationships around the international market crash of October 1987.[55] These studies generally suggest that intermarket relationships intensified for a brief

[51] It should be noted that a specific alternative is not formulated and that the recursive analysis should be seen as a misspecification test where the purpose is to detect possible instabilities in the parameters.

[52] The parameter constancy tests for Hong Kong refer to the bivariate case.

[53] In the case of Thailand the "R" representation and in the case Singapore the "Z" representation are marginally higher than unity in the first few months of 1995. Had the level of significance been 1 percent the null hypothesis of parameter constancy would have been accepted.

[54] See World Economic Outlook (May, 1998), IMF.

[55] See e.g. Dwyer and Hafer, (1988), Hardouvelis (1988) and Roll (1989).

period around the crash, but then quickly resumed their normal pre-crash period relationships.

4.4 Summary and conclusions

In this paper, we have examined the long-run and short-run dynamics between stock prices and exchange rates in a group of Pacific Basin countries. Our main concerns were to examine whether these links were affected by the existence of foreign exchange controls, and especially foreign ownership restrictions, and by the Asian financial crisis of mid 1997.

We have examined these issues by applying cointegration methodology, which tests for a long-run relationship between the stock market in each Pacific Basin country, its real exchange rate, and the US stock market, and we have used recursive-based estimation to test for parameter constancy. We performed multivariate Granger Causality tests to study further the interactions between the various markets.

The following conclusions have been derived from our analysis:

First, we found no long-run relationship between the real exchange rate and the local stock market in each Pacific Basin country for either the decade of the 1980's, or the decade of the 1990's, with the exception of Hong Kong. These cointegration and causality inferences are however invalid because the system is shown to be incomplete.

Secondly, the U.S. stock market is found to be an important "causing" variable, which acts as a conduit through which the foreign exchange and the local markets are linked. The results of the trivariate system suggest that for all the countries the real exchange rate and the U.S. stock prices are positively related to domestic stock prices for the period of the 1990's.

Thirdly, foreign exchange restrictions have not been found to be an important determinant of the link between the domestic stock and foreign exchange markets on the one hand, and between the domestic capital and world capital markets on the other hand. Free capital flow is not sufficient for international investment, access to market information is also important. Links between markets can also be fostered through other channels. This latter result supports the evidence presented in other studies (see e.g. Phylaktis (1997, 1999), which have found for the shorter end of financial instruments that there is substantial capital market integration between the Pacific-

Basin Region and U.S. during the 1990's even for countries with extensive foreign exchange controls. The open character of these economies in terms of exports and imports and the substantial trade with U.S. provides a possible explanation for these results. A country's external trade to another country measures the degree of economic integration between them and the degree of how much the two economies' cash flows are intertwined. Thus, financial integration can be closely related to economic integration. In addition, the analysis has provided evidence that Country Funds may offer a way to foreign investors for accessing local markets and increasing their integration with global markets even in the presence of foreign exchange restrictions. Our results are at variance with Bekaert and Harvey (1998b), who have also made an attempt to date the integration of emerging markets with world markets by looking for common break in the process generating the financial time series, which are likely to be related to the integration process. They included four of the countries in our sample, Malaysia, Indonesia, Philippines and Thailand. For Indonesia and Malaysia, the breaks found are much latter than either the official liberalisation date or the introduction of the FCF. For Philippines, the dividend yield series presents the earliest break and is very close to the FCF date, while for Thailand, U.S. equity flows to market capitalisation has the earliest break and is close to the official liberalisation date. A possible explanation for the different results between our study and Bekaert and Harvey (1998b) might be the fact that our analysis is done within a better defined framework.

Fourthly, the results of the multivariate causality tests indicate that on the whole, the US stock market drives the system confirming the influence of the US on these economies. They also show the channel through which this influence brings together the foreign exchange and local stock markets. The channel has been found not to be connected to the degree of stock market openness.

Finally, the parameter constancy tests indicate that the increase in the parameters during the height of the Asian crisis was short lived and confirm that Indonesia and Thailand were badly affected. These results are in agreement with other studies which have studied the October 1987 crash and found that intermarket relationships intensified for a brief period around the crash, but then quickly resumed their normal pre-crash period relationship.

In conclusion, the analysis indicates that care should be taken in implementing exchange rate policies since stock and foreign exchange markets are closely linked.

Furthermore, it indicates that the existence of foreign exchange restrictions does not isolate the domestic capital markets from world influences. The general increase in international trade and the resultant increase in economic integration have also increased financial integration and reduced the benefit of international diversification.

Tables

Table 4.1.1: Comparison of different signals of liberalisation

Country	Official Liberalisation date	First Country Fund	First ADR
Hong Kong	01.73[a]	-	-
Indonesia	09.89[b]	02.89[b]	04.91[e]
Malaysia	12.88[b]	12.87[b]	08.92[b]
Philippines	06.91[c]	05.86[b]	03.91[b]
Singapore	06.78[a]	-	-
Thailand	09.87[d]	07.85[b]	01.91[b]

Source:
[a] Exchange Arrangements and Restrictions, IMF publications, (various issues).
[b] Bekaert and Harvey (1998a) and coincides with the International Finance Corporation (IFC) official liberalisation date, which is based on the Investable Index and represents the ratio of the market capitalisation of stocks that foreigners can legally hold to market capitalisation. A large jump in the Index is considered as evidence of an official liberalisation.
[c] Bekaert, and Harvey (2000). The date is in accord with the Foreign Investment Act, which removed, over a period of three years, all restrictions on foreign investments. Under the provisions, foreign investors are required only to register with the Securities and Exchange Commission and most sectors of the economy are opened to 100 percent foreign ownership. This date differs from the IFC official liberalisation date, which is October 1989, and is not associated with any particular regulatory changes.
[d] Bekaert and Harvey (2000). This date is in accord with the inauguration of the Stock Exchange of Thailand's Alien Board, which allows foreigners to trade stocks of those companies that have reached their foreign investment limits. Thais continue to trade stocks on the Main Board. Bailey and Jagtiani, (1994) report the same liberalisation date. This date differs, however, from the IFC liberalisation date, which is December 1988, and is not associated with any particular regulatory changes.
[e] Bekaert and Harvey (2000). In Bekaert and Harvey (1998a) 02.1992 is reported as the first ADR.

Table 4.1.2: Emerging stock markets - Direct and indirect barriers for institutional investors (end-1989)

	Foreign ownership Limit	Dividends Repatriation	Capital Repatriation	Withholding Taxes on Dividend	Taxes on Capital Gains
Hong Kong	100%	Free	Free	0.0%	0.0%
Indonesia	49%[a]	Free	Free	20.0%	20.0%
Malaysia	100%[b]	Free	Free	35%(0%)	0.0%
Philippines[c]	40%[d]	Free	Free	15.0%	0.25%
Singapore	100%	Free	Free	0.0%	0.0%
Thailand	49% (25%)[e]	Free[f]	Free	20%(10)	25%(10)

Source: The table is based on the information provided in the IFC' s Factbook, Harrison (1994), the Euromoney Annual Report and the Exchange Arrangements and Restrictions, IMF. All the data are as of end-1989. Rates shown in brackets apply only to approved new money Country Funds, where these may be different from normal treatment.

[a] The limit is reduced to 25% of own capital for foreign exchange banks and non-bank financial institutions.
[b] Foreign acquisition of investments exceeding M$ 5 million in value or equivalent of 15% or more of voting power in a Malaysian company requires the prior approval of the Foreign

Investment Committee. In September 1998, the financial markets were completely closed to foreigners.
[c] Transaction taxes on gross transaction value.
[d] Foreign nationals may purchase shares up to 40% of a company's shares via B shares. Foreign participation beyond 40% needs to have prior approval by the Board of Investment (BOI). Investment not exceeding 40% need simply to be reported to BOI and the Central Bank of the Philippines for purposes of repatriation of capital and remittance of profits.
[e] Foreign investors are allowed to hold up to 49% of companies listed on the SET with the exception of the commercial banks and finance companies, where foreign ownership is restricted to 25% of the capital.
[f] A report is required for the repatriation of dividends and capital gains.
[g] Foreign ownership restriction of up to 10% of market capitalisation for "non-limited" industries and of up to 8% of market capitalisation for "limited" industries.
[h] The repatriation of initial capital, capital gains and dividend is subject to approval by the Ministry of Finance.
[i] Of net capital gains or gross sales proceeds, respectively.
[l] Foreign investors who open an account in a local brokerage house may only invest in three listed funds – Kwang Hua Growth Fund, NITC Fuyuan Fund and Citizen Fund. Domestic residents are allowed to remit outwards up to US$5 million per annum.

Table 4.2: Bivariate Cointegration tests

	Johansen test statistics	
	H_0:r = 0	H_0:r ≤ 1
Hong Kong		
Jan1981-Dec1989(IFC)	1.71	0.22
Jan1990-Dec1998(IFC)	54.73**	6.13
Indonesia		
May1983-Jan1989(FCF)	9.18	1.91
May1983-Aug1989(IFC)	4.57	0.74
Feb1989-Dec1998(FCF)	6.06	0.20
Sep1989-Dec1998(IFC)	5.25	0.00
Malaysia		
Jan1980-Nov1987(FCF)	2.49	0.27
Jan1980-Nov1988(IFC)	4.57	0.87
Dec1987-Dec1998(FCF)	4.13	1.14
Dec1988-Dec1998(IFC)	3.39	0.49
Philippines		
May1986-Dec1998(FCF)	10.40	0.08
June1991-Dec1998(IFC)	4.70	0.19
Singapore		
Jan1990-Dec1998(IFC)	13.84	1.53
Thailand		
Jan1980-May1985(FCF)	7.64	3.01
Jan1980-Aug1987(IFC)	6.46	0.38
June1985-Dec1998(FCF)	3.37	0.18
Sep1987-Dec1998(IFC)	1.52	0.00

Notes: In the case of Hong Kong, a dummy variable was used, which took the value of one for the period 1997.01-1998.12 to capture the unification with China. If r denotes the number of significant vectors, then the Johansen trace statistics test the hypotheses of at most one and zero cointegrating vectors, respectively. The critical values introduced by Osterwalt-Lenum (1992) were used. The only exception is for Hong Kong, where the critical values have been re-evaluated by applying a Monte Carlo Simulation, repeated 10,000 times for a number of 400 observations, using the program DiSco, in order to consider the presence of the dummy. The statistics include a finite sample correction (see Reimers (1992)). * and ** denote significance at 10 % and 5% level respectively. IFC indicates International Financial Corporation liberalisation date; and FCF indicates the date for the introduction of the First Country Fund.

Table 4.3: Trivariate Cointegration tests

	Johansen test statistics		
	H_0:r = 0	H_0:r ≤ 1	H_0:r ≤ 2
Hong Kong			
Jan1981-Dec1989(IFC)	17.18	7.70	0.01
Indonesia			
May1983-Jan1989(FCF)	18.35	5.57	1.87
May1983-Aug1989(IFC)	12.68	4.37	0.67
Feb1989-Dec1998(FCF)	36.72**	15.64	5.47
Sep1989-Dec1998(IFC)	34.93**	13.82	4.14
Malaysia			
Jan1980-Nov1987(FCF)	15.64	4.57	0.55
Jan1980-Nov1988(IFC)	13.48	6.00	0.63
Dec1987-Dec1998(FCF)	41.28**	16.78	3.36
Dec1988-Dec1998(IFC)	25.61**	3.46	0.00
Philippines			
May1986-Dec1998(FCF)	43.07**	17.18	3.48
June1991-Dec1998(IFC)	35.09**	8.57	3.18
Singapore			
Jan1990-Dec1998(IFC)	41.05**	15.96	5.00
Thailand			
Jan1980-May1985(FCF)	20.66	11.03	3.42
Jan1980-Aug1987(IFC)	19.77	7.23	0.05
June1985-Dec1998(FCF)	34.91**	15.30	6.16
Sep1987-Dec1998(IFC)	41.41**	16.70	5.72

Notes: If r denotes the number of significant vectors, then the Johansen trace statistics test the hypotheses of at most two, one and zero cointegrating vectors, respectively. The critical values introduced by Osterwalt-Lenum (1992) were used. The statistics include a finite sample correction (see Reimers (1992)). * and ** denote significance at 10 % and 5% level respectively. IFC indicates International Financial Corporation liberalisation date; and FCF indicates the date for the introduction of the First Country Fund.

Table 4.4 : The long-run cointegrating vector of $P_t^{PBC} = \alpha_0 + \alpha_1 S_t^{PBC} + \alpha_2 P_t^{US} + v_t$ for the post-liberalisation period starting with the introduction of the First Country Fund.

	α_0	α_1	α_2
Indonesia Feb1989-Dec1998	10.561	1.635	1.361
Malaysia Dec1987-Dec1998	2.427	3.823	1.320
Philippines May1986-Dec1998	9.601	2.600	0.674
Singapore Jan1990-Dec1998	3.884	3.443	0.576
Thailand June1985-Dec1998	17.971	6.510	1.617

Table 4.5: Test of exclusion restrictions for S_t^{PBC} and P_t^{US}

	S_t^{PBC}	P_t^{US}
Indonesia Feb1989-Dec1998	6.40**	8.19**
Malaysia Dec1987-Dec1998	4.24**	8.10**
Philippines May1986-Dec1998	9.35**	6.84**
Singapore Jan1990-Dec1998	4.14**	6.20**
Thailand June1985-Dec1998	4.40**	6.91**

Notes: Figures are χ^2 statistics with one degree of freedom. ** denotes significance at 5%.

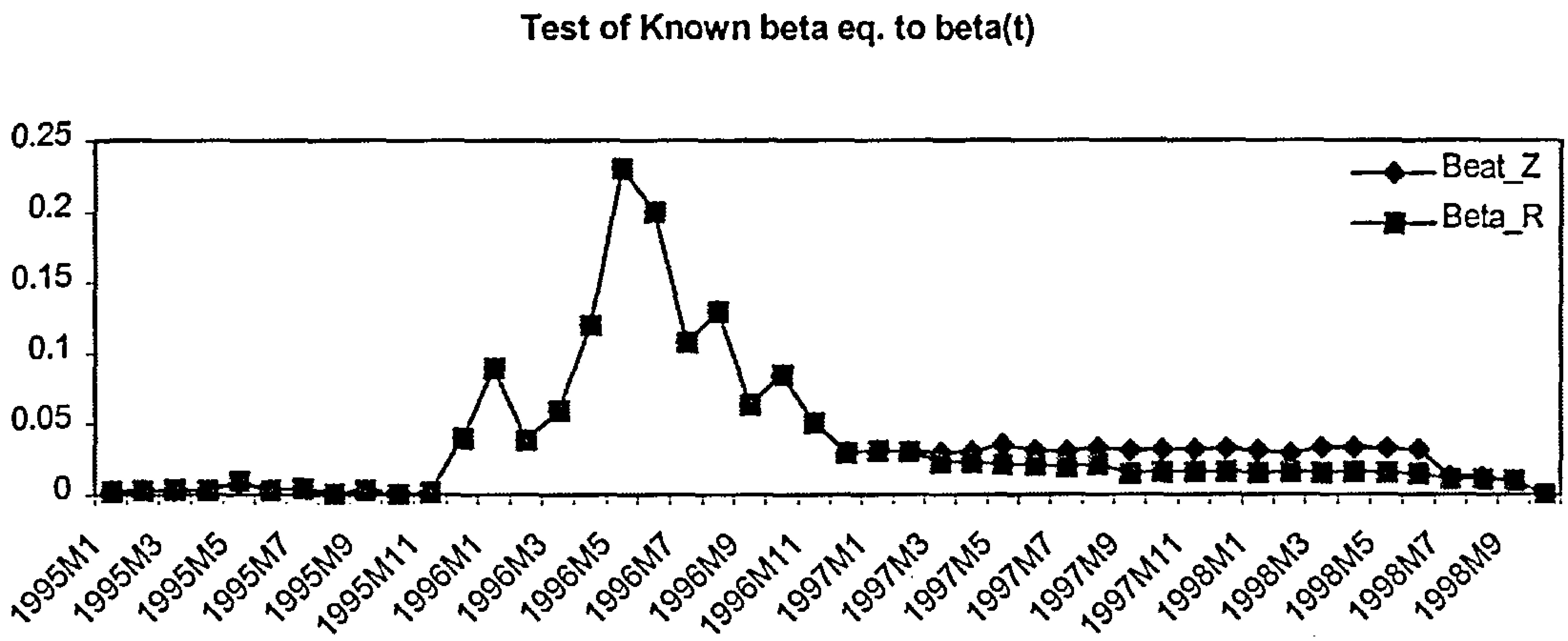
Table 4.6: Multivariate Granger Causality Tests for the post-liberalisation period starting with the introduction of the First Country Fund.

	$A_{12}(L)=0$	$A_{13}(L)=0$	$A_{21}(L)=0$	$A_{23}(L)=0$	$A_{31}(L)=0$
Indonesia	8.376**	12.006**	0.990	4.677*	4.161
Feb89-Dec98	(0.01)	(0.00)	(0.38)	(0.09)	(0.13)
Malaysia	14.336**	31.315**	15.787**	7.096**	2.800
Dec87-Dec98	(0.00)	(0.00)	(0.00)	(0.03)	(0.25)
Philippines	5.909*	19.001**	6.349**	6.545**	12.729**
Ma86-Dec98	(0.052)	(0.00)	(0.042)	(0.04)	(0.00)
Singapore	5.772*	49.036**	1.342	10.873**	3.578
Jan90-Dec98	(0.055)	(0.000)	(0.511)	(0.004)	(0.17)
Thailand	7.775**	35.875**	5.452*	3.351	3.460
Jun85-Dec98	(0.02)	(0.00)	(0.06)	(0.187)	(0.18)

Notes: For an explanation of the restrictions see equation (4.6). Each estimated statistic is distributed as a $\chi^2(2)$. Between paranteses the corresponding p-values are reported. Figures in parentheses are P-values. * and ** denote significance at 10% and 5% level respectively.

Figures

Figure 4.1a: Hong Kong



1 is the 5% significance level

Figure 4.1b: Hong Kong

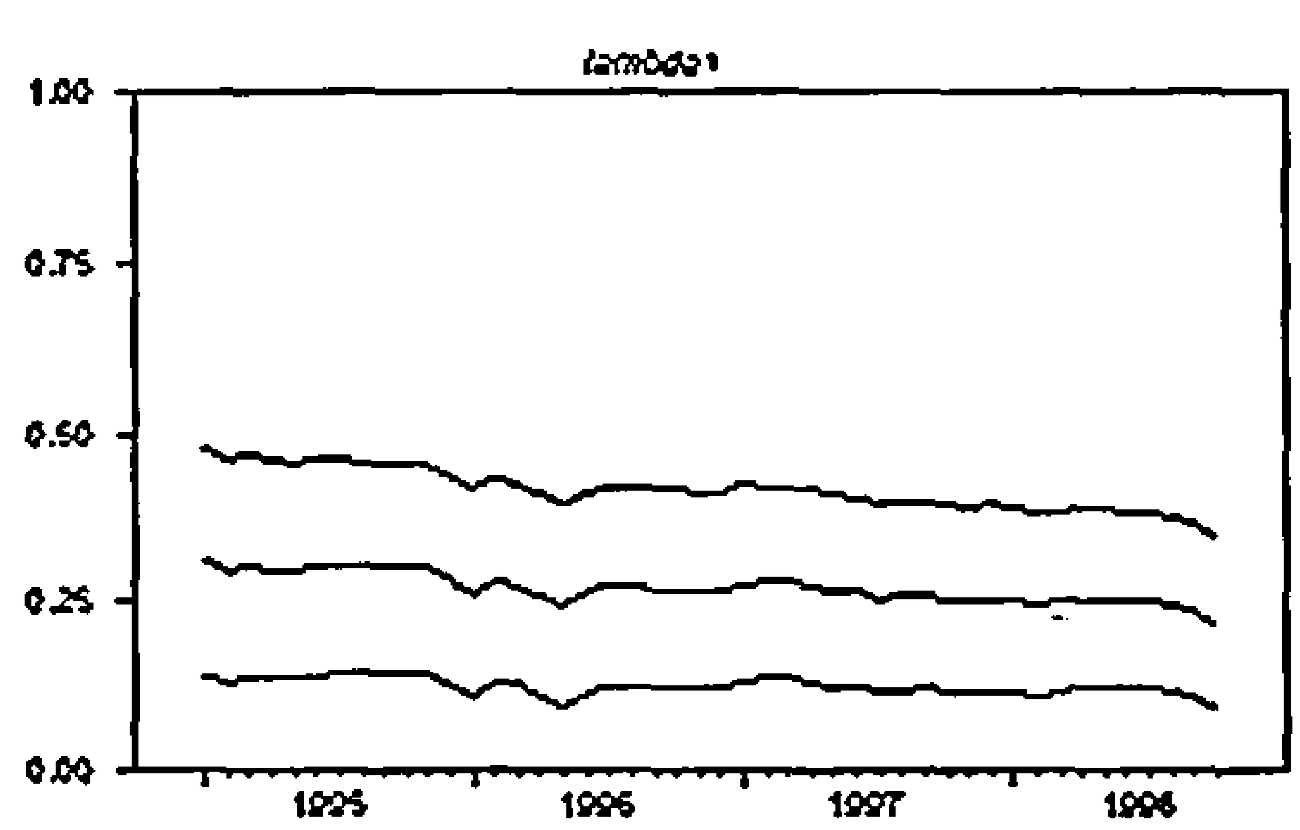
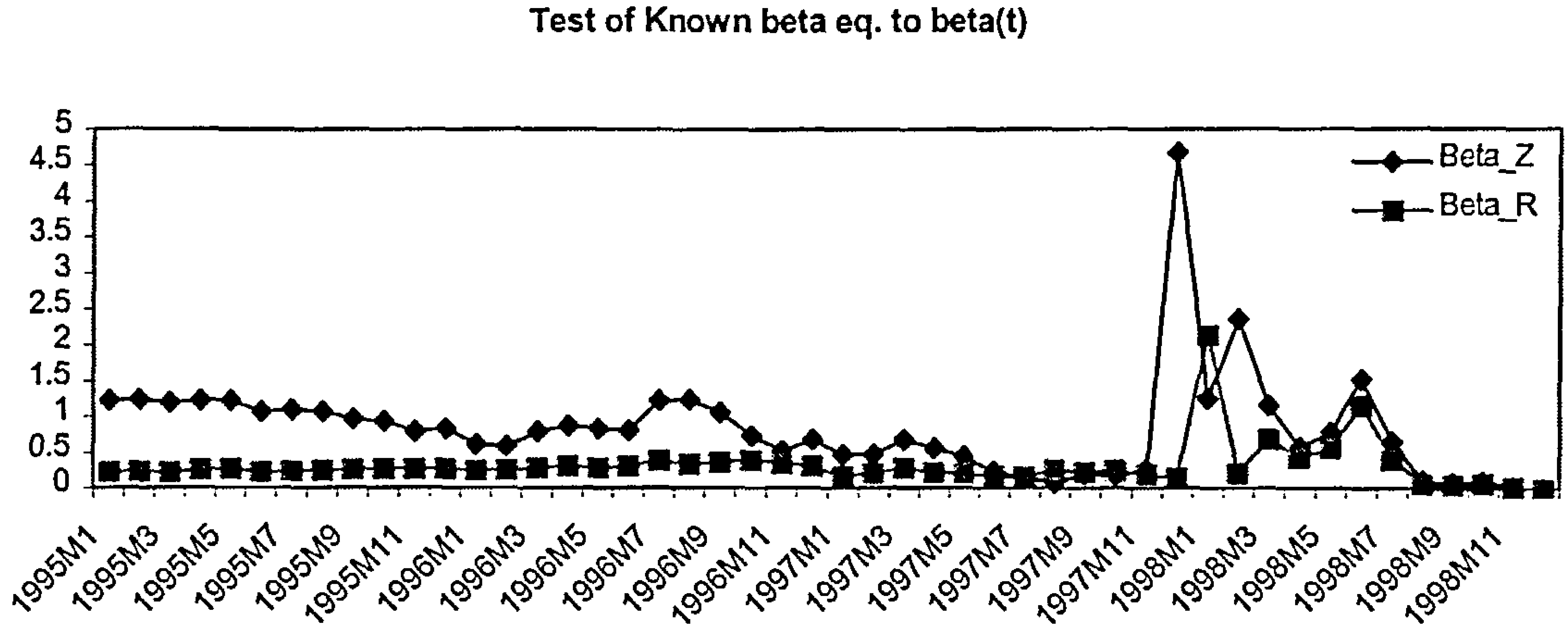


Figure 4.2a: Indonesia



1 is the 5% significance level

Figure 4.2b: Indonesia

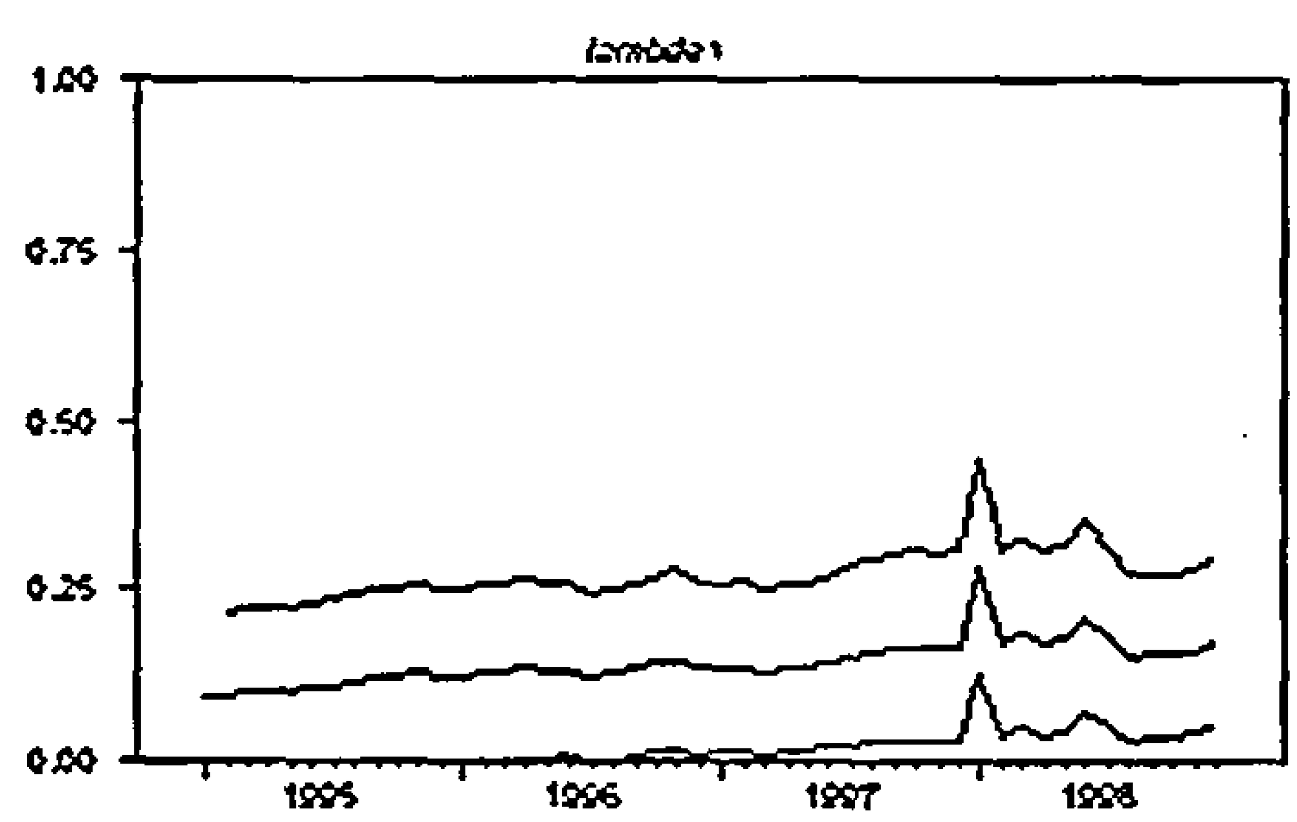
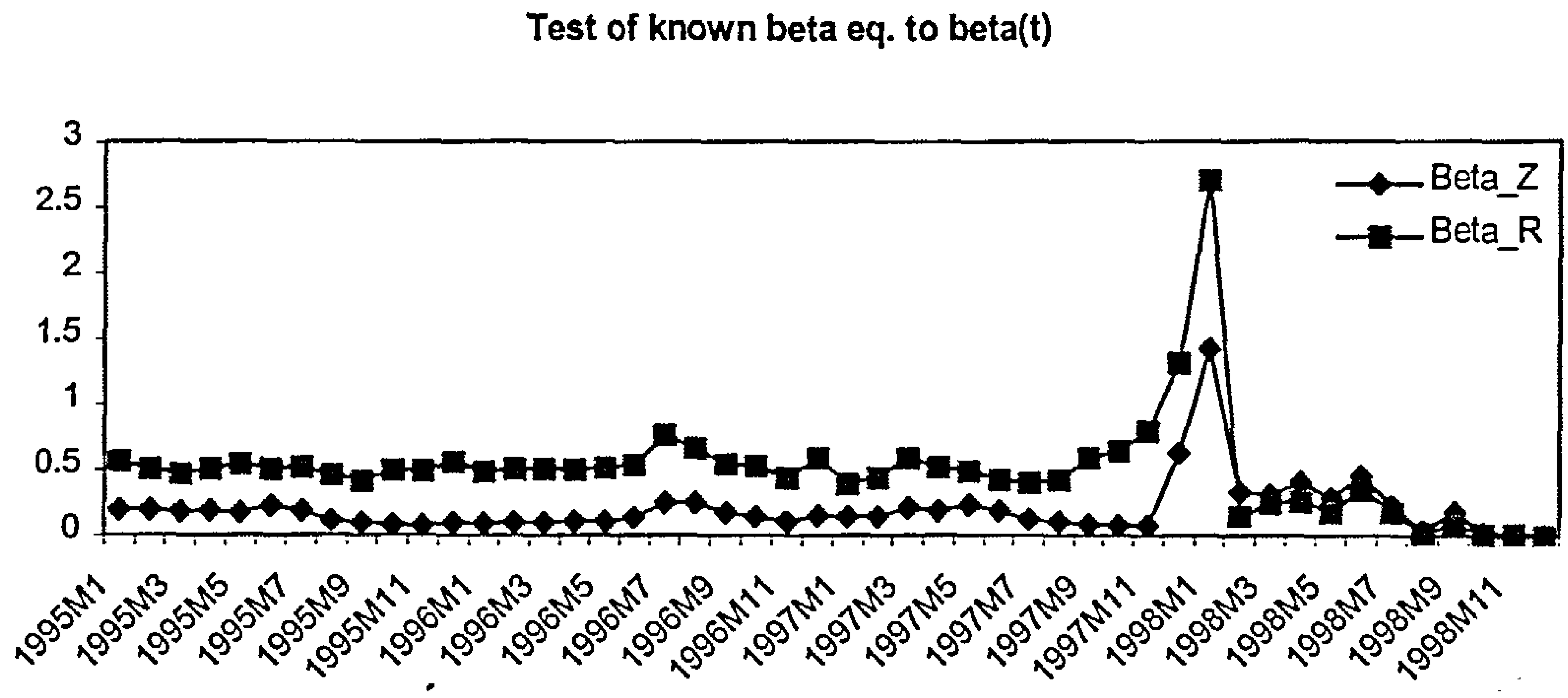


Figure 4.3a: Malaysia



1 is the 5% significance level

Figure 4.3b: Malaysia

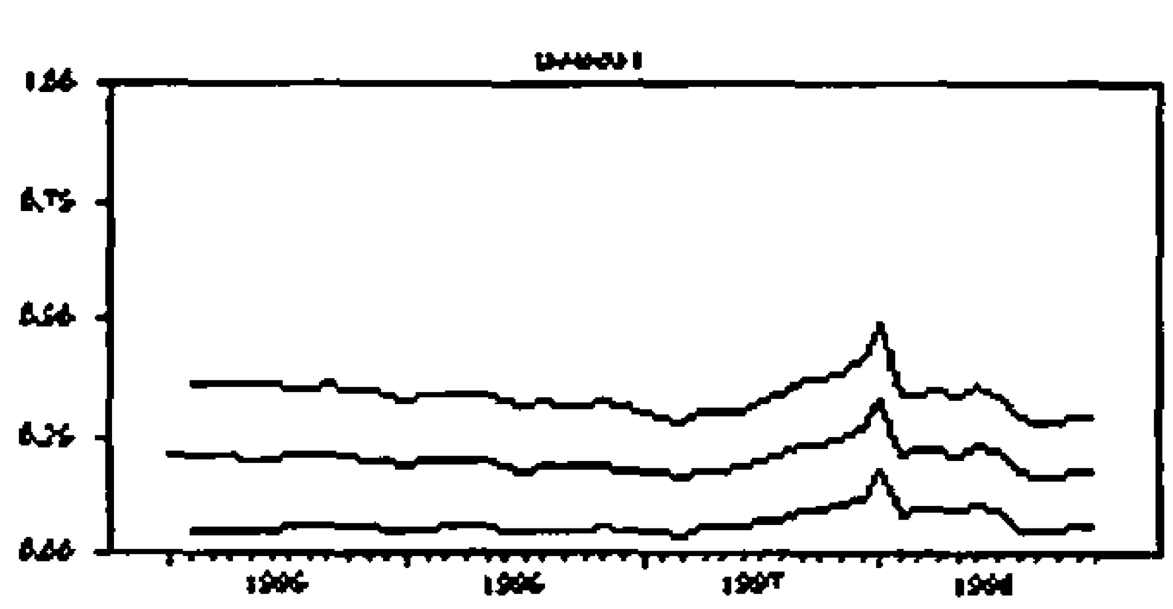
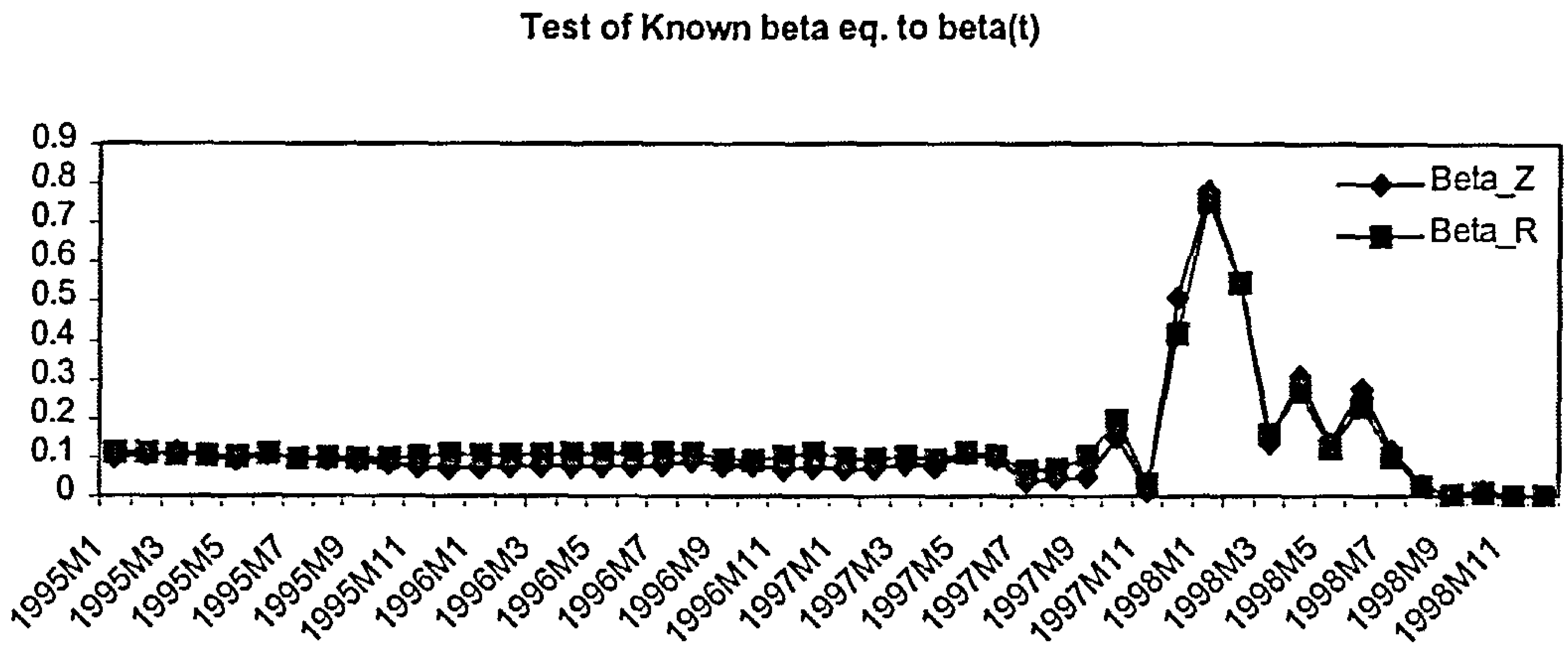


Figure 4.4a: Philippines



1 is the 5% significance level

Figure 4.4b: Philippines

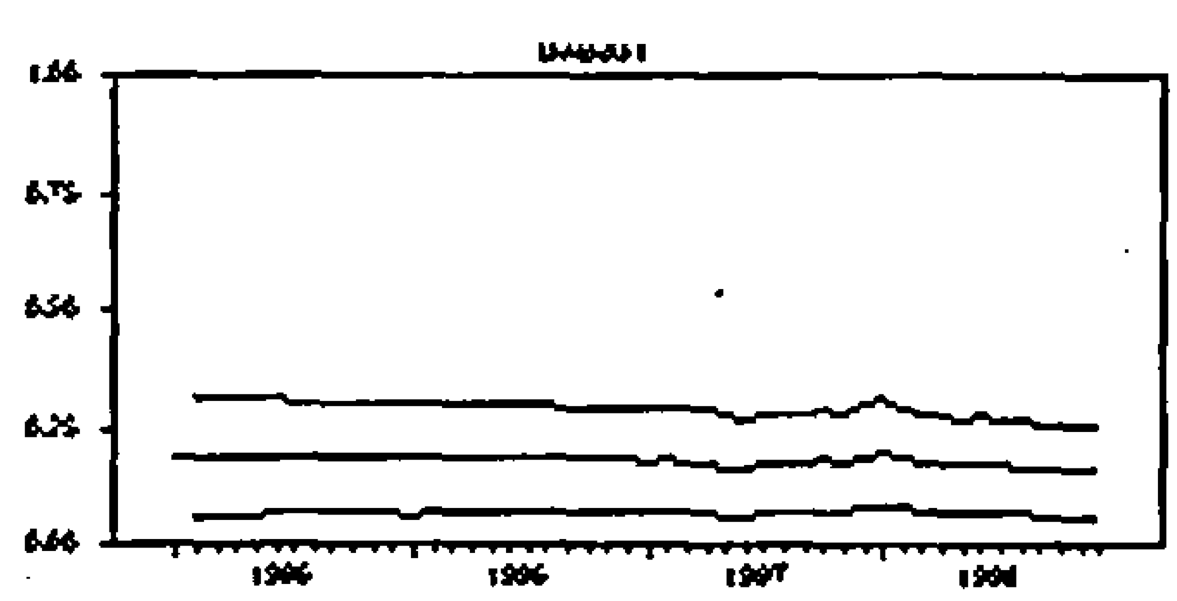
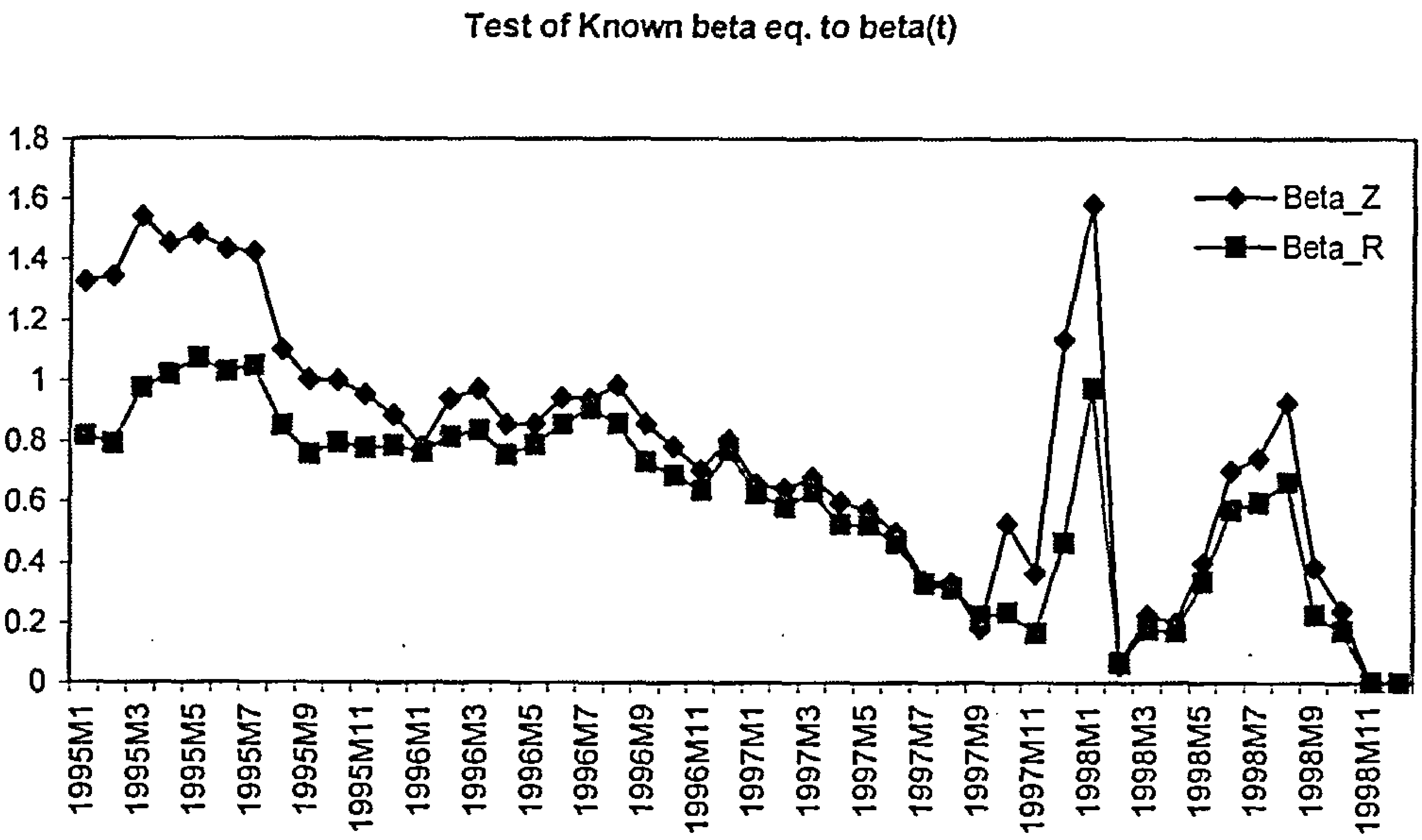


Figure 4.5a: Singapore



1 is the 5% significance level

Figure 4.5b: Singapore

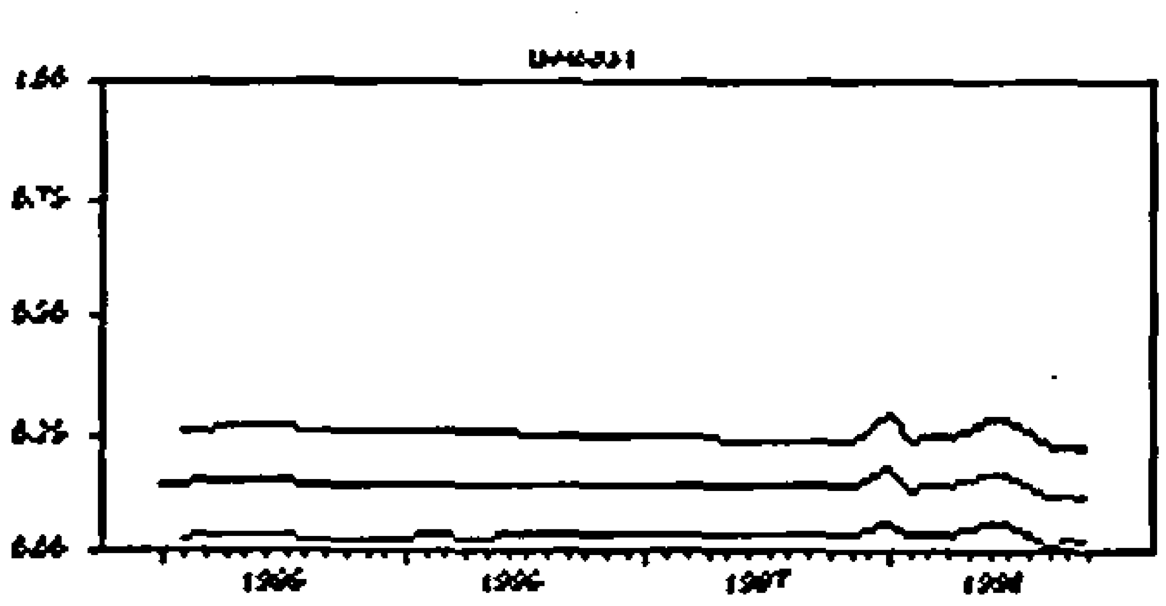
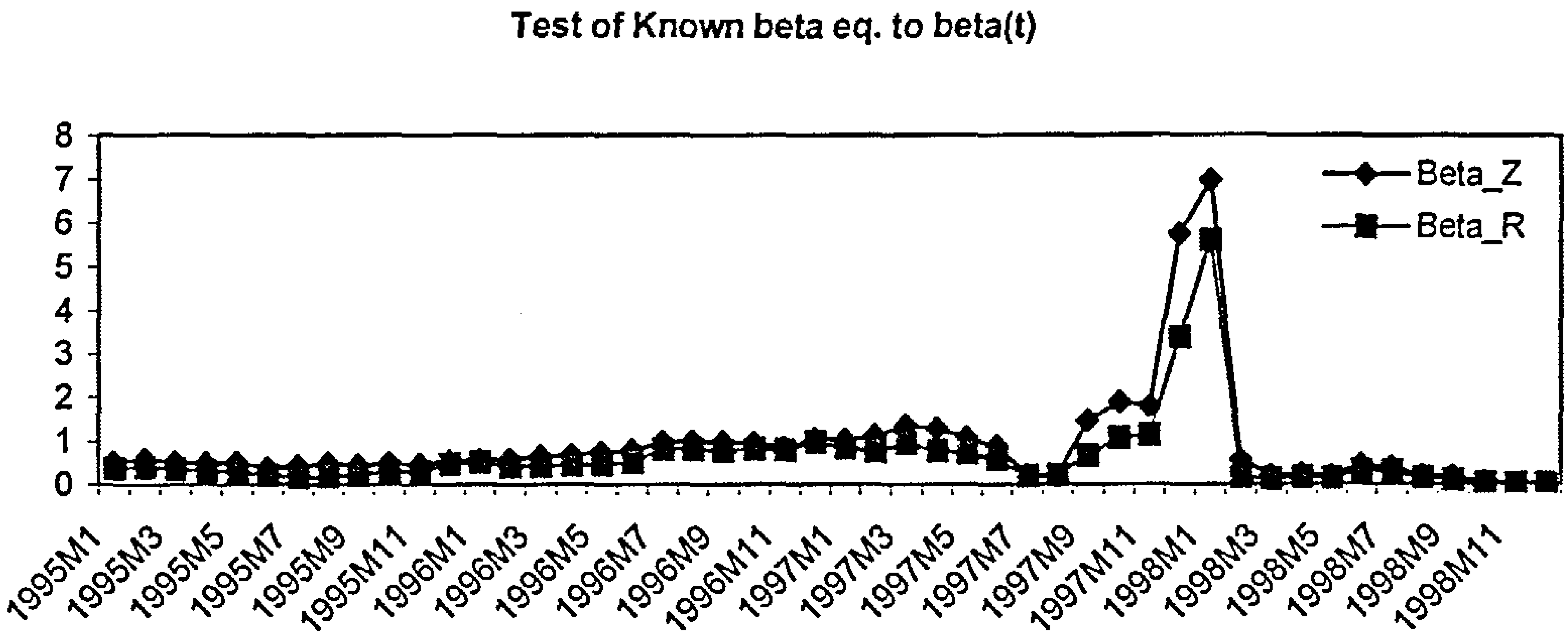
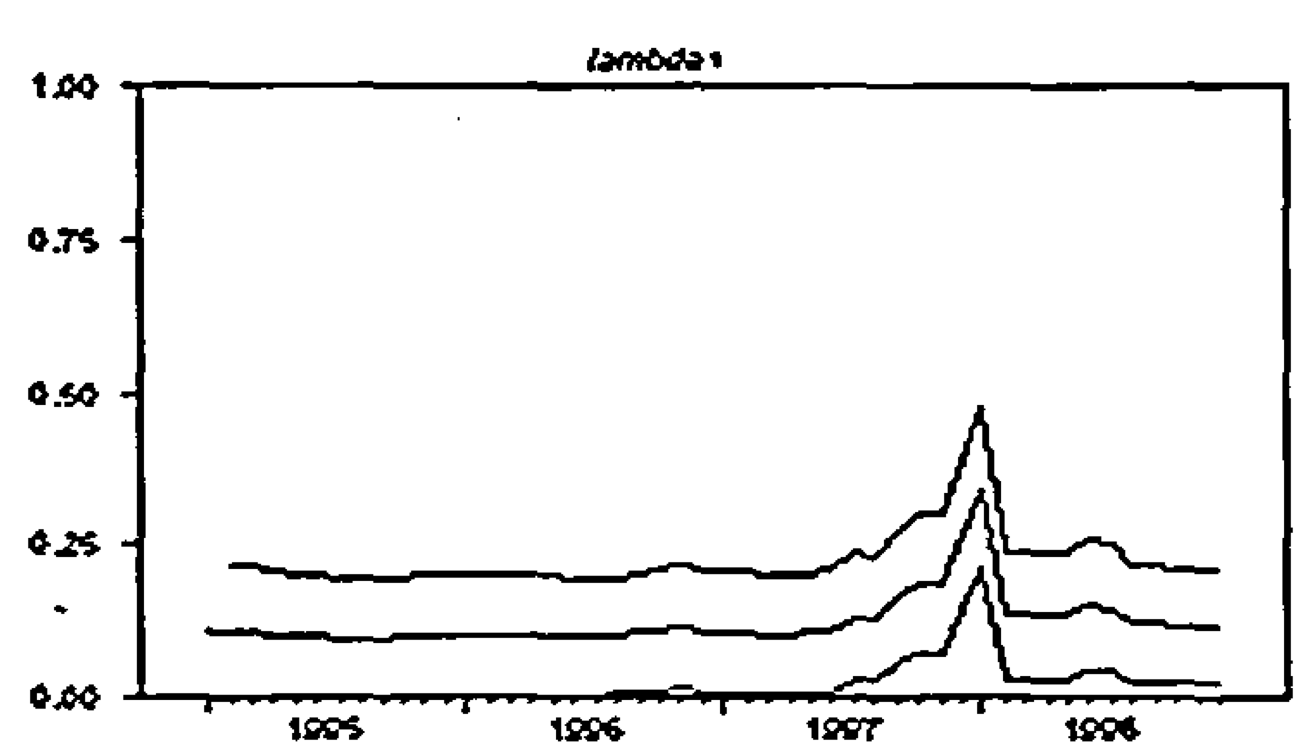


Figure 4.6a: Thailand



1 is the 5% significance level

Figure 4.6b: Thailand



CHAPTER FIVE

STOCK MARKET LINKAGES IN EMERGING MARKETS: IMPLICATION FOR INTERNATIONAL PORTFOLIO DIVERSIFICATION

5.1 *Introduction*

Financial literature has presented a strong emphasis on the interaction amongst international stock markets. The interest has increased considerably following the abolition of foreign exchange controls in both mature and emerging markets, the technological developments in communications and trading systems, and the introduction of innovative financial products, such as Country Funds and American Depository Receipts, which have created more opportunities for global international investments. In particular, the new remunerative emerging equity markets have attracted the attention of international fund managers as an opportunity for portfolio diversification and have also intensified the curiosity of academics in exploring international market linkages.[56]

The earliest studies on international stock market integration have focused on the identification of short-term benefits of international portfolio diversification. For example, Levy and Sarnat (1970) and Solnik (1974), examined short-term correlations of returns across national markets and pointed out the existence of substantial possibilities to diversify internationally. More recently, Eun and Shim (1989), Hamao et al. (1990), Koch and Koch (1991), Roll (1992), Longin and Solnik (1995), exploited more sophisticated econometric techniques to measure cross-country correlations, and found evidence of significant linkages between stock markets around the world. Other studies have focused on the evolution of integration of emerging capital markets. Studies such as Harvey (1995a), but particularly Bekaert and Harvey (1995), examined one period returns and the conditional means and variances of one period returns by examining a one factor asset-pricing model, which did not assume the degree of segmentation to be constant through time. They allowed conditionally expected returns in a country to be affected by their covariance with a world benchmark portfolio and by the variance of the country returns. If the market was perfectly integrated then only covariance counted, while if the market was completely segmented then the variance was the relevant measure of market risk. Bekaert and Harvey (1995) used a conditional regime-switching model to account for periods when national markets were segmented from world capital markets and when they became integrated later in the sample.

[56] See e.g. Hawawini (1994) for evidence on the increasing flow of funds to new capital markets and the importance of these markets to portfolio management.

Other studies have measured financial integration (see the paper of Chapter 6) by analysing the covariance of excess returns on national stock markets of emerging economies. A major advantage of this framework is that by examining the comovement of future returns aggregated over a long horizon instead of the comovement of one period expected returns one can detect small but persistent movements in expected returns and more accurately measure the degree of financial integration than one period stock return regression models.

Another group of studies has concentrated on examining financial links amongst stock markets by using either bivariate or multivariate cointegration methodology. Taylor and Tonks (1989) were the first to apply bivariate cointegration on the UK and U.S. markets to test the importance of the latter after the abolition of foreign exchange controls in 1979; while Kasa (1992) was the first to apply multivariate cointegration method to five well-established financial markets in order to estimate the permanent and transitory components of stock price series and examine the existence of a single common stochastic trend as a driver of the cointegrated system. When markets share a single common stochastic trend, then this means that these markets present substantial financial linkages.

In the current study, we apply Kasa's (1992) approach and examine the potential inter-relationships amongst the trending behaviour of the stock price indices of a group of Pacific-Basin countries, Japan and U.S. These capital markets have attracted a substantial proportion of international capital flows to emerging markets. In 1996, 48 percent of net private capital flows to all emerging market economies[57] was directed to the Asian[58] capital markets. Our analysis is conducted in the light of Richards' (1995) comments on the selection of the correct order of VAR systems; and the use of a more sophisticated technique in the estimation of the common stochastic trend system, which is equivalent to the permanent component of stock prices, as recommended by Gonzalo and Granger (1995). Richards (1995) criticised Kasa (1992) for using extra lags to capture the possible effect of mean reversion in equity

[57] See "World Economic Outlook", (October 1999) published by the International Monetary Fund. In the source, net capital flows comprise net direct investment, net portfolio investment, and other long- and short-term net investment flows, including official and private borrowing. Emerging markets include developing countries, countries in transition, and Korea, Singapore, Taiwan Province of China, and Israel. Data for Hong Kong are not available.

[58] It includes the economies of Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand.

prices and make the error terms from the VARs more consistent with the Gaussian/i.i.d. assumption under which the Johansen methodology is derived. He noted that serial correlation was not present in the lower order VARs estimated by Kasa and that the inclusion of extra lags to remove the non-normality of residuals was inappropriate if changes in stock prices were fundamentally fat-tailed or otherwise non-normal. He suggested the use of the Akaike and Schwartz information criteria, (AIC) and (SIC) respectively, for the selection of the correct order VAR systems.[59] In fact, when he repeated Kasa's estimation and in addition corrected for small sample bias, number of variables and lags as recommended by Reimers (1992) and Gregory (1994), he found that the five stock markets were not cointegrated in contrast to the results of Kasa that there were four cointegrating vectors and one single common stochastic trend.

As mentioned before the multivariate cointegration analysis will be applied in the current paper to a group of Pacific-Basin countries and the U.S. In particular, the objective is to identify how the financial links have evolved during the 1980s and 1990s and whether they bear any relationship to the existence of foreign exchange restrictions.[60] As Bekaert and Harvey (2000) point out liberalisation may not be enough to induce foreign investors to actually invest in the country. Home bias or other concerns, such as lack of information on company stocks, may impede international investment.[61] On the other hand, economic integration between countries may provide a channel for financial integration even in the presence of foreign exchange controls.[62] Integration between countries implies a comovement in their output, corporate earnings and consequently in their stock markets.[63]

We will be examining the financial links of these markets by estimating the multivariate cointegration model in both the autoregressive and moving average forms. The autoregressive form allows us to examine the long-run relationships of

[59] Reimers (1992) finds also that the SIC does well in selecting the lag length.

[60] In linking the statistical concept of cointegration with capital market integration we are assuming that the same model of required returns applies to all assets regardless of where they are traded.

[61] See also Levine and Zervos (1996).

[62] Support for this proposition can be found in the work included in Chapter 6. In fact, the study indicates overwhelming evidence that economic integration always accompanies financial integration.

[63] The long-run positive relationship between economic activity and stock prices has been confirmed theoretically and empirically (see e.g. Cheung and Ng (1998), Canova and DeNicole (1995), Roll (1992), and Schwert (1990)).

these markets, and the moving average form the potential drivers of the system. Finally, we apply the recursive analysis to the cointegrating system developed by Hansen and Johansen (1998) in order to identify the evolution of integration of these capital markets during the 1980s and 1990s. That constitutes a novel approach to examining this issue. The same technique allows us to examine the effects of the Asian crisis of mid 1997 on the financial integration of the region.

The analysis in the paper has implications for international portfolio diversification. If a Pacific Rim market is cointegrated with the world market portfolio (in our study proxied by U.S. and Japan), this means that international investors are holding the considered market. This is because they gain portfolio diversification benefits from this investment. However, exploiting portfolio diversification opportunities by holding the Pacific Basin market, they contribute to an increase of its financial links with the world market portfolio. Therefore, the presence of cointegration indicates the existence of financial linkages amongst the analysed markets mainly driven by international investors exploiting portfolio diversification opportunities. In addition, the methodology used in this paper, that is the moving average representation of the multivariate cointegration model, allows also to estimate the transitory component of each market and explore possible short-term diversification benefits. When decomposing time series into permanent and transitory components, if the permanent component is far away from the time series suggesting that the transitory is more important, then international investors might exploit short-term opportunities. In fact, the substantial contribution of the transitory component can be related to the fact that speed of adjustment to equilibrium is slow, therefore speculators may gain benefits based on the forecast that the market will revert to its long term relationship with world market, but really slowly.

The paper is structured as follows. Section 5.2 explains the multivariate cointegration model in autoregressive (AR) and moving average (MA) forms. It also introduces the recursive-based method to test for the evolution of integration. Section 5.3 reports the empirical results of the analysis of the cointegration space and the complementary common trend system. The final section summarises the main findings and offers some concluding remarks.

5.2 The multivariate cointegration model

5.2.1 The autoregressive (AR) representation

Financial literature affirms that stock price levels are non-stationary. In operating with non-stationary variables one can focus on the first differences of time series and apply the basic regression analysis to study potential links between their short-term movements. Otherwise, one can use the cointegration technique, introduced by Granger (1981) and developed by Engle and Granger (1987), to analyse relationships amongst series, overcoming the problem of non-stationarity and allowing the investigation into both the levels and first differences of stock prices.

In the current study, we apply the multivariate cointegration analysis of Johansen (1988, 1991) to investigate for integration amongst a group of stock price levels by looking for the existence of potential linear combinations amongst them.

Consider a vector Y_t that contains p variables. If all p variables are integrated of order one, I(1), then the VAR(k) model can be written in the error-correction form as

(5.1) $$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-i} + \mu + \theta D_t + \varepsilon_t,$$

where k is the order of the VAR system; μ is a vector of constants; D_t is a vector of seasonal dummies orthogonal to the constant; and ε_t is *i.i.d.* errors. The matrix Π, in equation (5.1) is defined as $\alpha\beta'$, where α and β are $(p \times r)$ matrices; it has rank equal to r; and it can be written as $\Pi = -(I - A_1 - \ldots - A_k)$; and the matrix $\Gamma_i = -(I - A_1 - \ldots - A_i)$, with $i = 1, .., k$.

As shown in Johansen and Juselius (1990), the estimation procedure is simplified by reformulating model (5.1) as

(5.2) $R_{0t} = \alpha\beta' R_{1t} + \text{error}, \quad t = 1, \ldots, T.$

The vector R_{0t} and R_{1t} obtained as residuals from the auxiliary regressions

(5.3) $$\Delta Y_t = \hat{B}_1 \Delta z_{t-1} + \hat{B}_2 D_t + R_{0t}$$

and

(5.4) $$Y_{t-1} = \hat{B}_3 \Delta z_{t-1} + \hat{B}_4 D_t + R_{1t},$$

where B_1, B_2, B_3 and B_4 are estimated by ordinary least squares regressions. The maximum likelihood estimator of β is found by solving the equation

(5.5) $$\left|\lambda S_{11} - S_{10} S_{00}^{-1} S_{01}\right| = 0,$$

which gives the eigenvalues $\hat{\lambda}_1 \succ ... \succ \hat{\lambda}_p$ and the corresponding eigenvectors $\hat{V} = (\hat{v}_1,...,\hat{v}_p)$ normalized such that $\hat{V}'S_{11}\hat{V} = I$. The matrices S_{11}, S_{10} and S_{00} are appropriately defined covariance matrices (for further details, see Johansen and Juselius (1990)). The eigenvalues $\hat{\lambda}_i$ correspond to the squared canonical correlations between the "levels" residuals and the "difference" residuals, as defined above. The eigenvectors $\hat{v}_i$ determine the linear combinations $\hat{v}_i'z_t$, i =1, k-1.

The Johansen likelihood ratio test statistic of the null hypothesis that there are at most r cointegrating vectors $0 \leq r \leq p$, and thus (p-r) common stochastic trends is

(5.6) $$\text{trace} = -T \sum_{i=r+1}^{p} \ln(1-\hat{\lambda}_i),$$

where $\hat{\lambda}_i$'s are the p-r smallest squared canonical correlations as described above.

In this study, we define Y_t as composed of p elements, which represent the stock price levels of a selected group of financial markets.[64] We perform the Johansen Likelihood ratio test to verify if a system of p variables is cointegrated and identify the number of linear combinations they share. We perform the exclusion statistic tests on the coefficients of the cointegrating vectors related to each variable to diagnose if each stock market is participating to the cointegration space. The rejection of the null hypothesis of exclusion of the variable from the cointegration space, confirms the existence of integration amongst the variables of the system. In case of acceptance of the null hypothesis, we conclude the absence of cointegration amongst the analysed variables and therefore lack of integration amongst the select stock price indices.[65] The test statistic presents a χ^2 distribution with r degrees of freedom.

5.2.2 The recursive estimation of the trace test statistics

The selection of the cointegrating rank is one of the most sensitive steps in the cointegration analysis. Stepthon and Larsen (1991) have shown that Johansen's test may be characterised by sample dependency. This is specifically relevant to our study for two reasons. First, the liberalisation of the capital markets could have attracted the

[64] The data representing the stock price indices are transformed by natural logarithms.

interest of international investors and affected the amount of capital inflows to that market inducing an increase in the degree of integration with the rest of the financial world. Secondly, the Asian financial crisis in mid 1997 might have temporarily affected the links amongst international stock markets, as previously verified by work on the 1987 stock market crash and the Mexican crisis (see e.g. Dwyer and Hafer (1988), Hardouvelis (1988), King and Wadhwani (1990), and Roll (1989) on the 1987 crash; and Calvo and Reinhard (1996) on the Mexican crisis). Moreover, the application of this analysis could be exploited to identify when integration started and whether that coincided with events on liberalisation.

We apply the recursive estimation suggested by Hansen and Johansen (1998) in the estimation of cointegrated VAR models, using estimates from the Johansen FIML technique under two VAR representations. In the "Z-representation" all the parameters of VECM are re-estimated during the recursions, while under the "R-representation" the short-run parameters are kept fixed to their full sample values and only the long-run parameters are re-estimated.

We perform the trace tests to visually inspect the time path of these statistics and identify potential changes in the rank r over time or during "crisis" periods. From equation (5.6) each Trace test is calculated as

$$(5.7)\quad \text{Trace}_j = T\sum_{i=j}^{p}\ln(1-\hat{\lambda}_i)\ ,\ \ j = 1, \ldots, p\text{-}1,$$

and each statistic is scaled by the 90% quantile of the trace distribution derived for the select model.[66] For a specific t, we identify the rank r as the number of Trace_j statistics presenting an upward slope and above the critical value of one, which indicates the 10 percent statistical significance.

5.2.3 The moving average (MA) representation of cointegrated systems

The study of a cointegrated system can be conducted in a dual way. This is because of a direct relationship between the number of stationary relations, r, of a p-dimension system, and the number of linearly independent non-stationary relations, p-

[65] It should be noted that this exclusion tests on the coefficients of the cointegrating vectors were not presented by Kasa (1992) and as a result it is not clear whether all markets contributed to the cointegration space.

[66] The model does not include exogenous variables or dummies. In case of inclusion of these variables the critical value has to be computed again.

r, defined as common trends. As introduced by Stock and Watson (1988), if a cointegrated system of p variables present r linear combinations, then the p components share p-r common trends.

The duality between the number of cointegration relations and common trends is useful for a full understanding of the generating mechanism of our system of financial variables. While the autoregressive form is informative about the long-run relationships amongst the variables, which is useful in identifying if a group of financial markets is integrated, the moving average form is informative about the underlying stochastic and deterministic trends and helpful in recognizing the components driving the system.

The moving average representation of model (5.1) is given by

(5.8) $\Delta Y_t = C(L)(\varepsilon_t + \mu + \phi D_t)$,

where C(L) can be developed as $C(L) = C(1) + (1\text{-}L)\tilde{C}(L)$, (see Engle and Granger (1987)). In integrated form (5.8) is given by

(5.9) $Y_t = Y_0 + C\sum_{i=1}^{t}\varepsilon_i + C\mu t + C\sum_{i=1}^{t}\phi D_i + \tilde{C}(L)(\varepsilon_t + \phi D_t)$,

where $C = C(1)$ and $\tilde{C}(L) = (1\text{-}L)^{-1}[C(L)\text{-}C(1)]$.

As shown in Johansen (1991) the link to the AR form of the model is given by

(5.10) $C = \beta_\perp(\alpha_\perp'(-I + \Gamma_1)\beta_\perp)^{-1}\alpha_\perp'$,

where $\alpha_\perp$ and $\beta_\perp$ are the orthogonal complements of α and β, respectively. The matrix $\alpha_\perp$, of order $p \times (p\text{-}r)$, reports the coefficients of the common trends indicating the contribution of each component to the stochastic vector; and the matrix $\beta_\perp$, of order $p \times (p\text{-}r)$, includes the loading factors indicating the effect of each common trend on each variable. The matrix C determines how the non-stationary part of the process Y_t is generated from the underlying stochastic and deterministic trends.[67]

Gonzalo and Granger (1995) show that the matrix C also identifies the permanent component of a system. A simple decomposition of Y_t into its transitory and common trend components based on the estimators from the cointegration tests, is

(5.11) $Y_t = \alpha(\beta'\alpha)^{-1}X_t + \beta_\perp(\alpha_\perp'\beta_\perp)^{-1}Z_t$,

[67] From equation (5.1) it is easy to verify that the choice of variables in D_t can affect the statistical description of the trend component in Y_t. To make sure that there are no seasonal trend effects in the model, in case there are fixed seasonal effects in the data, we use centered seasonal dummies.

where $X_t = \beta' Y_t$ is defined as the stationary or transitory process (which is actually the deviation from the cointegration relationship), $Z_t = \alpha_\perp' Y_t$ is defined as the non-stationary permanent component.[68] Gonzalo and Granger (1995) demonstrated that this non-stationary permanent component in the decomposition (5.11) corresponds to the common trend of the Stock-Watson decomposition through the Wold representation of ΔY_t,

(5.12) $\Delta Y_t = C(L)\varepsilon_t = C(1)\,\varepsilon_t + \Delta\tilde{C}(L)\varepsilon_t$,

where C(1) is defined as in equation (5.10) for the model (5.1) and $\tilde{C}(L)$ is defined as in equation (5.9).[69]

In our analysis, we estimate the moving average representation of the cointegrated system in order to investigate the non-stationary or permanent component, which drives the set of capital markets in the long-run.

5.3 The empirical evidence of integration

5.3.1 Data

The sample of countries examined in the paper includes: Japan, U.S., Hong Kong, South Korea, Malaysia, Singapore, Taiwan and Thailand.[70] The sample period covers from January 1980 to December 1998. The data consist of end of the month observations of stock market index prices (1990=100) expressed in domestic currency. The data were obtained from *Datastream*. The stock market index prices used are as follows: the Hang Seng Price Index for Hong Kong; the Nikkei 225 for Japan; the Korean Stock Exchange composite for Korea; the Kuala Lumpur Stock Exchange Composite Price Index for Malaysia; the Singapore Straits Times Price Index for Singapore; the Taiwan Stock Exchange weighted - price index for Taiwan; the Bangkok S.E.T. Price Index for Thailand; and the Standard and Poor's 500 Composition Index for the U.S.

---

68 See also Park (1990) for a similar decomposition of Y_t.

69 It should be noted that this correspondence applies by imposing the condition that the permanent component is a linear combination of the variables and that the transitory component does not have any permanent effect on the variables.

70 It was our intention to include Indonesia and the Philippines as well. However, because data were available only from May 1983 for Indonesia and January 1986 for the Philippines, we excluded these two countries.

The analysis in the paper was repeated using stock price indices expressed in local currencies, in U.S. dollars and in real U.S. dollars (named real terms in the rest of the paper). The logarithm of stock market index price expressed in U.S. dollars was computed as $\ln P_t^i - \ln ex_t^{PBC}$, where P_t^i was the stock market index price for country i, and ex_t^{PBC} was the nominal exchange rate defined as local currency per U.S. dollar. The logarithm of stock market index price expressed in U.S. dollars and in real terms was defined as $\ln P_t^i - \ln ex_t^{PBC} - \ln CPI_t^{US}$, where P_t^i is defined as above and CPI_t^{US} is the U.S. consumer price index. [71]

5.3.2 *Criteria for selecting potential groups of integrated stock markets*

In capital market integration analysis one expects to obtain strong links amongst capital markets that enjoy a high degree of openness. However, previous studies on international linkages have found surprising results. For instance, Bekaert and Harvey (1995) when analysing the time-varying integration of twelve emerging markets for the period December 1975 to the end of 1992, found that some markets appeared more integrated than one might have expected based on prior knowledge of investment restrictions.[72] Moreover, the work included in Chapter 4, which focuses on the analysis of potential linkages between stock prices and exchange rate dynamics of the PBCs, shows lack of integration during the eighties for the free financial markets of Hong Kong and Singapore. In contrast, the same study shows that markets were integrated during the nineties even in countries such as Indonesia, Philippines and Thailand, where capital markets still had foreign exchange restrictions. This evidence underlines the fact that capital market liberalisation is neither a necessary nor a sufficient condition for capital market integration and that other factors might exert an effect, such as information availability, accounting standards, and investor protection; and specific emerging equity market risks, such as liquidity, political or currency risks (see Bekaert (1995)). At the same time, there can also be a situation in which foreign investors use alternative vehicles, such as Country Funds, to enter equity markets with foreign restrictions.

[71] Calculating the stock market index in U.S. dollars eliminates the location inflation. However, the U.S. inflation remains in the stock price level.
[72] For instance the Korea, Taiwan and Thailand markets.

Based on these observations we select the group of countries to analyse for the presence of integration by adopting the following criteria. First, we select the free capital markets. In the case where integration is absent amongst these markets and the ones of Japan and the U.S., we use an alternative criterion. We consider equity markets in which foreign ownership restrictions are still in existence, but have alternative financial vehicles to allow foreign investors to invest in them. Bekaert and Harvey (2000), Bekaert (1995) and Chang, Eun and Kolodny (1995) suggest Country Funds as an alternative channel for entering restricted capital markets.

Information regarding the date of official liberalisation as reported by the International Finance Corporation (IFC) and the date of the First Country Fund (FCF) and American Depository Receipts (ADRs) is given in Table 5.1. The IFC date is based on the Investibility index, which represents the ratio of the market capitalisation of stocks that foreigners can legally hold to total market capitalisation. A large jump in the Index is evidence of an official liberalisation. What is clear is that all countries had either liberalised or started the process of liberalisation by the beginning of the 1990's.[73] Thus, dividing the sample period into two sub-periods, the pre-liberalisation ending in December 1989, and the post-liberalisation sub-period covering the period between January 1990 and December 1998, seems appropriate for examining the effect of stock market liberalisation on financial links between the countries. It should be noted that in the case of favourable results to closer financial linkages the application of recursive estimation will provide us with further details of the evolution over time.

5.3.3 *The analysis of the cointegration space*

Before testing for cointegration we tested for unit roots in all stock market indices expressed in local currencies, in U.S. dollars, and in real terms. The results are not presented but can be made available by the authors. We used the Augmented Dickey Fuller test with and without trend as recommended by Engle and Granger (1987) and the Phillips and Perron (1988) test again with and without trend. We found that the null hypothesis of a unit root for the first difference can be rejected for all series. On the other hand, the null hypothesis of a unit root in levels was accepted

[73] Table 5.1 gives also the extent of some of the main direct and indirect barriers at the end of 1989.

in all cases.[74] Thus, like most financial series, the stock market levels are I(1), which means that first differencing is required to achieve stationarity.

We proceeded to test for cointegration for the selected group of Pacific Basin stock markets and the financial markets of Japan and the U.S. We use the Johansen trace statistic, which is corrected for small sample bias (see Reimers (1992)).[75] Thus, we use *(T - pk)* in equation (5.6) instead of T. The lag length was one and was chosen by applying the (AIC) and (SIC) on the undifferenced VAR models.[76]

We started our investigation by testing for the presence of cointegration for the period 1980 to 1989 amongst all the Pacific Basin capital markets of our sample, i.e. Hong Kong, Korea, Malaysia, Singapore, Taiwan, Thailand and the established financial markets of Japan and the U.S. The analysis was performed for three different cases: the stock price indices expressed in U.S. dollars, the stock price indices expressed in U.S. dollars and deflated by the U.S. consumer price index as has been used by Kasa (1992) and the stock price indices expressed in local currency. The results of the Johansen trace tests are reported in panel A of Table 5.2 and suggest the selection of two cointegrating vectors for the system when indices are expressed in U.S. dollars and one cointegrating vector for the systems when indices are expressed in real terms and local currency. The results of the exclusion tests are reported in panel B of Table 5.2 and show that when indices are expressed in U.S. dollars the stock markets of Hong Kong, Malaysia and Thailand can be excluded from the system, or in others words they do not participate to the cointegration space. The exclusion tests for the system when indices are expressed in real terms show that only Taiwan and Japan cannot be excluded from the cointegration space; and finally the results of the exclusion tests for the system when the indices are expressed in local currency show that only Korea and Taiwan cannot be excluded from the cointegration space. Thus, the findings indicate lack of integration amongst the group of Pacific Basin capital markets of Hong Kong, Korea, Malaysia, Singapore, Taiwan, Thailand and the developed equity markets of Japan and U.S. in all three cases.

We proceeded the analysis by selecting smaller groups of capital markets to investigate for the presence of cointegration using the criteria discussed in section

[74] Lags were added in order to induce whiteness of the residuals.
[75] The trace test appears to be more robust to nonnormality of errors compared to the maximal eigenvalue (see Cheung and Lai (1993) for Monte Carlo results on this issue).
[76] To test the sensitivity of the results to the selection of k the analysis was repeated by using higher number of lags. We obtained similar results to the ones of a lower-order VAR system.

5.3.2.[77] We tested first to see whether the open equity markets of Hong Kong, Malaysia, and Singapore are cointegrated with Japan and U.S. The results of the Johansen trace tests are reported in panel A of Table 5.3 and show lack of cointegration amongst this group of countries. Since the openness of the Malaysian capital market only started in the late eighties and might have affected the cointegration results amongst the considered group of countries, we repeated the tests including only the countries of Hong Kong, Singapore, Japan and the U.S. In this case also the results do not reveal stock market linkages. The exclusion tests reported in panel B of Table 5.3, show that not all capital markets enter into the cointegration space highlighting an interesting point, namely that the lack of foreign exchange restrictions might not be a sufficient condition for a link amongst stock markets. A possible explanation might lie with the existence of *de facto* barriers that discourage foreign investors in entering into these financial markets e.g. lack of sufficient information, as suggested by Levine and Zervos (1996), and specific country risks, such as the liquidity risk, as noted by Chuhan (1994).

We next adopted an alternative criterion in the selection of potential countries for integration as discussed in section 5.3.2. We selected the countries of Korea, Taiwan and Thailand as potential candidates for financial integration because they had Country Funds from the middle of the eighties, which allowed foreigners to invest in their markets. The results of the trace statistics, when considering the system of five markets of Korea, Taiwan, Thailand, Japan and the U.S., show the presence of one cointegrating vector (see panel A, Table 5.4). However, the exclusion tests, reported in panel B of the same Table, indicate the acceptance of the exclusion test for the variable corresponding to the Korean stock price index. This may indicate that the lack of cointegration of this system of five variables could be due to the presence of the Korean capital market. Therefore, we repeated the analysis excluding the Korean market. The trace tests reported in panel A of Table 5.4, indicate the presence of one cointegrating vector and the exclusion tests, reported in panel B of Table 5.4, show that all four countries participate in the cointegration space and therefore that the capital markets of Taiwan, Thailand, Japan and U.S. are integrated during the

[77] For the sub-groups we present and discuss the results only for the case in which stock price indices are expressed in U.S. dollars. The findings for the alternative definitions present strong similarities.

eighties. These findings underline the importance of Country Funds as a channel for international investors to enter highly regulated capital markets.[78]

We continued our analysis by computing the trace statistics and exclusion tests for the subperiod 1990 to 1998 for the same groups of countries, which were considered for the subperiod 1980 to 1989. The finding for all countries, is given for indices expressed in US dollars, in real terms and in local currencies; for the groups of open countries; and for the groups of the semi-open countries are (see panels A and B of Table 5.5, 5.6 and 5.7 respectively). While for this period also there is lack of cointegration amongst the group of all countries, we found cointegration for the group of open countries, which were found not to be cointegrated during the eighties, and the group of semi-open countries. Furthermore, there is a general increase in the number of cointegrating vectors shared by the semi-open economies. The capital markets of Taiwan, Thailand, Japan and US, which were sharing one cointegrating vector and three common trends in the pre-liberalisation period, now, in the post-liberalization period, share three cointegrating vectors and only one common trend. This is an indicator of the increased degree of integration of these capital markets during the most recent period of more open capital markets.

Based on this evidence, we continued our analysis and performed the recursive estimation of the group of countries presenting the highest integration since the early eighties, namely that consisting of Taiwan, Thailand, Japan and the U.S.

5.3.3 The recursive trace test statistics

We examine the time path of the trace statistics recursively estimated to find when exactly integration amongst Taiwan, Thailand, Japan and the U.S. started. As described in section 5.2.3, each trace statistics is scaled by the 90% quantile of the trace distribution derived for the model. The number of trace statistics showing an upward behavior and above the critical value of one, indicates the number r of cointegrating vectors shared by the cointegrated system.

Figures 5.1.a reports these statistics for the period 1980 to 1989. Only one trace statistic presents an upward trend in the period of the analysis and that assumes a

[78] An interesting point is that the capital markets of Taiwan, and Thailand present turnover ratios in some cases higher than the ones of the Japanese and U.S. stock markets (see Appendix 5.1 for details). This confirms that institutional investors, where possible, are

value just above one at the end of the 1985, beginning of 1986. It considerably increased in the second half of 1986. This indicates that the integration of these countries started between the end of 1985 and the middle of 1986. This period corresponds to the introduction of the First Country Fund for Thailand (July 1985) and of the three Country Funds for Taiwan (May 1986). Thus, the analysis indicates that financial links with world markets increased with the introduction of a vehicle of investment, which was accessible to foreign investors.

Looking now at the recursive estimation during the nineties we observe one statistic to be above one for the full period of the nineties and another two statistics to have an upward behaviour and reach the line of one at the beginning of the 1996 (see figure 5.1.b). Thus, during the Asian crisis of mid 1997 and the post-crisis period the graph still indicates the presence of three statistics above one. This evidence suggests that these countries were strongly financially integrated in the period preceding the crisis and that the Asian crisis did not have a substantial effect on the financial integration of these capital markets.[79] It is interesting to note that the R(t) representation, which keeps short-run dynamics constant, shows similar evidence confirming the lack of even short-run effects on the analysis.

In conclusion, the recursive analysis suggests that First Country Funds have been an important channel for international investors to enter equity markets, in which foreign ownership restrictions are still in existence. In particular, it shows that integration started in the period of the introduction of the First Country Funds. Furthermore, it shows that the Asian crisis of mid 1997 had a small effect, if any, on the financial links.

5.3.4 The analysis of common trends

We estimate the moving average process of a cointegrated system in order to investigate the non-stationary common trend or permanent component, which drives our set of capital markets. We conduct the analysis by considering the two subperiods of 1980 to 1989 and 1990 to 1998 in order to investigate possible changes in the potential driver of the system.

---

interested in investing in highly liquid markets, even when there are access limitations to equity markets. This fact has also been underlined by Chuhan (1994).

The system of the capital markets of Taiwan, Thailand, Japan and U.S share one cointegrating vector and three common trends during the period of 1980-89. The estimation of the common trend mechanism for this subperiod is reported in Table 5.8, where panel A indicates the estimated coefficients of each common trend; and panel B the loading factors for each common trend. Looking at panel A, we can identify that the Thai stock market provides the major contribution to the first common trend, while the United States and Japan to the second and third common trends, respectively. Focusing on panel B, which reports the loading factors of each common trend, we can note that for all common trends, the Taiwanese stock market reacts most to common trend movements followed by the Thai and the Japanese stock markets. In contrast, the stock price index of the U.S. is the least affected by common trend comovements.

For the period 1990 to 1998 the same group of countries share three cointegrating vectors and one common trend. The results of the estimated common trend system are reported in Table 5.9. Panel A indicates that the only common trend shared by the group of countries is dominated equally by the Thai and Japanese stock markets. In contrast, Taiwan is the stock market most affected by this common stochastic trend. If we make the normalisation that the sum of the common trend coefficients sum to unity then we see that the Thai and Japanese stock markets receive a weight of about 41 percent, while the U.S. market has a share of only 17 percent. These results are somewhat surprising because they do not reflect relative market capitalisation. For instance, at the end of 1995 the market capitalisation was 187,206 US$ million for Taiwan; 141,507 US$ million for Thailand; 3,667,292 US$ million for Japan and 6,857,622 US$ million for U.S.

A different approach to investigate the relative importance of the trend to the various markets during this period is to compare the plots of the permanent component of each market, which corresponds to the common trend as shown by Gonzalo and Granger (1995), and the actual stock price behaviour. The plots are presented in Figures 5.2 to 5.5.[80] As it is suggested by the weights in the common trend, the trend or permanent component tracks closely the stock market behaviour in

[79] The study of Chapter 6 shows also that these markets were strongly financially integrated in the period preceding the crisis. This substantial degree of integration may have been the cause of the generation of the contagion effect in 1997.

[80] It should be noted that the trend may lie consistently above or below the stock price series because the stock price indices are in different units.

Thailand and Japan throughout the period. In contrast, the trend tracks closely the stock markets of Taiwan and U.S. only up to the beginning of 1996, i.e. before the onset of the Asian crisis. Subsequently, the transitory component becomes important. This confirms the fact both markets were not affected as much by the Asian crisis as the other two countries.

Thus, the results show that the stock market of Taiwan has not been a driver of our set of capital markets and has been responding to the common trend. On the other hand, Thailand and Japan have been the main drivers, while U.S. contribution has remained small.

5.4 Conclusion

In this paper, we have investigated for presence of financial integration amongst a group of Pacific Basin countries and the industrialized countries of Japan and U.S. Our main objective was to examine whether financial linkages were affected by the existence of foreign exchange controls. Furthermore, we wanted to investigate, whether alternative financial vehicles, such as Country Funds, provide a channel through which international investors access capital markets.

We have examined these issues by applying the multivariate cointegration model in the autoregressive and moving average form in terms of stable long-run comovements and common stochastic trends driving the system. We performed the recursive-based estimation to explore the beginning of integration and the effects of the Asian crisis on the linkages and that constitutes a novel approach to the examination of this issue. Our main findings are as follows:

First, we found that all the stock markets under investigation were not linked together for either the 80s or the 90s. Similar results were found for the open markets of Hong Kong, Malaysia and Singapore during the eighties. This evidence suggests that the relaxation of foreign exchange restrictions is not sufficient to attract international investors' attention and strengthen international market interrelations. There exist other factors, possibly related to information availability, accounting standards, or liquidity and political risk, which may affect the portfolio diversification decision. On the other hand, the increase in financial links for open and semi-open markets in the second sub-period suggests that the relaxation of foreign ownership restrictions might have enhanced financial links with world markets.

Secondly, we found strong financial links for Taiwan and Thailand with both Japan and U.S., during the first sub-period in which foreign ownership and other restrictions were in place. The results of the recursive analysis detect that the first forms of integration correspond to the period of the introduction of First Country Funds. This underlines the importance of alternative financial instruments to access emerging equity markets and increase their financial links with world markets. It confirms evidence found that Country Funds provide statistically significant diversification benefits.[81]

Thirdly, the recursive analysis for the most recent period indicates that the Asian crisis did not have a substantial effect on the degree of integration of these markets.

Finally, the estimated common trends mechanisms show that neither Japan, nor the U.S. has a unique influence in the Pacific Rim. U.S. plays a role, but small in magnitude, while Japan plays a more significant role, but is equally important as that of Thailand. Plotting the permanent component of each market, which corresponds to the common trend, and the actual stock price behaviour, we find that the difference of the two – the transitory component – to be substantial for Taiwan and U.S. in the post 1996 period, thus offering short-run diversification opportunities to international investors.

The analysis in the paper of stock market linkages in these emerging markets has indicated that international investors have opportunities for portfolio diversification by investing in the studied Pacific Basin countries in both short and long horizon. In addition, the results for the semi-open economies show that their financial linkages with developed world originated in the 80s and have increased in recent years. Moreover, the results for the open economies show that their financial links with U.S. and Japan have been weak during the 80s, but intensified during the 90s.

[81] See Bekaert and Urias (1999) and Chang et al. (1995).

Tables

Table 5.1.1: Different signals of liberalisation

Country	IFC official liberalisation	First Country Fund	First ADR introduction
Hong Kong	01.73	-	-
S.Korea	01.92	08.84	11.90
Malaysia	12.88	12.87	08.92
Singapore	06.78	-	-
Taiwan	01.91	05.86	12.91
Thailand	09.87	07.85	01.91

Table 5.1.2: Emerging stock markets - Direct and Indirect Barriers for Institutional Investors (end-1989)

	Foreign ownership Limit	Dividends Repatriation	Capital Repatriation	Withholding Taxes on Dividend	Taxes on Capital Gains
Hong Kong	100%	Free	Free	0%	0%
Japan	100%(25%)[a]	Free	Free	20% (0-15%)	0%
Korea	10%(8%)[b]	Some Restrictions[c]	Some Restrictions[c]	25% (10-21.5%)	0% (11-27%[e])
Malaysia	100%[d]	Free	Free	35%(0%)	0%
Singapore	100%	Free	Free	0.0%	0%
Taiwan[f, g]	Special Funds only[h]	Free	Free	20%	0.6%
Thailand	49% (25%)[i]	Free[k]	Free	20%(10)	25%(10)

Source: The table is based on the information provided in the *International Financial Corporation's Factbook*, the *Euromoney annual report*, the *Exchange arrangements and restrictions*, IMF and Bekaert and Harvey (1998a). All the data are as of end-1989. Rates shown in brackets apply only to approved new money Country Funds, where these may be different from normal treatment.

[a] The foreign ownership limit is up to 100% in case of companies classified as "non-strategic". The limit is reduced to 25% in case of "national interest" companies such as mining, agriculture, nuclear power, gas, railways, banks, aircraft, pharmaceutical industries and oil refineries. Direct inward investment in a listed corporation, which represents more than 10% of the corporation's issued capital when aggregated with the existing holdings of the investor and its related parties, or in the acquisition of shares in any non-listed corporation, requires a specific report to be filed with the Ministry of Finance and other Ministries prior to the transactions.
[b] Foreign ownership restriction of up to 10% of market capitalisation for "non-limited" industries and of up to 8% of market capitalisation for "limited" industries.
[c] The repatriation of initial capital, capital gains and dividend is subject to approval by the Ministry of Finance.
[d] Foreign acquisition of investments exceeding M$ 5 million in value or equivalent of 15% or more of voting power in a Malaysian company requires the prior approval of the Foreign Investment Committee.
[e] Of net gains or gross sales proceeds respectively.
[f] Transaction taxes on gross transaction value.
[g] Available only to investors in approved investment vehicles.
[h] Foreign investors who open an account in a local brokerage house may only invest in four listed funds – Kwang Hua Growth Fund, NITC Fuyuan Fund and Citizen Fund. Domestic residents are allowed to remit outwards up to US$5 million per annum.
[i] Foreign investors are allowed to hold up to 49% of companies listed on the SET with the exception of the commercial banks and finance companies, where foreign ownership is restricted to 25% of the capital.

[k] A report is required for the repatriation of dividends and capital gains.

Table 5.2: Multivariate cointegration, all countries 1980-1989.

Panel A: Trace test

Countries	$H_0:r=0$	$H_1:r\leq 1$	$H_2:r\leq 2$	$H_3:r\leq 3$	$H_4:r\leq 4$	$H_5:r\leq 5$	$H_6:r\leq 6$	$H_7:r\leq 7$
HK KO MA SG TA TH JP U.S.[1] (US dollars)	162.1**	105.2**	70.3	24.7	24.7	11.4	4.2	0.7
HK KO MA SG TA TH JP U.S.[1] (Real terms)	157.2**	100.8	68.7	41.4	23.9	11.1	3.3	0.04
HK KO MA SG TA TH JP U.S.[2] (Local currency)	169.5**	120.0	85.5	54.3	36.6	16.9	9.2	2.1

Notes: [1] indicates a model that does not include neither a restricted constant, neither an unrestricted one; [2] indicates a model including a restricted constant. The critical values introduced by Osterwalt-Lenum (1992) were used. The statistics include a finite sample correction (see Reimers (1992)). * and ** denote significance at 10% and 5% level respectively.

Panel B: Exclusion test

Countries	χ^2	*HK*	*KO*	*MA*	*SG*	*TA*	*TH*	*JP*	*U.S.*
HK KO MA SG TA TH JP U.S. (US dollars)	$\chi^2(2)$	4.6	5.1**	2.2	7.1**	9.4**	4.4	12.7**	7.5**
HK KO MA SG TA TH JP U.S. (Real terms)	$\chi^2(1)$	0.23	0.18	0.5	2.5	6.9**	1.7	11.7**	0.0
HK KO MA SG TA TH JP U.S. (Local currency)	$\chi^2(1)$	1.5	3.8**	1.7	0.7	7.4**	0.2	0.5	0.7

Notes: ** indicates significance at 5% level.

Table 5.3: Multivariate cointegration, open markets 1980-1989.

Panel A: Trace test

Countries	$H_0: r = 0$	$H_1: r \leq 1$	$H_2: r \leq 2$	$H_3: r \leq 3$	$H_4: r \leq 4$
HK MA SG JP U.S.[1]	51.2	18.4	9.0	1.6	0.0
HK SG JP U.S.[1]	38.1*	6.3	2.1	0.0	

Notes: see notes to Table 5.2.

Panel B: Exclusion test

	χ^2	*HK*	*MA*	*SG*	*JP*	*U.S.*
HK MA SG JP U.S.		-	-	-	-	-
HK SG JP U.S.	$\chi^2(1)$	2.34		15.3**	4.9**	19.5**

Notes: see notes to Table 5.2.

Table 5.4: Multivariate cointegration, semi-open markets 1980-1989.

Panel A: Trace test

Countries	$H_0: r = 0$	$H_1: r \leq 1$	$H_2: r \leq 2$	$H_3: r \leq 3$	$H_4: r \leq 4$
KO TA TH JP U.S.[1]	90.5**	34.2	20.8	8.5	0.5
TA TH JP U.S.[1]	57.3**	16.6	7.8	0.5	

Notes: see notes to Table 5.2.

Panel B: Exclusion test

	χ^2	*KO*	*TA*	*TH*	*JP*	*U.S.*
KO TA TH JP U.S.	$\chi^2(1)$	0.5	16**	3.5**	3.4**	5.0**
TA TH JP U.S.	$\chi^2(1)$		17.5**	9.8**	16.1**	17.7**

Notes: see notes to Table 5.2.

Table 5.5: Multivariate cointegration, all countries 1990-1998.

Panel A: Trace test

Countries	H_0:r=0	H_1:r≤1	H_2:r≤2	H_3:r≤3	H_4:r≤4	H_5:r≤5	H_6:r≤ 6	H_7:r≤ 7
HK KO MA SG TA TH JP U.S.[1] (US dollars)	155.4**	102.2	69.2	42.9	23.1	12.7	5.4	0.1
HK KO MA SG TA TH JP U.S.[1] (Real terms)	155.2**	102.1	69.1	42.8	23.1	12.7	5.4	0.1
HK KO MA SG TA TH JP U.S.[2] (Local currency)	188.6**	126.8	89.4	58.9	35.3	23.4	14.1	6.7

Notes: see notes to Table 5.2.

Panel B: Exclusion test

Countries	χ^2	*HK*	*KO*	*MA*	*SG*	*TA*	*TH*	*JP*	*U.S.*
HK KO MA SG TA TH JP U.S. (US dollars)	χ^2 (1)	0.0	13.2**	4.9**	2.0	2.2	0.8	0.6	3.2*
HK KO MA SG TA TH JP U.S. (Real terms)	χ^2 (1)	0.0	13.2**	5.1**	2.0	2.2	0.9	0.6	3.2*
HK KO MA SG TA TH JP U.S. (Local currency)	χ^2 (1)	2.2	4.4**	8.6**	0.9	5.7**	2.2	3.0*	1.1

Notes: see notes to Table 5.2.

Table 5.6: Multivariate cointegration, open markets 1990-1998.

Panel A: Trace test

Countries	$H_0: r = 0$	$H_1: r \leq 1$	$H_2: r \leq 2$	$H_3: r \leq 3$	$H_4: r \leq 4$
HK MA SG JP U.S.[1]	73.6**	40.1**	16.7	7.1	0.0
HK SG JP U.S.[1]	49.7**	27.4**	7.4	0.0	

Notes: see notes to Table 5.2

Panel B: Exclusion test

	χ^2	*HK*	*MA*	*SG*	*JP*	*U.S.*
HK MA SG JP U.S.	$\chi^2(2)$	10.5**	13.3**	18.9**	15.8**	9.7**
HK SG JP U.S.	$\chi^2(2)$	16.1**		20.3**	22.9**	5.0*

Notes: see notes to Table 5.2.

Table 5.7: Multivariate cointegration, semi-open markets 1990-1998.

Panel A: Trace test

Countries	$H_0: r = 0$	$H_1: r \leq 1$	$H_2: r \leq 2$	$H_3: r \leq 3$	$H_4: r \leq 4$
KO TA TH JP U.S.[2]	100.0**	55.8**	30.6	14	3.8
TA TH JP U.S.[1]	58.3**	28.0**	12.2**	0.03	

Notes: see notes to Table 5.2.

Panel B: Exclusion test

	χ^2	*KO*	*TA*	*TH*	*JP*	*U.S.*
KO TA TH JP U.S.	$\chi^2(2)$	17.0**	6.0**	11.0**	5.2**	6.7**
TA TH JP U.S.	$\chi^2(3)$		21.0**	16.0**	17.3**	19.6**

Notes: see notes to Table 5.2.

Figures

Figure 5.1.a: Recursive estimation of the trace statistics for the system composed of Taiwan, Thailand, Japan and the United States. Period 1980.01-1989.12

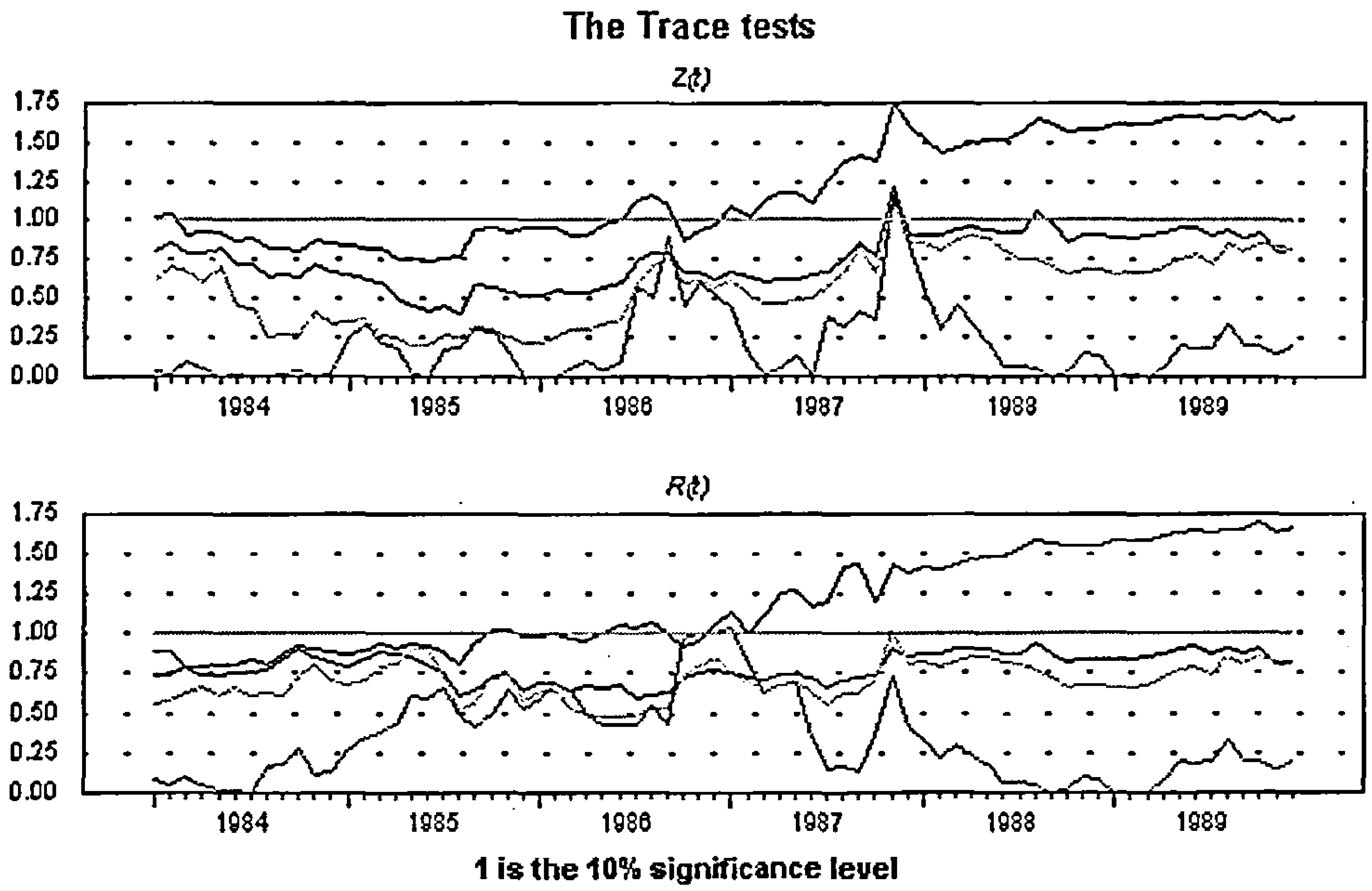


Figure 5.1.b: Recursive estimation of the trace statistics for the system composed of Taiwan, Thailand, Japan and the United States. Period 1990.01-1998.12

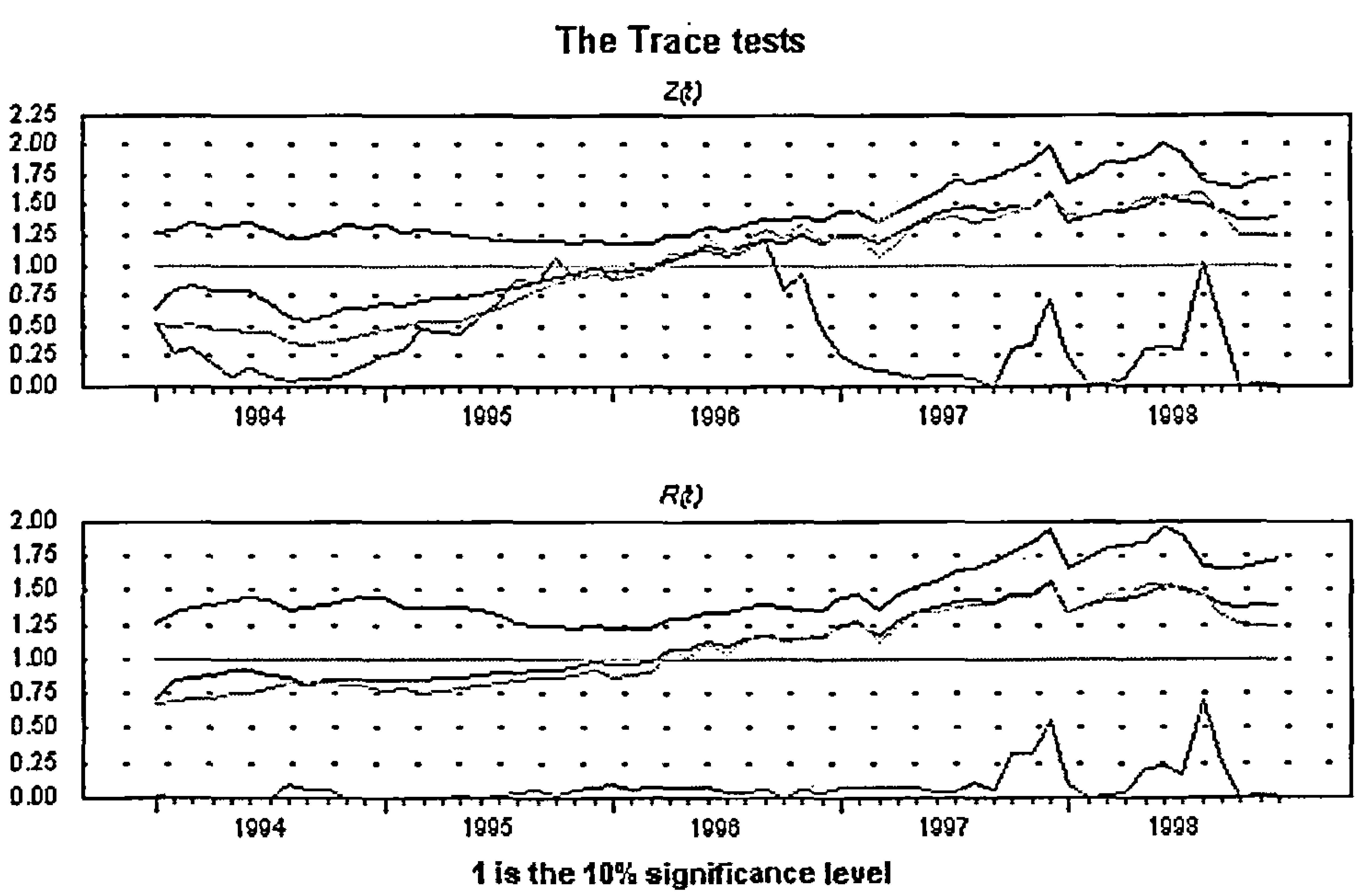


Table 5.8: Common trend system for Taiwan, Thailand, Japan and U.S. during the 80s.

Panel A: Common trend coeffcients ($\alpha_{\perp}$)

	Taiwan	Thailand	Japan	United States
Common trend 1	-0.137	0.889	-0.407	-0.160
Common trend 2	0.110	-0.123	0.080	-0.983
Common trend 3	0.435	-0.315	-0.843	0.019

Panel B: Loading factors ($\beta_{\perp}$)

	Common trend 1	Common trend 2	Common trend 3
Taiwan	5.154	-4.192	-6.454
Thailand	3.645	-2.073	-3.831
Japan	1.407	-1.791	-3.442
United States	0.419	-1.506	-0.734

Table 5.9: Common trend system for Taiwan, Thailand, Japan and U.S. during the 90s.

Panel A: Common trend coefficients ($\alpha_{\perp}$)

	Taiwan	Thailand	Japan	United States
Common trend 1	0.025	-0.675	-0.681	-0.282

Panel B: Loading factors ($\beta_{\perp}$)

	Common trend 1
Taiwan	-0.998
Thailand	-0.672
Japan	-0.391
United States	-0.679

Figure 5.2 to 5.5: Stock price indices decomposition for the system Taiwan, Thailand, Japan and U.S. during the 90s.

Figure 5.2

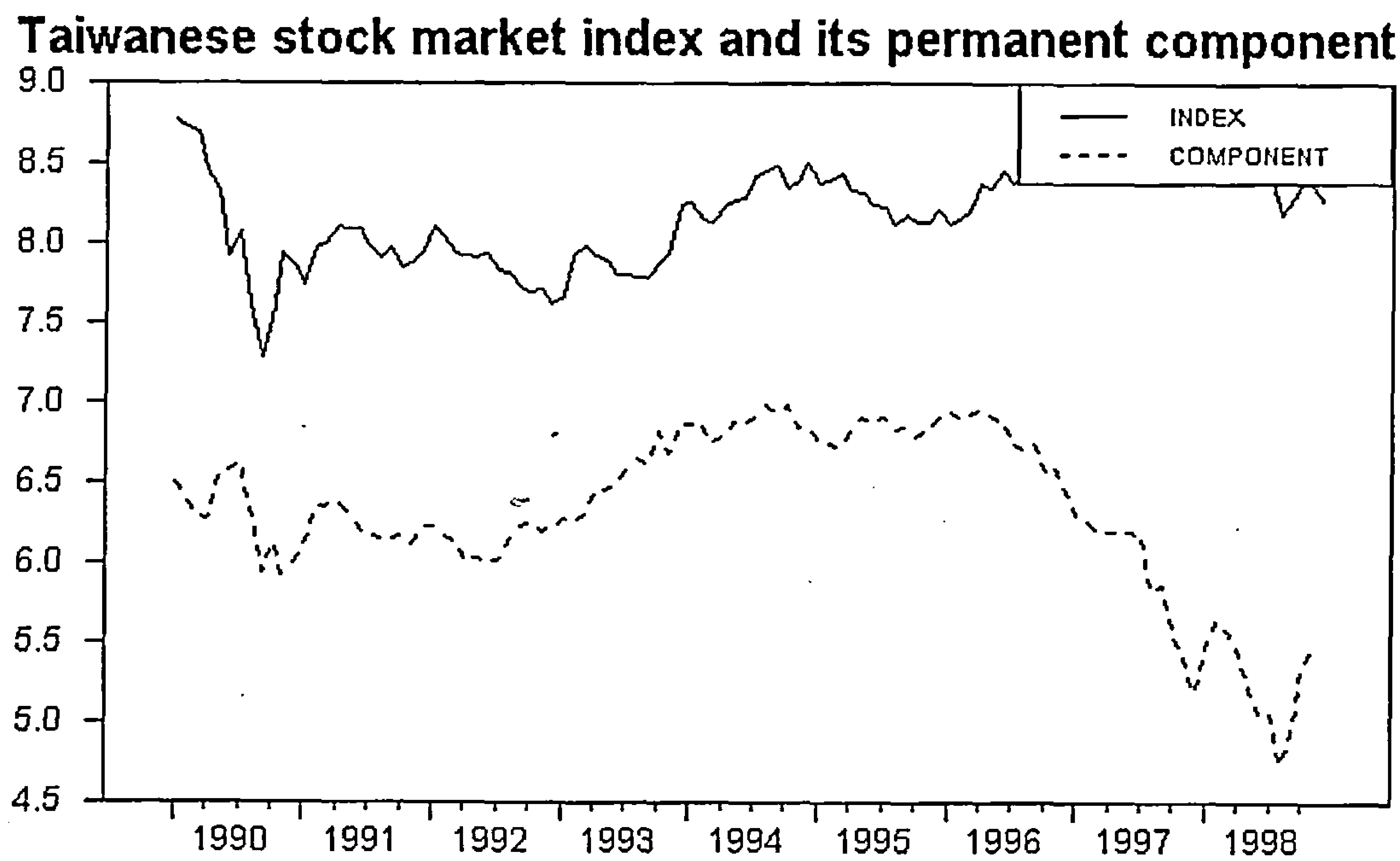


Figure 5.3

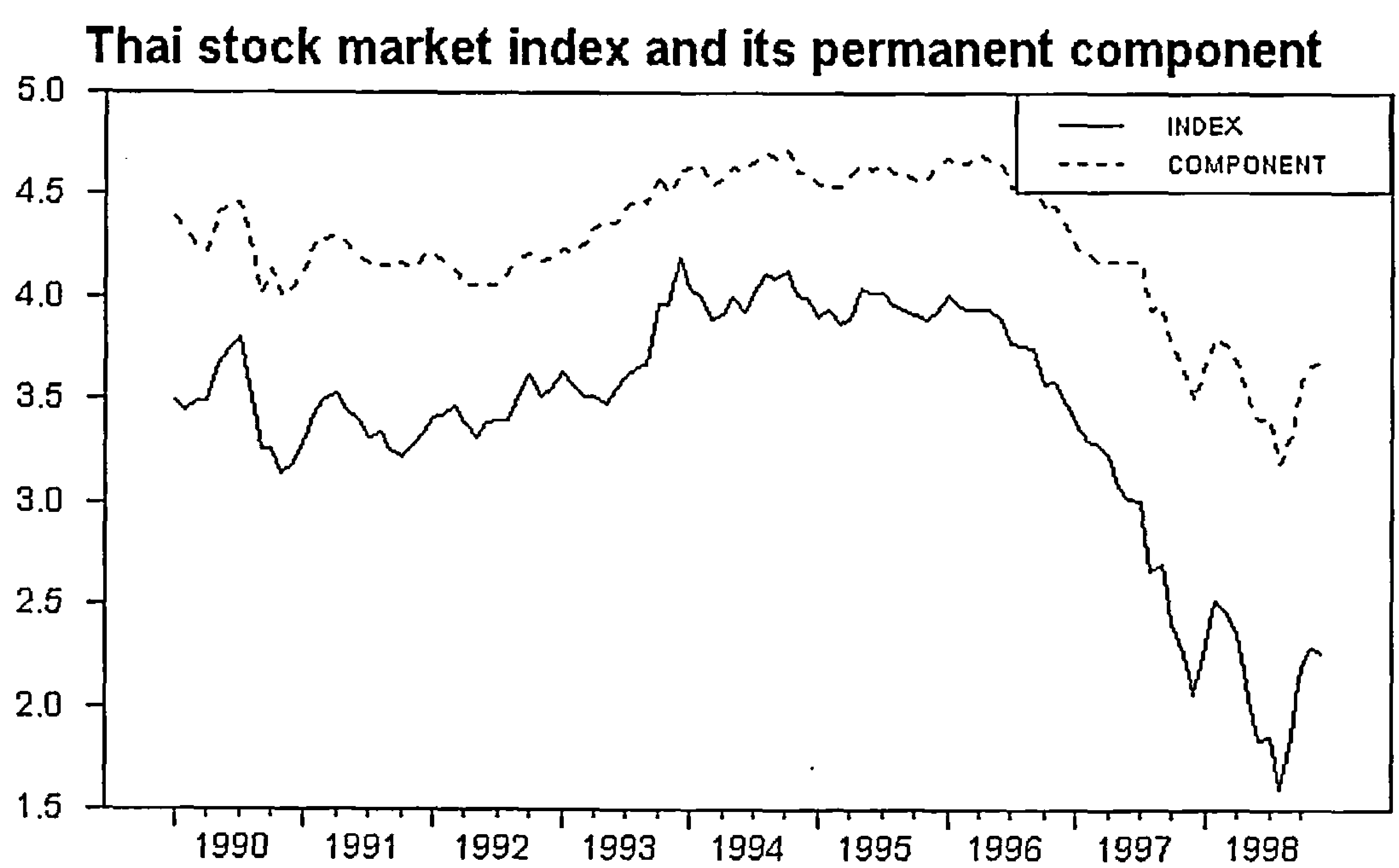


Figure 5.4

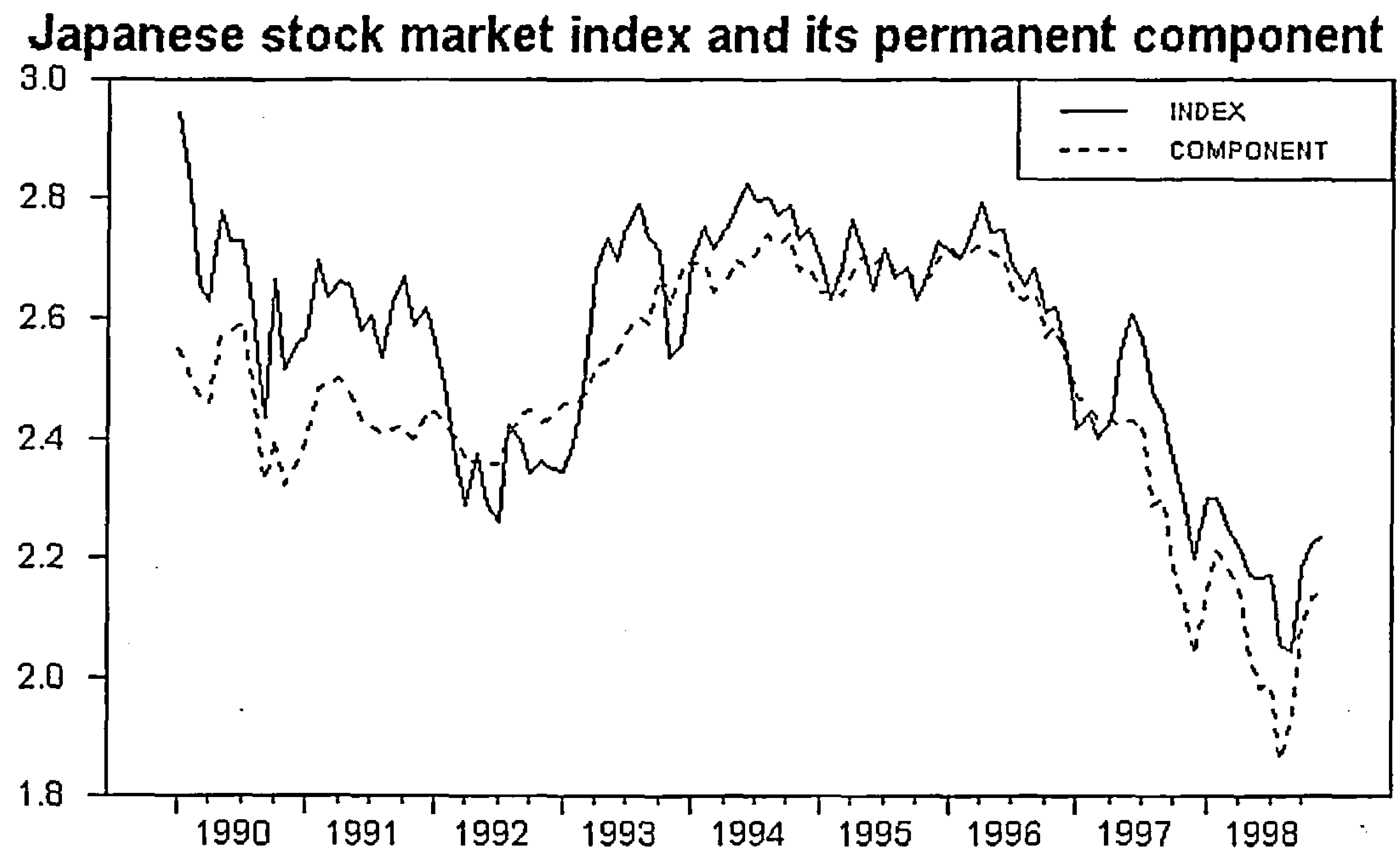
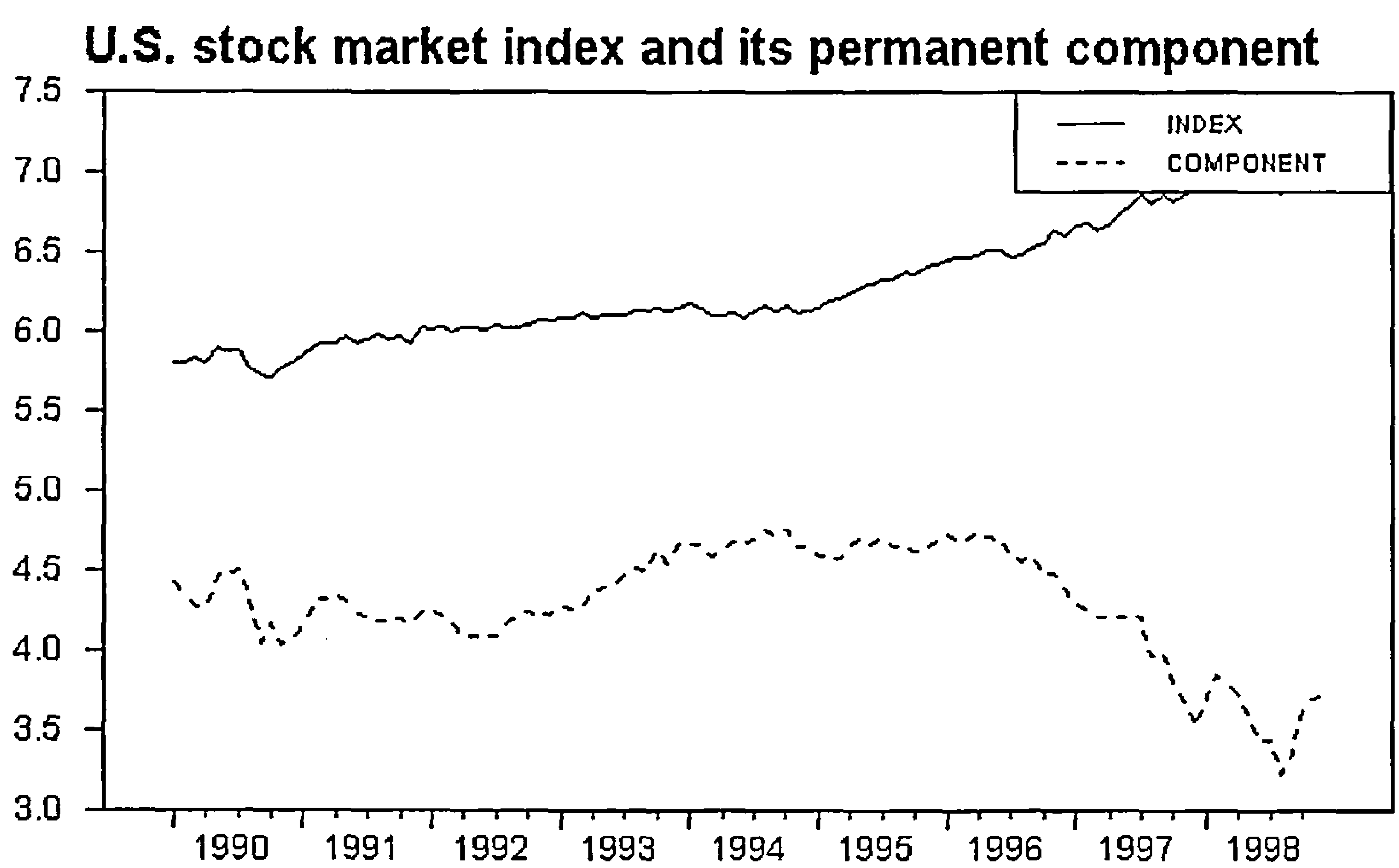


Figure 5.5



Appendix 5.A Stock markets turnover ratios

	Ratios					Rankings				
	1984	*1987*	*1990*	*1994*	*1998*	*1984*	*1987*	*1990*	*1994*	*1998*
HK	26.45	88.05	41.53	54.60	59.97	6	3	7	7	4
JP	42.90	73.04	54.92	30.15	38.00	3	6	6	8	7
KO	62.17	75.73	68.67	149.16	120.30	2	5	3	2	2
MA	11.47	20.66	22.36	63.46	29.25	8	8	8	4	8
SG	31.43	38.22	59.15	60.25	53.71	5	7	4	6	6
TA	82.86	172.95	709.96	287.62	340.25	1	1	1	1	1
TH	25.23	84.47	95.90	60.99	59.40	7	4	2	5	5
US	42.20	93.59	58.76	79.50	97.75	4	2	5	3	3

Source: Emerging Stock Markets Factbook, IFC publications (1993-1999).

CHAPTER SIX

MEASURING FINANCIAL AND ECONOMIC INTEGRATION WITH EQUITY PRICES IN EMERGING MARKETS

6.1 Introduction

The recent emergence of new capital markets and the relaxation of foreign capital controls, which has opened the possibility of international investment and portfolio diversification, have increased the interest of academics and practitioners in studying the degree of financial integration of these markets. In this paper, the analysis is focused on the Pacific-Basin region, which constitutes an important part of emerging capital markets. The countries in our sample are: Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan and Thailand. In 1998, these markets constituted 43 percent of emerging markets capitalisation, while in 1999 this figure had risen to 47 percent.[82]

Financial integration is measured by testing the law of one price to financial assets with the same risk. For our selected group of countries work has concentrated on testing the international parity conditions. For example, Bhoocha-Oom and Stansell (1990) look at interest rates (adjusted and unadjusted for exchange rates changes) between Hong Kong and Singapore versus U.S. Faruquee (1992) examines the uncovered interest rate differential between Singapore, Korea and Thailand versus the Japanese LIBOR - taken to represent the world rate of interest.[83] Dooley and Mathieson (1994) look at seven Pacific Basin countries versus U.S. using an analytical framework for interest rate determination, where the prevailing interest rate represents a weighted average of open (U.S. interest rate adjusted for the change in the exchange rate) and closed economy rates that would have existed otherwise.[84] Reisen and Yeches (1993) using the same framework examine Korea and Taiwan by applying Kalmar Filter technique to capture changes in the degree of integration over time.

The results of these studies support the view that there is substantial integration between domestic and international financial markets in Hong Kong, Singapore, Malaysia, Philippines and Indonesia, while the views are divided for Korea and Thailand. In Taiwan capital market integration with world financial markets was found to be limited. Using, however, a different method of measuring

[82] See "Emerging Stock Market Fact Book", (1998,1999) published by the International Finance Corporation. Excluding Hong Kong and Singapore, which might not be considered as emerging markets, the figures still remain high at 30 percent and 32 percent in 1998 and 1999 respectively.
[83] The change in the exchange rate is assumed to be zero.
[84] This is based on work done by Edwards and Khan (1985) for the case of Singapore and Colombia; and Haque and Montiel (1991) for 15 developing countries.

capital mobility based on a portfolio balance model, Chinn and Maloney (1998) found evidence of greater degree of openness in Taiwan since early 1989. The extensive capital market integration in the Pacific Basin Region has also been supported by Phylaktis (1999), when in addition to looking at long-run comovements of real interest rates, another indicator of the degree of capital market integration was used, namely the speed of adjustment of real interest rates to long-run equilibrium following a shock in one of the markets. Thus, even in countries like Taiwan and to a lesser extent Korea, where controls were substantial in both countries, extensive linkages have been found with world capital markets.

Similar conclusions have been found in studies, which have looked at stock markets and tested whether stocks with the same risk i.e. exposure to a common world factor, have identical expected returns irrespective of the market. If a market is segmented from the rest of the world, its covariance with a common world factor will not be able to explain its expected return. For example, Bekaert and Harvey (1995) examined capital market integration using a one factor asset pricing model, which did not assume the degree of segmentation to be constant through time. They allowed conditionally expected returns in a country to be affected by their covariance with a world benchmark portfolio and by the variance of the country returns. If the market was perfectly integrated then only covariance counted, while if the market was completely segmented then the variance was the relevant measure of market risk. Bekaert and Harvey (1995) used a conditional regime-switching model to account for periods when national markets were segmented from world capital markets and when they became integrated later in the sample. They applied the model to a group of emerging capital markets including some Pacific Basin markets (Korea, Taiwan, Malaysia and Thailand) over the period 1975 to 1992. They found that integration was substantial for the entire period not only for Malaysia, which had less investment restrictions, but also for Korea and Taiwan, which had substantial foreign ownership restrictions. In the case of Thailand, a large shift in the degree of integration was noted in 1987 when foreign ownership restrictions were relaxed.[85]

[85] The issue of intergration of Japan, another important Pacific-Basin country, with world markets has also been examined in the literature. For example, Gultekin et al (1989) show using multifactor asset pricing models that the risk in the US and Japanese stock markets was different before the enactment of the Foreign Exchange and Foreign Trade Control Law in December of 1980, which liberalised short-term capital movements, but not after. Similarly, Campbell and Hamao (1992) using the predictability of monthly excess returns on US and

The current paper attempts to provide an explanation for the high degree of financial market integration, which has been found even in the presence of foreign exchange controls, by examining whether economic integration plays a role in linking the financial markets. Real economic integration has been measured in many ways and refers to the international trade links between countries. Frequent measures include the degree of openness calculated as the ratio of exports and/or imports between countries to national output; the amount of price and quantitative restrictions on traded goods; and the extent of contemporaneous movement of output growth between countries, which is based on the theory that substantial trade interdependence transmits economic activity from one country to the other producing a common business cycle.

However one measures economic integration, it can provide channels in linking the financial markets even in the presence of foreign exchange restrictions on international capital flows. For example, economic integration, if that is measured by the contemporaneous movement of output growth of countries, provides a channel for financial integration through the effects of expected economic activity on the expected cash flows of firms and their stock prices. Thus, if two countries experience a comovement in their output then their cash flows will move together and so will their stock markets too. Empirical studies have confirmed the long-run positive relationship between economic activity and stock prices (see e.g. Fama and French (1988), Schwert (1990), Roll (1992) for U.S. and Canova and DeNicole (1995) for the European countries).

A look at the indicators of economic integration for our group of countries provides some evidence that the countries in our group are economically integrated with other countries, such as Japan and U.S. For example, Table 6.1 shows exports and imports of each Pacific Basin country (PBC) versus Japan and U.S. as a percent of GDP over a number of years. The ratios seem high for some of the countries, but in the absence of a benchmark one cannot say anything about the degree of economic integration. Neither the amount of tariffs on trade seems to provide an accurate

---

Japanese equity portfolios over the US Treasury bill found that in post-liberalisation period, i.e. the 1980s, US variables helped forecast excess Japanese stock returns, which is suggestive of integration of long-term capital markets.

Studies examining the international parity condition have also found financial market integration following the abolition of foreign exchange restrictions (see e.g. Otani and Tiwari, (1981), Ito (1988) and Bosner-Neal and Roley (1994)).

picture of real economic integration as non-tariff barriers to trade might be in existence. The World Bank in its 1987 World Development Report constructed an "outward orientation" index based mainly on the use of direct controls such as quotas and import licensing schemes and the use of export incentives for 41 countries including most of the countries in our sample for two periods 1963-73 and 73-85. Classifying Korea as a "strongly outward oriented" country in both periods highlights the subjectivity of such measures since the Korean trade regime was considerably more restrictive during the first period compared to the second. Finally, we have computed the correlations of contemporary monthly industrial production for the period 1990-98 (see Table 6.2). These are on the whole not very big. Contemporaneous movements of output might, however, underestimate the degree of economic integration because of lags in the international transmission of shocks.

The current paper contributes to the literature in the following ways. First it uses a different way to measure financial and economic integration to previous studies on the PBCs based on the framework developed by Ammer and Mei (1996) for Europe and the U.S., which measures both types of integration by analysing the covariance of excess returns on national stock markets. This approach has several advantages. It examines financial integration by studying the comovement of future returns aggregated over a long horizon instead of the comovement of one period expected returns as used in studies by Bakaert and Harvey (1995, 2000). As Ammer and Mei stress this methodology could detect small but persistent comovements in expected returns and more accurately measure the degree of financial integration than one-period stock returns regression models. Similar comments can be made about the proposed measure of real economic integration compared to measures based on the contemporaneous movements in output.[86] Another advantage of the framework used in this paper is that both types of integration can be examined simultaneously and that is important for examining the role of economic integration in financial integration. The framework uses the Campbell and Shiller (1988) approximate present value model to decompose excess stock return innovations between different countries into news about excess returns, dividend growth rates, interest rates and exchange rates. By examining the comovements of these different excess return components amongst

[86] A disadvantage of our method, which also applies to output-based measures of economic integration, is that the positive covariance in economic activity may occur because of a common exogenous shock.

various countries one can get an insight into the type of international linkage among these economies. Real economic integration is measured by the correlations of dividend innovations between two countries, while financial integration is measured by the correlations between innovations in future expected stock returns. The former is an indicator of real integration because in a fully integrated economic system, labour and capital would be able to move freely across national borders. In addition, international differences in technology and production costs should diminish. As a consequence, a common shock (e.g. exogenous technology disturbances) would have a similar impact on economic growth, and thus corporate earnings and dividends, in different countries. In this study, the use of dividend innovation correlations as a measure of real economic integration is based on the fact that news on long-term corporate dividends move in tandem with news about real production measures such as long-term GDP growth. Future dividends are directly related to future cash flows and profits of companies, which directly depend on the state of local and global economic activity.[87] In addition, the more open the economy the greater is the trade activity and the better this transmission mechanism works. In fact, if exports are a big component of the GDP of a country, corporate dividends are even more sensitive to external demand and therefore more related to the economic growth of the rest of the world.

The latter is an indicator of financial integration because if asset returns in different countries are conditionally multivariate normal so that the Capital Asset Pricing Model (CAPM) holds, the conditional means of these excess returns must move together as linear combinations of a set of common risk premiums. In the case of one factor model with fixed factor loadings (betas), any variation over time in mean returns would have to be correlated across assets.[88]

Another contribution of the paper is the examination of the relationship between foreign investment restrictions and the integration of capital markets since

[87] This technique might present two limitations. First, Ammer and Mei (1996) argue that if the distribution of national income shifts dramatically across labor, capital, and government, such dramatic changes in the relative importance of corporate taxes and wage compensation, then our dividend correlations may be a poor measure of real economic integration across different countries. Secondly, future dividends and their innovations might be affected by dividend policies conducted by companies. However, while these weaknesses could have a great impact on short-term horizon analysis, they will have a smaller effect in our framework, which captures persistent long-term comovement and thus less likely to be affected by occasional policy changes.

the emerging markets in our sample differ in the degree of capital market openness. As Bekaert and Harvey (2000) point out liberalisation may not be enough to induce foreign investors to actually invest in the country. Home bias or other concerns, such as lack of information on company stocks, may impede international investment (see Bekaert (1995) and Levine and Zervos (1996)). A third contribution of the paper is the examination of the issue of regional integration i.e. integration amongst the PBCs, including the more developed stock market of Japan as a possible driving force, in addition to examining integration with world markets as represented by U.S. Answers to the above questions have important policy implications for the use of restrictions to isolate capital markets from world influences. This research comes at a time when many countries, and especially the East Asian countries, are contemplating the reintroduction of foreign restrictions on international capital flows in the aftermath of the Asian crisis.

The paper is structured as follows. Section 6.2 draws from Ammer and Mei (1996) and describes the decomposition of domestic and foreign excess stock returns and their variances. Section 6.3 explains the estimation procedure, while Section 6.4 applies it to U.S. and PBCs data over the period 1980 to 1998. Section 6.5 reports the empirical results concerning real and financial links for PBCs at both the regional and global level and Section 6.6 tests the robustness of these empirical findings to the Asian financial crisis. The final section offers some concluding remarks.

6.2 Decomposition of excess stock returns and of their variances

6.2.1 The Components of Domestic and Foreign Excess Stock Returns

This section contains a brief description of the decomposition of domestic and foreign excess stock returns, which is based on the log-linear approximate asset pricing framework of Campbell (1991) and Campbell and Ammer (1993). The domestic unexpected excess stock return can be expressed as a linear function of news about future dividend growth rates, real interest rates, and excess stock returns as follows:

[88] See Campbell and Hamao (1992). In our study, we have divided the sample period into two sub-periods, pre and post capital control liberalisation, to increase the possibility of having constant betas.

(6.1) $e_{t+1} - \mathrm{E}_t e_{t+1} = (\mathrm{E}_{t+1} - \mathrm{E}_t)\left\{\sum_{j=0}^{\infty}\rho^j \Delta d_{t+1+j} - \sum_{j=0}^{\infty}\rho^j r_{t+1+j} - \sum_{j=1}^{\infty}\rho^j e_{t+1+j}\right\}$,

where e_{t+1} is the excess return on a stock held from the end of period t to the end of period $t+1$, relative on the one-period interest rate, d_{t+1} the real dividend paid during period $t+1$, and r_{t+1} the real interest rate from t to $t+1$.[89] Here E_t denotes an expectation formed at the end of period t, conditional on an information set, which includes at least the history of stock prices and dividends, while Δ denotes a one-period backward difference. All variables are measured in real terms and in logs. The parameter ρ is a constant of linearization; it assumes a value a little smaller than one[90,91]. In order to simplify the notation in equation (6.1), we define the three news components as

(6.2) $\tilde{e} = \tilde{e}_d - \tilde{e}_r - \tilde{e}_e$.

In a similar way, the unexpected foreign excess stock return, when expressed in dollars and over the domestic interest rate $(\tilde{f})$, can be decomposed into news about the future dividend growth $(\tilde{f}_d)$, real interest rates $(\tilde{f}_r)$, excess stock returns $(\tilde{f}_f)$, and changes in the real exchange rate $(\tilde{f}_q)$ as shown in equation (6.3) below

(6.3) $\tilde{f} = \tilde{f}_d - \tilde{f}_r - \tilde{f}_q - \tilde{f}_f$.

In equations (6.2) and (6.3) news of an increase of future dividends are associated with a capital gain today, while an increase in expected future returns is associated with a capital loss today other things being equal. The latter effect is due to the fact that higher future returns can only be generated by future price appreciation from a lower current price. In equation (6.3) we have the additional term of the innovations related to real exchange rate changes, which is negatively related to unexpected stock returns. The arrival of information that the dollar will appreciate sometime in the

[89] Equation (6.1) is derived by taking a first-order Taylor approximation of the equation relating the log stock returns to log stock prices and dividends. The approximate equation is based on the condition that the log dividend-price ratio does not follow an explosive process (see Campbell and Shiller, (1988)).

[90] The parameter ρ is defined as 1/(1 + exp(d - p)), where (d - p) represents the sample mean of the log dividend-price ratio.

[91] In our empirical work the coefficient ρ assumes a range of values from 0.9584 to 0.9921, for the analysed countries. Campbell and Ammer (1993) testing for the accuracy of equation (6.1), found that the approximation holds quite well for a wide range of possible values of ρ.

future will reduce expected dollar returns on foreign assets at some point in time. The loss will occur today in the absence of information regarding future expected excess returns.

So far we have stated a number of identities relating innovations in long-term asset returns to revisions in investors' expectation of future dividends, real interest rates, real exchange rates and excess long-term asset returns. Our major objectives are: (i) to use these identities to estimate the relative importance of the different components for the historical behaviour of asset returns; and (ii) to measure the degree of financial and economic integration between two economies by evaluating the correlation between the long-run components in equations (6.2) and (6.3), of their excess stock returns. In particular, real economic integration between two countries is measured by the correlation between the future domestic dividend innovations, $\tilde{e}_d$, and the future foreign dividend innovations, $\tilde{f}_d$, and financial integration by the correlation between the future domestic expected excess returns innovations $\tilde{e}_e$ and the future foreign expected excess returns innovations, $\tilde{f}_f$.

There could be two extreme situations. One where there is real economic integration and no financial integration and will be characterised by a high correlation between $\tilde{e}_d$ and $\tilde{f}_d$, and zero correlation between $\tilde{e}_e$ and $\tilde{f}_f$. In that case, macroeconomic shocks affect output and profits in each country and through the flow of goods, information and labour, effects are transmitted and expected corporate earnings (dividends) are correlated internationally. The other extreme situation is when there is financial integration and no real economic integration. In this case, capital markets are open, but there is no trade of goods between the two countries and no international labour mobility. Thus, there will be zero correlation between $\tilde{e}_d$ and $\tilde{f}_d$ but perfect correlation between $\tilde{e}_e$ and $\tilde{f}_f$. Changes in the stock market risk premium reflect variation in the price of risk and are driven by a common world market factor.

There will be interactions between financial and economic integration if there is correlation between $\tilde{e}_d$ and $\tilde{e}_e$, in which case the stock market premium in the domestic country (cost of capital) has effects on the production or long-term profits; and/or if there is correlation between $\tilde{e}_e$ and $\tilde{f}_d$, i.e. the cost of capital in the domestic country (i.e. U.S. in our study) has effects on the production and long-term profits in the foreign country (i.e. Pacific-Basin country).

6.2.2 Variance decomposition and covariances between components of domestic and foreign excess stock returns.

Before calculating the correlations between the long-term components of excess stock returns of U.S. and PBCs we focus our attention on the decomposition of the variances of excess stock returns and the covariances between components of domestic and foreign excess stock returns. Thus, using the decomposition of equation (6.2), the variance of the domestic excess return innovation can be defined as the sum of six terms:

$$(6.4)\quad \mathrm{Var}(\tilde{e}) = \mathrm{Var}(\tilde{e}_d) - 2\,\mathrm{Cov}(\tilde{e}_d, \tilde{e}_r) + \mathrm{Var}(\tilde{e}_r) - 2\,\mathrm{Cov}(\tilde{e}_d, \hat{e}_e) + \mathrm{Var}(\tilde{e}_e) + 2\,\mathrm{Cov}(\tilde{e}_r, \tilde{e}_e).$$

Similarly, using the decomposition of equation (6.3), the variance of the foreign excess return innovation can be defined as the sum of ten elements:

$$(6.5)\quad \mathrm{Var}(\tilde{f}) = \mathrm{Var}(\tilde{f}_d) - 2\,\mathrm{Cov}(\tilde{f}_d, \tilde{f}_r) - 2\,\mathrm{Cov}(\tilde{f}_d, \tilde{f}_q) - 2\,\mathrm{Cov}(\tilde{f}_d, \tilde{f}_f) + \mathrm{Var}(\tilde{f}_f) + 2\,\mathrm{Cov}(\tilde{f}_r, \tilde{f}_q) + 2\,\mathrm{Cov}(\tilde{f}_r, \tilde{f}_f) + \mathrm{Var}(\tilde{f}_q) + 2\,\mathrm{Cov}(\tilde{f}_q, \tilde{f}_f) + \mathrm{Var}(\tilde{f}_f).$$

Finally, from both equations (6.2) and (6.3), the covariance of domestic and foreign excess stock returns is decomposed as follows:

$$(6.6)\quad \mathrm{Cov}(\tilde{e}, \tilde{f}) = \mathrm{Cov}(\tilde{e}_d, \tilde{f}_d) - \mathrm{Cov}(\tilde{e}_d, \tilde{f}_r) - \mathrm{Cov}(\tilde{e}_d, \tilde{f}_q) - \mathrm{Cov}(\tilde{e}_d, \tilde{f}_f) - \mathrm{Cov}(\tilde{e}_r, \tilde{f}_d) + \mathrm{Cov}(\tilde{e}_r, \tilde{f}_r) + \mathrm{Cov}(\tilde{e}_r, \tilde{f}_q) + \mathrm{Cov}(\tilde{e}_r, \hat{f}_f) - \mathrm{Cov}(\tilde{e}_e, \tilde{f}_d) + \mathrm{Cov}(\tilde{e}_e, \tilde{f}_r) + \mathrm{Cov}(\tilde{e}_e, \tilde{f}_q) + \mathrm{Cov}(\tilde{e}_e, \tilde{f}_f).$$

6.3 Estimation Procedure

To estimate multiperiod expectations composed of domestic and foreign excess stock returns, we combine the asset-pricing framework, described in Section I, with a vector autoregression system (VAR) in long-term asset returns, interest rates, real exchange rates and other information that helps to forecast these variables.

The application of this technique permits one to write the unobserved components of returns as linear combinations of innovations to observable variables. The coefficients in these linear combinations are identified by using a time-series model to construct forecasts of the discounted value of future dividends, real interest rates, excess returns and real exchange rates. Revisions in these forecasts are then used as proxies for revisions in investors' expectations[92]. In order to improve the forecasting power of multiperiod expectations of components of excess stock returns, we include instrumental variables in the estimation of the VAR system, such as, dividend yields for each stock market and the change of nominal domestic interest rate (see e.g. Ferson and Harvey (1991)).

We begin the procedure by defining a vector of state of variables, z_t, of which the first four elements are domestic excess stock return, e, foreign excess stock returns, f, domestic real interest rate, r, and changes of real exchange rate, q. These variables are chosen to be stationary and for notational convenience we treat them as having zero means[93]. We assume that the state vector follows a first-order VAR process:

(6.7) $z_{t+1} = Az_t + \omega_{t+1}$,

where the matrix A is the coefficient matrix of the VAR, and ω_{t+1} is the error vector. The assumption that the VAR is first-order is not restrictive. Higher-order VAR models are handled by augmenting the state vector and reinterpreting the matrix A as the companion matrix of a system (see e.g. Campbell and Shiller (1988).

Using the fact that

(6.8) $(E_{t+1} - E_t)z_{t+1+j} = A_t^J\ \omega_{t+1}$,

we estimate each component of stock returns as a linear combination of the elements of the error vector ω_{t+1}[94]. We estimate the components denoting innovation of future dividend growth as a residual of the elements of equations (6.2) and (6.3). For instance, the innovations of future domestic dividend growth is computed as in the equation

92 Monte Carlo simulations of Hodrick (1992) and Campbell (1991) show that VAR systems have better finite-sample proprieties than direct regression methods with long-horizon variables. Moreover, this procedure has been widely used in financial literature (see, for instance, Campbell and Shiller, (1987, 1988); Campbell, (1991) and Campbell and Ammer, 1993)).

93 In this empirical work sample means are removed from all variables before estimating the VAR process.

94 See in Appendix 6.A for details on this computation.

(6.9) $\tilde{e}_d = \tilde{e} + \tilde{e}_r + \tilde{e}_e$.

It is important to underline that this procedure permits one to overcome the problem of seasonality and low frequency observations of dividend yield.

In accordance with Campbell (1991), the coefficients of the VAR system and the elements of the variance-covariance matrix of VAR innovations are jointly estimated using the Generalised Method of Moments (GMM) estimator of Hansen (1982). This is to correct for any heteroscedasticity that may be present in the error terms. The GMM parameter estimates are numerically identical to standard OLS estimates, but GMM delivers a heteroskedasticity-consistent variance-covariance matrix for the entire set of parameters (see White, 1984).

We evaluate the statistical significance of variances of the components of excess stock returns, their covariances and correlations, estimating the standard errors of these statistics. Denote the vector of the entire set of estimated parameters as θ and the heteroscedasticity adjusted variance-covariance matrix of the estimate of these parameters V. Any statistic such as the correlation between the components attributed to news about future domestic and foreign dividend growth can be written as a non-linear function $f(\theta)$ of the vector of parameters θ. The standard error for the statistic is then estimated as $\sqrt[2]{f_\theta' V f_\theta}$, where f_θ is the gradient of the statistic with respect to the vector of parameters θ.

6.4 An application to U.S. and PBCs

6.4.1 Data

The sample of countries examined in the paper includes: Japan, U.S., Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan and Thailand. The sample period varies for each country depending on the availability of data. For Japan, Singapore, Thailand and U.S. the sample period is 1980.01 to 1998.12; for Hong Kong 1981.01 to 1998.12; and for Malaysia, Indonesia, Korea, Philippines and Taiwan 1990.01 to 1998.12. The data consist of end of the month observations of stock market index prices (1990=100), expressed in domestic currency,[95] local

[95] The stock market index prices used are as follows: the Hang Seng Price Index for Hong Kong; the Jakarta Stock Exchange Composite Price Index for Indonesia; the Nikkei 225 for Japan; the Korean Stock Exchange composite for Korea; the Kuala Lumpur Stock Exchange

bilateral spot exchange rate expressed as U.S. dollar per Pacific-Basin country currency, dividend yield, consumer price index (1990=100), industrial production index, expressed at constant prices (1990=100), one month Treasury Bill for U.S. and the one month Gensaki rate for Japan. The data were obtained from *Datastream* with the exception of the Consumer Price Index (CPI) for Hong Kong, which was obtained from the *Monthly Statistical Bulletin* published by the Hong Kong Monetary Authority; the one month Gensaki rate in Japan, which was obtained from the *Economic Monthly Statistics Bulletin* published by the Bank of Japan; and the one month Treasury Bill rate in U.S., which was obtained from *Ibbotson Associates*.

The logarithm of the real exchange rate q is defined as $ln\,CPI_t^i - ln\,e_t^{PBC} - ln\,CPI_t^{PBC}$, where CPI_t^{PBC} is the consumer price index for the Pacific Basin country, e_t^{PBC} is the nominal exchange rate and CPI_t^i is the consumer price index for U.S.

6.4.2 Stock Market Liberalisation

Restrictions affecting stock market participation can take many different forms. They can affect for example, foreign ownership, the purchase of foreign assets by domestic institutional investors and the amount of dividends that can be repatriated. They can also be indirect such as the withholding taxes on dividends. The countries in our sample have liberalised their stock markets at different times. In Table 6.3.1, we summarize three different signals of liberalisation for each country: the official liberalisation date (OLD), which is based on information obtained from a variety of sources reported in the table, the First Country Fund (FCF) and the First ADR. The latter two signals signify indirect ways of foreign participation in the local stock markets, which are usually available prior to the lifting of various restrictions on foreign investors. What is clear from these various signals of liberalisation is that all countries had either liberalised or started the process of liberalisation by the beginning of the 1990's. Furthermore, in order to show the extent of liberalisation in these countries we present in Table 6.3.2 various indicators of direct and indirect barriers

---

Composite Price Index for Malaysia; the Philippines Stock Exchange Composite Price Index for Philippines; the Singapore Straits Times Price Index for Singapore; the Taiwan Stock Exchange weighted – price index for Taiwan; the Bangkok S.E.T. Price Index for Thailand; and the Standard & Poor's 500 Composition Index for the US.

for institutional investors at the end of 1989.[96] As it can be seen our countries differ in the degree of foreign exchange restrictions. We have on the one hand, Hong Kong and Singapore, which have virtually no foreign exchange controls and foreign ownership regulations throughout the period, i.e. they have open markets, and on the other hand, Indonesia, Philippines and Thailand, which maintained restrictions even after they have opened their markets to foreign investors. Malaysia was a closed market until 1989 and completely open until September 1998. The controls are even more stringent in the case of Taiwan and Korea.

Thus, dividing the sample period into two sub-periods, the pre-liberalisation ending in December 1989, and the post-liberalisation sub-period covering the period between January 1990 and December 1998, seems appropriate for examining the effect of stock market liberalisation on financial links between the countries.

6.4.3 Variance decomposition for U.S. and Pacific Basin excess stock returns

In the first part of the study, we examine the variance decomposition of excess stock returns of U.S. and each Pacific Basin Country (PBC). Table 6.4 presents the results for the decomposition of U.S. excess stock returns when the PBC is Hong Kong for the two sub-periods. The results were not quantitatively different if the foreign country was another PBC.[97] Comparing the variance between the two sub-periods one notes that it is lower in the second sub-period. The components of the variance are presented as proportions of the total variance. The biggest contribution to aggregate volatility comes from variation in dividends, in long-term profits, [98] while the contribution of the equity risk premium is much smaller.

Table 6.5 presents the variance decomposition for the PBCs. The variance of excess stock returns is higher in the second subperiod in two of the four countries (Japan and Thailand) that we have data for both subperiods. This could reflect the effects of the Asian crisis. The main source of variation is also the long-term profits while the contribution of risk premium is smaller. In a similar fashion to U.S., we find the contribution of the covariance between $\tilde{f}_d$ and $\tilde{f}_e$ to be substantial. These

[96] We chose that date because many liberalisations clustered in the late 1980's.
[97] The lag structure of one lag was selected using the Akaike Information Criterion. Higher lags did not produce qualitatively different results.

results differ from those in Campbell (1991), Campbell and Ammer (1993) and Ammer and Mei (1996), who found that for some of the sample periods the contribution of the equity risk premium was higher than that of the dividends and the covariance between $\tilde{f}_d$ and $\tilde{f}_e$ was close to zero.

6.5 Real and Financial links between U.S. and the Pacific Basin countries

6.5.1 Covariance decomposition

The covariance of domestic and foreign stock returns are decomposed in 12 components as shown in equation (6.6). In Tables 6.6.1 and 6.6.2 we list in the various panels the major contributions to the covariance for two sub-periods, 1980.01-1989.12 and 1990.01-1998.12. We did this exercise not only for U.S. and each PBC but also for every possible pair for our sample of countries.

The major contribution to the covariance of domestic and foreign stock returns comes from correlated news about future dividend growth in the two countries. The other important component comes from the correlated news about future excess returns and news of the interaction between future domestic excess return and future foreign dividend news. The covariance concerning interest rate news makes a relatively small contribution confirming the difficulty in forecasting real interest rates. Similarly the contribution of the real exchange rate was found small for the same reason.

For both sub-periods, the covariance of future dividend news is much higher than the covariance of future excess returns indicating the strength of economic integration in the region. Furthermore, this economic integration seems to have strengthened during the 1990's for most PBCs. The same can be said about the covariance of future excess returns news and financial integration. Developments between U.S. and PBCs have been different. The covariance of future dividend news has increased only for U.S. versus Japan and Singapore, while the covariance of future excess news has increased only versus Japan. At the same time, the high and statistically significant covariance between future domestic excess returns and future

[98] In fact the proportion is higher than one to offset the negative covariances.

foreign dividend news for both sub-periods indicates the interaction between economic integration and financial integration.

In order to test the robustness of our results to a different specification, we estimated the VAR without the instrumental variables (see Table 6.8.1 and 6.8.2 of Appendix 6.B). This specification did not have a great impact on the decomposition results. Thus, our results remained robust to the different specification of our forecasting model.

6.5.2 Correlations of the return components

In the next set of Tables, 6.7.1 and 6.7.2, we present the correlation matrices of the return components for the two sub-periods, 1980.01- 1989.12 and 1990.01-1998.12. In interpreting these results we provide answers to the questions posed in the introduction relating to the effect of stock market openness on financial integration; the importance of regional versus global integration; and the link between economic and financial integration.

6.5.2.1 Financial integration in pre and post liberalisation periods

During the 1980s there were only five cases out of ten of financial integration (see Table 6.7.1, Panel C). Those were Singapore versus Hong Kong, Thailand, Japan and U.S., and U.S. versus Thailand. In the cases of U.S. versus Singapore and Thailand the correlations were very high indeed. It is interesting to note that Hong Kong, Japan and U.S. were found not to be financially integrated, even though all three markets were open at the time, implying that other factors might have discouraged international investors. The result for Thailand was considered rather strange in view of the substantial restrictions, which existed during this period. The correlations were thus reestimated for the shorter pre-liberalisation period 1980.01 to 1987.08 so that the end of the period coincided exactly with the official liberalisation date for Thailand. The correlation of future excess returns news between U.S. and Thailand was found to be statistically insignificant, implying no financial integration between the two countries.

During the 1990's, all PBCs were found to be financially integrated (see Table 6.7.2, Panel C). No difference could be observed in the degree of integration amongst the highly open markets, like those of Hong Kong and Singapore, and the less open markets, such as those of Thailand, Indonesia and Philippines. Even in Taiwan and Korea, which were highly regulated, there was a high degree of integration corroborating the results of previous studies. The high financial integration at both the regional and global level found for Thailand in the post-liberalisation period compared to the pre-liberalisation period is also in line with the results of other studies. Bekaert and Harvey (1997) in their time series and cross sectional models of analysing the effect of capital market liberalisation on emerging equity market volatility and allowing for correlations between local market and world market to vary, found that for some countries (Thailand from the PBCs) capital market liberalisation increased the correlation in post liberalisation periods, i.e. increased financial integration.[99].

The picture for U.S. is very different. Only Philippines and Thailand are financially integrated with U.S. There is no integration with Singapore unlike the 1980s. Japan the most financially advanced country was not found to be integrated with U.S. This result is in agreement with Ammer and Mei (1996), who included Japan in their study for the period 1974.01 to 1990.12. They find a negative but statistically insignificant correlation of future excess return news.[100]

6.5.2.2 Regional versus global integration

Developments in economic integration can be seen by examining correlations of future dividend news. During the 1980s there is economic integration amongst all PBCs (see Table 6.7.1, Panel B) and that remains strong during the 1990s (see Table 6.7.2, Panel B).[101] For U.S. the situation is different. It is integrated with all PBCs

[99] In a more recent study Bekaert and Harvey (2000) developed a cross-sectional time-series model and assessed the impact of market liberalisation in emerging equity markets on the cost of capital, volatility, beta and correlation with World market returns and found that correlation increased by a small amount, 4.2 percent, in post-liberalisation periods.

[100] We run the exercise, as they have done, by correcting for the asymmetry in the sense that Japanese excess return was measured relative to the US interest rate. Thus, we undertook a symmetric covariance decomposition and obtained a positive, high and statistically significant correlation (0.936 for the period 1990.01-1998.12) confirming their result although for a different sample period. The different results when measuring the Japanese excess returns in Yen rather in US dollars might reflect the pattern of depreciation of the dollar against the yen during the sample period.

[101] There is only one exception, Japan versus Thailand.

for which data exist during the 1980s, but only with Hong Kong, Japan and Singapore subsequently.

Comparing the above results of the correlations of future dividend news with the correlations of industrial production growth presented in Table 6.2 one can observe that these are generally higher. This confirms one of the advantages of using our methodology, which picks small but persistent comovements of long-term dividend growth compared to the contemporaneous correlations of output growth, which might understate the degree of integration.

Thus, regional economic integration has been important throughout the period of examination and more so during the 1990's. On the other hand, there is less global integration. These results are in accord with those relating to financial integration outlined in the previous section.

These findings, however, might have been influenced by the Asian financial crisis of mid 1997. Studies on the 1987 stock market crash and the Mexican crisis have shown that correlations between stock markets increase during a crisis (see e.g. Roll, (1989), Calvo and Reinhart, (1996), Longin and Solnik, (1995)) and Malliaris and Urrutia, (1992). Thus, in Section 6.6, we test the robustness of the results for the period 1990.01 to 1997.06.

6.5.2.3 The link between economic and financial integration

Combining now the developments in economic and financial integration one can arrive at the following conclusions. First, during the 1980s, there is no case where financial integration has been found without the existence of economic integration. Second, during the 1990s in only two cases out of 38 we find financial integration, which is not accompanied by economic integration, namely Philippines and Thailand versus U.S. Thirdly, this link between economic integration and financial integration is also highlighted by the correlation of future domestic excess returns and future foreign dividend news. Throughout the period this correlation was high and statistically significant for all the cases where financial integration has been observed.

6.6 Robustness test to the Asian financial crisis

In Table 6.7.3 we present the correlations for the sub-period prior to the crisis 1990.01 to 1997.06. The results for U.S. are very different for this period compared to the 1990.01 -1998.12. Looking first at the correlations of future dividend news (see Panel B) we find U.S. to be economically integrated with all countries apart from Korea. Furthermore, the degree of economic integration is higher with two of the three countries with which integration was found in the post-crisis period, namely Hong Kong and Singapore.

The results are not very different for financial integration in the pre-crisis period (see Panel C) compared to the post-crisis period. U.S. was integrated with a few countries in both sub-periods; in the pre-crisis period with Indonesia, Singapore and Thailand; and in the post-crisis with Philippines and Thailand. PBCs on the other hand, were economically and financially integrated even before the crisis, but less so. Thus, the Asian financial crisis reduced global economic integration but increased regional economic and financial integration.

The link between economic and financial integration is highlighted also in this sub-period. There is only one case out of 30 where financial integration is not accompanied by economic integration (Japan/Malaysia). As in the previous sub-periods, this link is strengthened by the statistically significant correlation between future excess return and future foreign dividend news (see Panel D).

6.7 Conclusion

In this paper, we have examined questions relating to real and financial links amongst PBCs and between these countries and U.S. by analysing the covariance of returns on national stock markets. This framework has allowed us to examine these links simultaneously and more accurately and explore whether economic integration plays a role in linking the financial markets. This research has been motivated by the overwhelming evidence that financial markets can be integrated even in the presence of substantial foreign exchange restrictions. Our main empirical findings are as follows.

First, variation in dividends is the main source of stock return variance in all the countries examined. Correlated news about future dividend growth in each pair of countries is also the major contribution to the covariance of domestic and foreign excess stock returns indicating the strength of economic integration in the region. The substantial trade between each of the PBCs and the two large economies of Japan and U.S. observed in Table .6.1 provides an important transmission channel for country specific shocks. This channel has been examined and confirmed by Canova and Dellas (1993), Canova and DeNicolo (1995) and Canova and Marrinan (1998) for the European countries, and by Schmitt-Grohe (1998) for the transmission of shocks between U.S. and Canada. If for example, foreign capital goods are used in the production of domestic goods, then "allowing for production interdependencies introduces a previously neglected channel through which idiosyncratic shocks may be propagated across countries".[102] Furthermore, it should be noted that the economic integration observed in our paper is higher than that revealed by the contemporaneous correlation of industrial production confirming one of the advantages of using the methodology in this paper to measure economic integration.

Second, our results emphasised also the link between this economic integration with financial integration. We found overwhelming evidence that financial integration is accompanied by economic integration. This evidence seems to suggest that economic integration provides a channel for financial integration. If economic integration relates to countries' comovements of output growth, and economic activity is positively related to stock prices, as has been shown to be the case theoretically and empirically, then it is not surprising to find stock prices moving together as well. In fact the relationship between economic activity and stock prices is stronger if foreign influences are taken into account through consumption and production interdependencies (see Canova and DeNicole (1995)). Thus, our results explain, at least partly, the high financial market integration found in this study and in other studies even in the presence of foreign exchange restrictions. In the current study no differences could be observed in the degree of integration amongst countries with different degrees of stock market openness during the period of the 1990's. These findings do not lend support to the use of restrictions to isolate capital markets from world influences.

Third, the results indicate regional economic and financial integration, which became stronger during the 1990's even prior to the Asian crisis. This provides support to the view that economic integration and trade interdependencies might have

[102] See Canova and DeNicole (1995) pp 983-84.

played a major role to the contagion effect of the Asian crisis.[103] At the same time, the less pronounced financial integration of the PBCs at the global level before the crisis explains the mild effect of the crisis on world financial markets.

Finally, the results have revealed that some countries have close links with U.S., and other countries with Japan. For example, Thailand has been greatly financially integrated with U.S., while only the financial crisis seems to have linked it with Japan and even then less so than in U.S. On the other hand, Korea and Taiwan have had close links with Japan. They have been financially integrated with Japan before and after the crisis and have had no links with US. Ng (2000) finds similar links when examining volatility spillover effects from Japan and the U.S. to the PBCs.[104] These close links between Korea and Taiwan with Japan might stem from the substantial Japanese Direct Foreign Investment (DFI) in those countries since the mid 1980s. For example, it accounted for 52% of the DFI stock in Korea and 27% of Taiwan.[105] This DFI became increasingly export oriented, while at the same time imported a lot of parts and equipment from Japan, strengthening the economic and financial links of these countries.[106]

The study has produced some tentative results with regard to the financial and real links in the Pacific Basin region. As more data become available a more accurate picture will emerge. The main finding of the study regarding the importance of economic integration for financial integration needs to be tested for other emerging stock markets.

[103] See Glick and Rose, (1999) and Diwan and Hoekman, (2000).

[104] It is interesting to note that Thailand is not economically integrated with Japan, and Korea with US, if one concentrates at the pre-crisis period to avoid any possible effects of the crisis on integration. Taiwan, however, is equally economically integrated with both US and Japan.

[105] See Kreinin et al. (2000).

[106] In 1992, the ratio of export sales to total sales of Japanese affiliates in manufacturing was 45% in Asia compared with only 23% in Latin America.

Tables

Table 6.1: Exports and Imports from each PBC to U.S. and Japan over their GDP

Panel A: Exports and Imports from each PBC to U.S over its GDP

		1980	1985	1990	1995	1996	1997	1998	1999
Hong Kong	Exports	18.63	26.71	26.52	25.73	24.90	23.96	24.88	26.18
	Imports	9.58	8.08	8.90	10.11	10.16	9.48	8.42	8.02
Indonesia	Exports	5.93	4.62	3.03	3.21	3.04	5.30	4.51	5.92
	Imports	1.94	1.93	2.00	2.42	2.26	4.03	2.25	1.36
Korea	Exports	8.07	11.81	7.79	4.96	4.39	8.07	6.25	6.96
	Imports	8.54	7.18	6.19	6.24	6.72	11.21	5.53	5.87
Malaysia	Exports	8.83	6.16	11.31	17.52	14.20	20.09	21.22	23.54
	Imports	6.80	5.89	11.22	14.48	12.09	18.29	15.29	14.50
Philippines	Exports	4.97	5.52	8.07	8.55	8.43	14.62	14.87	14.15
	Imports	6.08	4.47	6.60	7.18	7.56	12.59	10.09	8.59
Singapore	Exports	20.23	26.12	29.44	25.82	25.08	27.58	26.20	25.52
	Imports	28.28	21.57	25.73	22.41	23.43	26.70	22.51	22.01
Taiwan	Exports			14.92	11.32	11.03	11.13	12.51	12.62
	Imports			7.21	7.25	6.55	6.73	6.66	6.55
Thailand	Exports	2.56	3.59	6.07	6.20	5.57	11.09	8.84	10.09
	Imports	4.15	2.70	4.17	5.23	5.13	8.62	6.29	4.65

Panel B:Exports and Imports from each PBC to Japan over its GDP

		1980	1985	1990	1995	1996	1997	1998	1999
Hong Kong	Exports	3.28	3.67	6.26	7.20	7.68	6.68	5.58	5.94
	Imports	18.58	19.67	17.75	19.44	17.47	16.75	14.21	13.25
Indonesia	Exports	14.89	9.82	3.03	6.24	5.59	9.25	5.83	7.34
	Imports	4.71	3.07	4.92	4.68	3.81	6.11	2.75	3.45
Korea	Exports	5.31	4.98	5.06	3.51	3.23	5.53	3.32	3.73
	Imports	10.23	8.27	7.44	6.69	6.33	10.41	4.56	5.68
Malaysia	Exports	12.33	11.84	10.22	10.52	10.46	13.78	10.31	12.50
	Imports	10.30	8.86	16.01	24.23	19.18	23.98	15.32	17.32
Philippines	Exports	4.80	2.91	4.22	3.77	4.44	6.92	6.21	6.28
	Imports	5.15	2.49	6.23	8.67	8.37	13.13	9.34	8.28
Singapore	Exports	13.02	11.62	12.12	11.03	11.15	10.56	8.66	9.85
	Imports	35.97	24.26	32.19	31.48	25.92	27.77	20.39	21.41
Taiwan	Exports			2.94	5.38	5.32	4.12	3.73	4.44

	Imports			4.93	10.89	9.24	9.10	8.45	10.08
Thailand	Exports	3.06	5.01	4.60	5.83	5.21	8.68	5.43	6.77
	Imports	6.08	6.29	11.75	13.30	11.36	16.07	7.39	10.00

Source: The GDP per each PBC is from the *International Financial Statistics YearBook*, IMF publication; the Export and Import from each PBC to Japan and U.S. as well as total Exports and Imports of each PBC are from the *Direction of Trade Statistics Yearbook*, IMF publication. The only exception is for Taiwan were the GDP is from *Datastream*.

Table 6.2: Correlations of monthly industrial production: 1990.01-1998.12

	Japan	Korea	Malay	Phil	Sing	Taiw	Thai	U.S.
H-K	**-.130**							**0.167**
Indon	**0.181**							**-.022**
Japan	-							
Korea	0.266	-						
Malay	0.241	0.199	-					
Phil	-0.029	0.191	0.021	-				
Sing	0.039	0.378	0.517	0.198	-			
Taiw	0.042	0.454	0.530	0.066	0.847	-		
Thai	0.249	0.362	0.150	-0.134	0.200	0.306	-	
U.S.	0.025	0.123	0.102	-0.081	-0.059	0.012	-0.069	-

For Hong-Kong and Indonesia only the quarterly correlations with Japan and U.S. are reported due to data availability (Bold values).

Table 6.3.1: Comparison of different signals of liberalisation

Country	Official Liberalisation date	First Country Fund	First ADR
Hong Kong	01.73[a]	-	-
Indonesia	09.89[b]	02.89[b]	04.91[e]
Malaysia	12.88[b]	12.87[b]	08.92[b]
Philippines	06.91[c]	05.86[b]	03.91[b]
Singapore	06.78[a]	-	-
Thailand	09.87[d]	07.85[b]	01.91[b]
Korea	01.92[b]	08.84[b]	11.90[b]
Taiwan	01.91[b]	05.86[b]	12.91[b]

Source:
[a] Exchange Arrangements and Restrictions, IMF publications, (various issues).
[b] Bekaert and Harvey (1998) and coincides with the International Finance Corporation (IFC) official liberalisation date, which is based on the Investable Index and represents the ratio of the market capitalisation of stocks that foreigners can legally hold to market capitalisation. A large jump in the Index is considered as evidence of an official liberalisation.
[c] Bekaert, and Harvey (2000). The date is in accord with the Foreign Investment Act, which removed, over a period of three years, all restrictions on foreign investments. Under the provisions, foreign investors are required only to register with the Securities and Exchange Commission and most sectors of the economy are opened to 100 percent foreign ownership. This date differs from the IFC official liberalisation date, which is October 1989, and is not associated with any particular regulatory changes.
[d] Bekaert and Harvey (2000). This date is in accord with the inauguration of the Stock Exchange of Thailand's Alien Board, which allows foreigners to trade stocks of those companies that have reached their foreign investment limits. Thais continue to trade stocks on the Main Board. Bailey and Jagtiani, (1994) report the same liberalisation date. This date differs, however, from the IFC liberalisation date, which is December 1988, and is not associated with any particular regulatory changes.
[e] Bekaert and Harvey (2000). In Bekaert and Harvey (1998) 02.1992 is reported as the first ADR.

Table 6.3.2: Emerging stock markets - Direct and indirect barriers for institutional investors (end-1989)

	Foreign ownership Limit	Dividends Repatriation	Capital Repatriation	Withholding Taxes on Dividend	Taxes on Capital Gains
Hong Kong	100%	Free	Free	0.0%	0.0%
Indonesia	49%[a]	Free	Free	20.0%	20.0%
Malaysia	100%[b]	Free	Free	35%(0%)	0.0%
Philippines[c]	40%[d]	Free	Free	15.0%	0.25%
Singapore	100%	Free	Free	0.0%	0.0%
Thailand	49% (25%)[e]	Free[f]	Free	20%(10)	25%(10)
Korea	10%(8%)[g]	Some Restrictions[h]	Some Restrictions[h]	25.0% (10-21.5%)	0.0% (11-27%[i])
Taiwan[c]	Special Funds only[l]	Free	Free	20.0%	0.6%

Source: The table is based on the information provided in the IFC' s Factbook, Harrison (1994), the Euromoney Annual Report and the Exchange Arrangements and Restrictions, IMF. All the data are as of end-1989. Rates shown in brackets apply only to approved new money Country Funds, where these may be different from normal treatment.

[a] The limit is reduced to 25% of own capital for foreign exchange banks and non-bank financial institutions.
[b] Foreign acquisition of investments exceeding M$ 5 million in value or equivalent of 15% or more of voting power in a Malaysian company requires the prior approval of the Foreign Investment Committee. In September 1998, the financial markets were completely closed to foreigners.
[c] Transaction taxes on gross transaction value.
[d] Foreign nationals may purchase shares up to 40% of a company's shares via B shares. Foreign participation beyond 40% needs to have prior approval by the Board of Investment (BOI). Investment not exceeding 40% need simply to be reported to BOI and the Central Bank of the Philippines for purposes of repatriation of capital and remittance of profits.
[e] Foreign investors are allowed to hold up to 49% of companies listed on the SET with the exception of the commercial banks and finance companies, where foreign ownership is restricted to 25% of the capital.
[f] A report is required for the repatriation of dividends and capital gains.
[g] Foreign ownership restriction of up to 10% of market capitalisation for "non-limited" industries and of up to 8% of market capitalisation for "limited" industries.
[h] The repatriation of initial capital, capital gains and dividend is subject to approval by the Ministry of Finance.
[i] Of net capital gains or gross sales proceeds, respectively.
[l] Foreign investors who open an account in a local brokerage house may only invest in three listed funds – Kwang Hua Growth Fund, NITC Fuyuan Fund and Citizen Fund. Domestic residents are allowed to remit outwards up to US$5 million per annum.

Table 6.4: Variance of U.S. excess stock returns

The table gives the variance decomposition of U.S. stock excess returns using a VAR specification. The VAR is in excess return on U.S. stocks, excess return on Hong Kong stocks, U.S. real interest rate, change in U.S. nominal interest rate, U.S. dividend yield and Hong Kong dividend yield. Excess returns are measured in dollars relative to the one-month Treasury Bill rate. Dividend yields are computed as the sum of dividends over the last 12 months divided by the current price. The components of the variance are given in equation (6.4). The standard errors of each statistic are in parentheses. All variables are measured in logs. Variables are measured in real terms unless otherwise stated. * denotes significance at 10 % level and ** at the 5% level.

	1981.01 - 1989.12	1990.01 - 1998.12
$Var(\tilde{e})$	0.179** (0.047)	0.086 (0.036)
	Proportion (%)	Proportion (%)
$Var(\tilde{e}_d)$	1.382** (0.421)	1.681** (0.333)
$-2\ cov(\tilde{e}_d, \tilde{e}_r)$	-0.074 (0.069)	-0.124** (0.025)
$Var(\tilde{e}_r)$	0.025** (0.008)	0.008** (0.001)
$-2\ cov(\tilde{e}_d, \tilde{e}_e)$	-0.540** (0.070)	-1.119** (0.025)
$Var(\tilde{e}_e)$	0.192 (0.200)	0.551** (0.232)
$2\ cov(\tilde{e}_r, \tilde{e}_e)$	0.015 (0.045)	0.074** (0.017)

Table 6.5: Variance decomposition of PBC excess stock returns.
The table gives the variance decomposition of each PBC excess stock returns using a VAR specification. The VAR is in excess return on U.S. stocks, excess return on PBC stocks, U.S. real interest rates, change in U.S. nominal interest rate, the real exchange rate, U.S. dividend yield and PBC dividend yield. Excess returns are measured in dollars relative to the one-month Treasury Bill rate. Dividend yields are computed as the sum of dividends over the last 12 months divided by the current price. The components of the variance are given in equation (6.5). All variables are measured in logs and are in real terms unless otherwise stated. * denotes significance at 10 % level and ** at the 5% level.

	Hong Kong		Japan	
	1981.01 - 1989.12	1990.01 - 1998.12	1980.01 - 1989.12	1990.01 – 1998.12
Var($\tilde{f}$)	1.23** (0.113)	0.721** (0.085)	0.365** (0.060)	1.78** (0.077)
	Proportion(%)	Proportion (%)	Proportion(%)	Proportion (%)
Var($\tilde{f}_d$)	1.066** (0.219)	0.881** (0.148)	1.536** (0.409)	1.029** (0.432)
-2 cov($\tilde{f}_d$, $\tilde{f}_r$)	0.014 (0.025)	0.002 (0.006)	-0.086** (0.044)	-0.040** (0.009)
-2 cov($\tilde{f}_d$, $\tilde{f}_q$)	0.004** (0.000)	0.000 (0.000)	0.012** (0.000)	0.001** (0.000)
- 2 cov ($\tilde{f}_d$, $\tilde{f}_f$)	-0.154 (0.155)	0.098 (0.099)	-0.712** (0.349)	-0.112 (0.330)
Var($\tilde{f}_r$)	0.004 (0.145)	0.001 (0.541)	0.011 (1.077)	0.000 (0.001)
2 cov($\tilde{f}_r$, $\tilde{f}_q$)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.008)
2cov($\tilde{f}_r$, $\tilde{f}_f$)	0.018 (0.015)	-0.002 (0.004)	0.076** (0.032)	0.006** (0.000)
Var($\tilde{f}_q$)	0.000 (0.000)	0.000 (0.000)	0.000 (0.001)	-0.000 (0.000)
2 cov($\tilde{f}_q$, $\tilde{f}_f$)	-0.001** (0.000)	-0.000 (0.000)	-0.002 (0.122)	-0.000 (0.226)
Var($\tilde{f}_f$)	0.048 (0.044)	0.020* (0.011)	0.165 (0.122)	0.116 (0.226)

	Singapore		Thailand	
	1980.01 - 1989.12	1990.01 – 1998.12	1980.01 - 1989.12	1990.01 – 1998.12
Var($\tilde{f}$)	0.693** (0.084)	0.436** (0.067)	0.402** (0.065)	1.32** (0.119)
	Proportion (%)	Proportion (%)	Proportion(%)	Proportion (%)
Var($\tilde{f}_d$)	1.232** (0.179)	1.070** (0.257)	1.744** (0.765)	1.456** (0.272)
-2 cov($\tilde{f}_d$, $\tilde{f}_r$)	0.016** (0.000)	0.002 (0.009)	0.002 (0.072)	0.004 (0.006)
-2 cov($\tilde{f}_d$, $\tilde{f}_q$)	0.010 (0.022)	0.002** (0.000)	0.008** (0.000)	0.012** (0.005)
- 2 cov ($\tilde{f}_d$, $\tilde{f}_f$)	-0.318** (0.135)	-0.096 (0.190)	-0.870 (0.671)	-0.530** (0.214)
Var($\tilde{f}_r$)	0.005 (1.790)	0.001 (0.311)	0.009 (5.321)	0.000 (0.006)
2 cov($\tilde{f}_r$, $\tilde{f}_q$)	0.000 (0.032)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
2cov($\tilde{f}_r$, $\tilde{f}_f$)	0.020 (0.016)	-0.008 (0.006)	-0.004 (0.016)	0.000 (0.005)
Var($\tilde{f}_q$)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.005)
2 cov($\tilde{f}_q$, $\tilde{f}_f$)	0.000 (0.000)	0.000 (0.000)	-0.002** (0.000)	-0.002 (0.004)
Var($\tilde{f}_f$)	0.044 (0.054)	0.029 (0.045)	0.113 (0.192)	0.060* (0.032)

	Indonesia	Korea	Malaysia	Philippines	Taiwan
	1990.01 – 1998.12	1990.01 - 1998.12	1990.01 – 1998.12	1990.01-1998.12	1990.01-1998.12
$Var(\tilde{f})$	1.41** (0.130)	1.22** (0.118)	1.340** (0.118)	1.08** (0.109)	1.49** (0.125)
	Proportion(%)	Proportion (%)	Proportion (%)	Proportion (%)	Proportion (%)
$Var(\tilde{f}_d)$	1.544** (0.401)	1.305** (0.345)	1.110** (0.335)	1.763** (0.435)	1.166** (0.217)
$-2\,cov(\tilde{f}_d, \tilde{f}_r)$	0.013** (0.002)	0.014** (0.005)	0.017** (0.006)	0.008 (0.009)	-0.001 (0.003)
$-2\,cov(\tilde{f}_d, \tilde{f}_q)$	0.022** (0.003)	0.012** (0.002)	0.012** (0.005)	0.006** (0.001)	-0.000 (0.000)
$-2\,cov(\tilde{f}_d, \tilde{f}_f)$	-0.754** (0.370)	-0.496 (0.374)	-0.205 (0.274)	-0.923** (0.405)	-0.229 (0.173)
$Var(\tilde{f}_r)$	0.000 (0.260)	0.001 (0.032)	0.001 (0.018)	0.000 (0.531)	0.000 (0.031)
$2\,cov(\tilde{f}_r, \tilde{f}_q)$	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
$2cov(\tilde{f}_r, \tilde{f}_f)$	-0.012* (0.007)	-0.007** (0.003)	0.011** (0.005)	-0.006 (0.007)	-0.008** (0.003)
$Var(\tilde{f}_q)$	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
$2\,cov(\tilde{f}_q, \tilde{f}_f)$	-0.006** (0.003)	0.001** (0.000)	-0.002 (0.003)	-0.002** (0.000)	0.000 (0.000)
$Var(\tilde{f}_f)$	0.193 (0.158)	0.170 (0.138)	0.056 (0.086)	0.151 (0.148)	0.072 (0.071)

Table 6.6.1: Covariance Decomposition of U.S. and PBCs: 1980.01-1989.12

This table reports the major contributions to the excess covariance among U.S. and PBCs. The VAR is in excess return on U.S. stocks, excess return on PBC stocks, U.S. real interest rates, change in U.S. nominal interest rate, the real exchange rate, U.S. dividend yield and PBC dividend yield. Excess returns are measured in dollars relative to the one-month Treasury Bill rate. Dividend yields are computed as the sum of dividends over the last 12 months divided by the current price. The components of the variance are given in equation (6.6). All variables are measured in logs and are in real terms unless otherwise stated. For Hong Kong the sample period covers 1981.01 to 1989.12. * denotes significance at 10 % level and ** at the 5% level.

Panel A: Covariances of excess returns

	Hong Kong	Japan	Singapore	Thailand	U.S.
Hong Kong	-				
Japan	0.122** (0.000)	-			
Singapore	0.358** (0.000)	0.064** (0.000)	-		
Thailand	0.287** (0.000)	0.074** (0.000)	0.254** (0.000)	-	
U.S.	0.026** (0.000)	0.055** (0.000	-.029** (0.000)	0.009** (0.000)	-

Panel B: Covariances of future dividend news

	Hong Kong	Japan	Singapore	Thailand	U.S.
Hong Kong	-				
Japan	0.546** (0.002)	-			
Singapore	1.770** (0.022)	0.475** (0.017)	-		
Thailand	0.939** (0.034)	0.163** (0.014)	1.200** (0.025)	-	
U.S.	0.176* (0.105)	0.190** (0.087)	0.686 (0.561)	0.241** (0.099)	-

Panel C: Covariances of future excess returns news

	Hong Kong	Japan	Singapore	Thailand	U.S.
Hong Kong	-				
Japan	0.190** (0.012)	-			
Singapore	0.589** (0.013)	0.219** (0.010)	-		
Thailand	0.190** (0.019)	0.084** (0.008)	0.364** (0.013)	-	
U.S.	0.007** (0.002)	0.020** (0.002)	0.042** (0.003)	0.053** (0.004)	

Panel D: Covariances of future domestic excess return and future foreign dividend news

	Hong Kong	Japan	Singapore	Thailand	U.S.
Hong Kong	-				
Japan	0.423** (0.018)	-			
Singapore	0.060** (0.020)	0.279** (0.014)	-		
Thailand	0.336** (0.029)	0.085** (0.011)	0.615** (0.020)	-	
U.S.	0.180** (0.011)	0.094** (0.005)	0.266** (0.007)	0.212** (0.001)	-

Table 6.6.2: Covariance Decomposition of U.S. and PBCs: 1990.01-1998.12

Panle A: Covariances of excess returns

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	0.683** (0.000)	-							
Japan	0.132** (0.000)	0.133** (0.000)	-						
Korea	0.350** (0.080)	0.409** (0.000)	0.358** (0.000)	-					
Malay	0.611** (0.000)	0.729** (0.000)	0.182** (0.000)	0.305** (0.000)	-				
Philip	0.558** (0.000)	0.651** (0.000)	0.218** (0.000)	0.318** (0.000)	0.724** (0.000)	-			
Singap	0.411** (0.000)	0.471** (0.000)	0.253** (0.000)	0.250** (0.001)	0.540** (0.001)	0.516** (0.001)	-		
Taiwan	0.457** (0.000)	0.407** (0.000)	0.240** (0.000)	0.379** (0.000)	0.593** (0.002)	0.606** (0.000)	0.405** (0.000)	-	
Thai	0.617** (0.000)	0.465** (0.000)	0.300** (0.000)	0.517** (0.000)	0.884** (0.000)	0.855** (0.000)	0.550** (0.000)	0.547** (0.000)	-
U.S.	-.035** (0.000)	0.025** (0.000)	0.126** (0.000)	0.006** (0.000)	-.001** (0.000)	-.011** (0.000)	-.010** (0.000)	0.008** (0.000)	-.07** (0.000)

Panel B: Covariances of future dividend news

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	3.100** (0.041)	-							
Japan	0.519** (0.018)	0.699** (0.034)	-						
Korea	1.800** (0.042)	2.980** (0.108)	1.550** (0.039)	-					
Malay	3.000** (0.044)	4.280** (0.111)	1.160** (0.028)	2.850** (0.094)	-				
Philip	2.610** (0.035)	4.310** (0.072)	1.030** (0.039)	2.030** (0.007)	4.760** (0.093)	-			
Singap	1.710** (0.017)	2.230** (0.034)	0.967** (0.016)	1.270** (0.026)	2.640** (0.040)	2.740** (0.027)	-		
Taiwan	1.960** (0.016)	1.770** (0.059)	1.350** (0.020)	1.820** (0.038)	2.540** (0.041)	3.480** (0.037)	1.720** (0.021)	-	
Thai	2.780** (0.029)	2.810** (0.059)	1.090** (0.030)	2.740** (0.072)	4.920** (0.070)	4.670** (0.054)	2.780** (0.038)	2.520** (0.050)	-
U.S.	0.098** (0.021)	0.093 (0.102)	0.558** (0.142)	0.019 (0.012)	0.017** (0.008)	0.127 (0.112)	0.245** (0.132)	0.069 (0.052)	.079** (0.009)

Panel C: Covariances of future excess returns news

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	0.865** (0.021)	-							
Japan	0.136** (0.009)	0.242** (0.020)	-						
Korea	0.602** (0.029)	1.150** (0.064)	0.448** (0.021)	-					
Malay	0.912** (0.026)	1.520** (0.067)	0.427** (0.016)	1.230** (0.056)	-				
Philip	0.791** (0.020)	1.660** (0.044)	0.365** (0.022)	0.795** (0.035)	1.760** (0.058)	-			
Singap	0.445** (0.009)	0.679** (0.020)	0.276** (0.009)	0.416** (0.014)	0.808** (0.022)	0.886** (0.016)	-		
Taiwan	0.516** (0.009)	0.528** (0.034)	0.429** (0.012)	0.593** (0.023)	0.705** (0.023)	1.200** (0.023)	0.456** (0.012)	-	
Thai	0.792** (0.015)	1.070** (0.036)	0.330** (0.005)	0.962** (0.041)	1.640** (0.040)	1.540** (0.031)	0.870** (0.021)	0.711** (0.027)	-
U.S.	-.013** (0.002)	0.031** (0.004)	0.066** (0.004)	-.006** (0.003)	-.026** (0.002)	0.043** (0.003)	-.060** (0.002)	-.025** (0.002)	0.043** (0.008)

Panle D: Covariances between future domestic excess return and future foreign dividend news.

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	1.410** (0.029)	-							
Japan	0.206** (0.015)	0.559** (0.031)	-						
Korea	0.929** (0.028)	2.120** (0.094)	0.826** (0.027)	-					
Malay	1.540** (0.035)	2.940** (0.092)	0.646** (0.024)	1.940** (0.024)	-				
Philip	1.490** (0.026)	3.000** (0.055)	0.585** (0.030)	1.250** (0.050)	2.770** (0.077)	-			
Singap	0.871** (0.013)	1.440** (0.029)	0.485** (0.012)	0.706** (0.021)	1.460** (0.031)	1.660** (0.023)	-		
Taiwan	0.952** (0.016)	1.140** (0.052)	0.729** (0.019)	1.010** (0.032)	1.220** (0.012)	1.920** (0.034)	0.829** (0.019)	-	
Thai	1.500** (0.020)	1.950** (0.053)	0.568** (0.024)	1.710** (0.065)	2.940** (0.058)	2.860** (0.041)	1.560** (0.027)	1.400** (0.034)	-
U.S.	0.140** (0.004)	0.197** (0.009)	0.392** (0.005)	0.083** (0.009)	0.094** (0.005)	0.211** (0.009)	0.142** (0.004)	0.102** (0.003)	0.204** (0.008)

Table 6.6.3: Covariance Decomposition of U.S. and PBCs: 1990.01-1997.06

Panel A: Covariances of future dividend news

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	1.600** (0.027)	-							
Japan	0.057** (0.019)	-.241** (0.026)	-						
Korea	0.507** (0.010)	0.132** (0.027)	0.778** (0.021)	-					
Malay	1.100** (0.012)	1.38** (0.026)	0.274** (0.017)	0.307** (0.008)	-				
Philip	1.200** (0.018)	1.960** (0.032)	0.299** (0.030)	0.276** (0.023)	1.580** (0.021)	-			
Singap	0.987** (0.008)	0.968** (0.013)	0.657** (0.017)	0.324** (0.011)	1.000** (0.013)	1.480** (0.022)	-		
Taiwan	1.310** (0.018)	1.340** (0.055)	1.130** (0.016)	1.160** (0.017)	1.290** (0.022)	2.820** (0.025)	1.210** (0.022)	-	
Thai	1.130** (0.018)	1.630** (0.037)	0.392** (0.032)	0.354** (0.021)	1.640** (0.018)	2.340** (0.042)	1.380** (0.023)	1.080** (0.047)	-
U.S.	0.127** (0.001)	0.175** (0.001)	0.031** (0.000)	-.011** (0.000)	0.109** (0.000)	0.119** (0.000)	0.121** (0.000)	0.119** (0.000)	0.143** (0.001)

Panel B: Covariances of excess returns

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	0.332** (0.000)	-							
Japan	0.036** (0.000)	0.006** (0.000)	-						
Korea	0.137** (0.000)	0.072** (0.000)	0.187** (0.000)	-					
Malay	0.289** (0.000)	0.227** (0.000)	0.107** (0.000)	0.088** (0.000)	-				
Philip	0.359** (0.000)	0.325** (0.000)	0.066** (0.000)	0.084** (0.000)	0.352** (0.000)	-			
Singap	0.234** (0.000)	0.163** (0.000	0.148** (0.000)	0.109** (0.000)	0.230** (0.001)	0.314** (0.000)	-		
Taiwan	0.340** (0.000)	0.205** (0.000)	0.208** (0.000)	0.316** (0.000)	0.303** (0.000)	0.505** (0.000)	0.284** (0.000)	-	
Thai	0.325** (0.000)	0.289** (0.000)	0.091** (0.000)	0.087** (0.000)	0.359** (0.000)	0.531** (0.000)	0.285** (0.000)	0.299** (0.000)	-
U.S.	0.012** (0.000)	0.043** (0.000)	0.020** (0.000)	0.010** (0.000)	0.035** (0.000)	0.012** (0.000)	0.023** (0.000)	0.012** (0.000)	0.010** (0.000)

Panel C: Covariances of future excess returns news

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	0.478** (0.015)	-							
Japan	0.015 (0.010)	0.001 (0.015)	-						
Korea	0.118** (0.005)	-0.027* (0.016)	0.211** (0.011)	-					
Malay	0.291** (0.006)	0.478** (0.015)	0.015** (0.009)	0.081** (0.005)	-				
Philip	0.268** (0.009)	0.670** (0.017)	0.086** (0.016)	0.054** (0.012)	0.461** (0.011)	-			
Singap	0.259** (0.005)	0.323** (0.008)	0.193** (0.010)	0.052** (0.006)	0.279** (0.008)	0.434** (0.023)	-		
Taiwan	0.305** (0.009)	0.459** (0.032)	0.366** (0.011)	0.275** (0.009)	0.347** (0.012)	0.928** (0.016)	0.318** (0.013)	-	
Thai	0.247** (0.009)	0.538** (0.022)	0.113** (0.018)	0.092** (0.012)	0.475** (0.010)	0.640** (0.022)	0.407** (0.013)	0.222** (0.025)	-
U.S.	0.002** (0.000)	0.039** (0.000)	0.004** (0.002)	-.024** (0.000)	-.003** (0.000)	0.013** (0.000)	0.014** (0.000)	-.016** (0.000)	0.025** (0.000)

Panel D: Covariances between future domestic excess return and future foreign dividend news.

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	0.797** (0.022)	-							
Japan	-.036** (0.014)	-.132** (0.022)	-						
Korea	0.204** (0.008)	0.047** (0.019)	0.414** (0.015)	-					
Malay	0.590** (0.008)	0.009 (0.029)	0.012 (0.015)	0.189** (0.007)	-				
Philip	0.587** (0.004)	1.280** (0.028)	0.135** (0.012)	0.086** (0.018)	0.815** (0.019)	-			
Singap	0.519** (0.007)	0.673** (0.012)	0.302** (0.014)	0.109** (0.008)	0.536** (0.011)	0.865** (0.017)	-		
Taiwan	0.604** (0.017)	0.990** (0.044)	0.620** (0.018)	0.498** (0.016)	0.611** (0.023)	1.510** (0.029)	0.589** (0.019)	-	
Thai	0.566** (0.013)	1.030** (0.032)	0.152** (0.025)	0.207** (0.018)	0.869** (0.049)	1.230** (0.029)	0.709** (0.016)	0.530** (0.033)	-
U.S.	0.099** (0.001)	0.120** (0.001)	0.037** (0.000)	0.009** (0.000)	0.046** (0.000)	0.098** (0.000)	0.087** (0.000)	0.037** (0.009)	0.099** (0.001)

Table 6.7.1: Correlations of U.S. and PBCs: 1980.01-1989.12

This table reports the results of correlations of U.S. and PBCs excess stock returns components. . The VAR is in excess return on U.S. stocks, excess return on PBC stocks, U.S. real interest rates, change in U.S. nominal interest rate, the real exchange rate, U.S. dividend yield and PBC dividend yield. Excess returns are measured in dollars relative to the one-month Treasury Bill rate. Dividend yields are computed as the sum of dividends over the last 12 months divided by the current price. The components of the variance are given in equation (6.7). All variables are measured in logs and are in real terms unless otherwise stated. For Hong Kong the sample period covers 1981.01 to 1989.12. * denotes significance at 10 % level and ** at the 5% level.

Panel A: Correlations of excess returns

	Hong Kong	Japan	Singapore	Thailand	U.S.
Hong Kong	-				
Japan	0.184** (0.001)	-			
Singapore	0.409** (0.000)	0.137** (0.000)	-		
Thailand	0.393** (0.000)	0.012** (0.000)	0.491** (0.000)	- -	
U.S.	0.055** (0.000)	0.215** (0.000)	-.035** (0.000)	0.033** (0.000)	-

Panel B: Correlations of future dividend news

	Hong Kong	Japan	Singapore	Thailand	U.S.
Hong Kong	-				
Japan	0.127* (0.082)	-			
Singapore	0.484** (0.046)	0.228** (0.073)	-		
Thailand	0.310** (0.103)	0.056 (0.080)	0.496** (0.054)	-	
U.S.	0.311* (0.192)	0.484** (0.101)	0.532** (0.098)	0.552** (0.018)	-

Panel C: Correlations of future excess returns news

	Hong Kong	Japan	Singapore	Thailand	U.S.
Hong Kong	-				
Japan	0.120 (0.146)	-			
Singapore	0.576** (0.087)	0.345** (0.125)	-		
Thailand	0.255 (0.193)	0.077 (0.144)	0.501** (0.094)	-	
U.S.	0.139 (0.485)	0.436 (0.328)	0.799** (0.275)	0.975** (0.329)	

Panel D: Correlations of future domestic excess return and future foreign dividend news

	Hong Kong	Japan	Singapore	Thailand	U.S.
Hong Kong	-				
Japan	0.285** (0.113)	-			
Singapore	0.555** (0.079)	0.245** (0.011)	-		
Thailand	0.200 (0.182)	0.085 (0.109)	0.481** (0.116)	-	
U.S.	0.851** (0.242)	0.640** (0.182)	0.961** (0.053)	0.996** (0.015)	-

Table 6.7.2: Period 1990.01-1998.12

Panle A: Correlations of excess returns

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	0.616** (0.000)	-							
Japan	0.234** 0.000)	0.197** (0.000)	-						
Korea	0.363** (0.080)	0.316** (0.000)	0.425** (0.000)	-					
Malay	0.617** (0.000)	0.577** (0.000)	0.210** (0.000)	0.263** (0.000)	-				
Philip	0.624** (0.000)	0.516** (0.000)	0.279** (0.000)	0.277** (0.000)	0.627** (0.000)	-			
Singap	0.724** (0.000)	0.628** (0.000)	0.454** (0.000)	0.335** (0.001)	0.708** (0.001)	0.725** (0.001)	-		
Taiwan	0.441** (0.000)	0.297** (0.000)	0.250** (0.000)	0.276** (0.000)	0.416** (0.002)	0.486** (0.000)	0.494** (0.000)	-	
Thai	0.642** (0.000)	0.537** (0.000)	0.314** (0.000)	0.415** (0.000)	0.698** (0.000)	0.706** (0.000)	0.768** (0.000)	0.386** (0.000)	-
U.S.	-.140** (0.000)	0.069** (0.000)	0.276** (0.000)	0.016** (0.000)	-.116** (0.000)	-.034** (0.000)	-.154** (0.000)	0.020** (0.000)	- .200** (0.000)

Panel B: Correlations of future dividend news

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	0.666** (0.043)	-							
Japan	0.223** (0.055)	0.243** (0.063)	-						
Korea	0.452** (0.044)	0.516** (0.085)	0.428** (0.051)	-					
Malay	0.699** (0.032)	0.718** (0.061)	0.319** (0.065)	0.533** (0.086)	-				
Philip	0.638** (0.037)	0.644** (0.044)	0.320** (0.081)	0.321** (0.075)	0.774** (0.031)	-			
Singap	0.735** (0.027)	0.610** (0.044)	0.485** (0.051)	0.369** (0.073)	0.775** (0.029)	0.798** (0.005)	-		
Taiwan	0.476** (0.042)	0.589** (0.068)	0.330** (0.043)	0.286** (0.061)	0.417** (0.048)	0.541** (0.026)	0.479** (0.052)	-	
Thai	0.659** (0.039)	0.662** (0.052)	0.321** (0.068)	0.467** (0.078)	0.806** (0.030)	0.754** (0.032)	0.767** (0.036)	0.387** (0.072)	-
U.S.	0.322** (0.085)	0.180 (0.197)	0.724** (0.171)	0.039 (0.198)	0.038 (0.172)	0.249 (0.224)	0.344** (0.144)	0.139 (0.106)	0.15 (0.194)

Panel C: Correlations of future excess returns news

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	0.686** (0.076)	-							
Japan	0.212* (0.117)	0.310** (0.118)	-						
Korea	0.524** (0.081)	0.622** (0.107)	0.446** (0.095)	-					
Malay	0.774** (0.054)	0.810** (0.082)	0.415** (0.119)	0.731** (0.088)	-				
Philip	0.656** (0.067)	0.677** (0.066)	0.369** (0.142)	0.429** (0.127)	0.832** (0.043)	-			
Singap	0.732** (0.053)	0.373** (0.066)	0.523** (0.102)	0.443** (0.114)	0.832** (0.052)	0.811** (0.030)	-		
Taiwan	0.498** (0.086)	0.281** (0.125)	0.408** (0.088)	0.422** (0.092)	0.440** (0.100)	0.577** (0.024)	0.452** (0.105)	-	
Thai	0.669** (0.066)	0.675** (0.088)	0.335** (0.125)	0.871** (0.038)	0.497** (0.245)	0.778** (0.048)	0.804** (0.054)	0.379** (0.136)	-
U.S.	-.543 (0.508)	0.321 (0.441)	0.414 (0.692)	-0.525 (0.339)	-.320 (0.751)	0.546** (0.109)	-0.027 (0.854)	-.524 (0.347)	0.812** (0.213)

Panel D: Correlations between future domestic excess return and future foreign dividend news.

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	0.643** (0.074)	-							
Japan	0.189 (0.128)	0.226** (0.109)	-						
Korea	0.602** (0.023)	0.571** (0.133)	0.438** (0.061)	-					
Malay	0.757** (0.053)	0.800** (0.046)	0.338** (0.103)	0.639** (0.077)	-				
Philip	0.693** (0.043)	0.760** (0.048)	0.315** (0.114)	0.394** (0.106)	0.811** (0.041)	-			
Singap	0.766** (0.047)	0.775** (0.052)	0.355** (0.050)	0.394** (0.093)	0.800** (0.039)	0.846** (0.030)	-		
Taiwan	0.472** (0.079)	0.306** (0.117)	0.352** (0.048)	0.306** (0.080)	0.383** (0.093)	0.534** (0.079)	0.446** (0.088)	-	
Thai	0.719** (0.050)	0.647** (0.086)	0.285** (0.122)	0.555** (0.114)	0.865** (0.043)	0.794** (0.051)	0.804** (0.050)	0.412** (0.099)	-
U.S.	0.803** (0.086)	0.706** (0.193)	0.830** (0.369)	0.443 (0.432)	0.521** (0.241)	0.797** (0.189)	0.848** (0.096)	0.527** (0.183)	0.761** (0.161)

Table 6.7.3: Period 1990.01-1997.06

Panel A: Correlations of excess returns

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	0.595** (0.000)	-							
Japan	0.123** (0.000)	0.061** (0.000)	-						
Korea	0.287** (0.000)	0.176** (0.000)	0.359** (0.000)	-					
Malay	0.646** (0.000)	0.570** (0.000)	0.210** (0.003)	0.210** (0.000)	-				
Philip	0.600** (0.000)	0.523** (0.000)	0.094** (0.000)	0.115** (0.000)	0.609** (0.000)	-			
Singap	0.636** (0.000)	0.489** (0.000	0.383** (0.000)	0.292** (0.000)	0.726** (0.001)	0.703** (0.000)	-		
Taiwan	0.378** (0.000)	0.269** (0.000)	0.212** (0.000)	0.314** (0.000)	0.380** (0.000)	0.450** (0.000)	0.439** (0.000)	-	
Thai	0.515** (0.000)	0.464** (0.000)	0.135** (0.000)	0.154** (0.000)	0.637** (0.000)	0.665** (0.000)	0.636** (0.000)	0.288** (0.000)	-
U.S.	0.067** (0.000)	0.226** (0.000)	0.120** (0.000)	0.053** (0.000)	0.198** (0.000)	0.026** (0.000)	0.090** (0.000)	0.064** (0.000)	0.041** (0.000)

Panel B: Correlations of future dividend news

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	0.049** (0.061)	-							
Japan	0.077 (0.064)	0.047 (0.082)	-						
Korea	0.255** (0.055)	0.164* (0.098)	0.377** (0.077)	-					
Malay	0.660** (0.032)	0.701** (0.047)	-0.192 (0.337)	0.192** (0.054)	-				
Philip	0.515** (0.045)	0.613** (0.047)	0.100 (0.094)	0.084 (0.088)	0.626** (0.034)	-			
Singap	0.647** (0.030)	0.600** (0.043)	0.387** (0.070)	0.210** (0.066)	0.731* (0.032)	0.732** (0.033)	-		
Taiwan	0.363** (0.056)	0.397** (0.091)	0.269** (0.039)	0.263** (0.048)	0.396** (0.065)	0.566** (0.043)	0.431** (0.075)	-	
Thai	0.417** (0.048)	0.499** (0.088)	0.133 (0.102)	0.167** (0.080)	0.665** (0.043)	0.622** (0.058)	0.667** (0.047)	0.243** (0.097)	-
U.S.	0.535** (0.094)	0.550** (0.162)	0.223** (0.102)	-0.055 (0.104)	0.476** (0.148)	0.280* (0.162)	0.609** (0.122)	0.275** (0.080)	0.397** (0.166)

Panel C: Correlations of future excess returns news

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	0.685** (0.112)	-							
Japan	0.020 (0.018)	0.019 (0.157)	-						
Korea	0.210* (0.113)	-0.140 (0.202)	0.394** (0.150)	-					
Malay	0.657** (0.060)	0.785** (0.068)	0.989** (0.014)	0.192* (0.289)	-				
Philip	0.436** (0.098)	0.664** (0.074)	0.107 (0.189)	0.050 (0.181)	0.645** (0.065)	-			
Singap	0.650** (0.061)	0.668** (0.071)	0.400** (0.145)	0.126 (0.141)	0.720** (0.070)	0.753** (0.060)	-		
Taiwan	0.333** (0.112)	0.473** (0.156)	0.323** (0.085)	0.232** (0.101)	0.401** (0.132)	0.652** (0.077)	0.411** (0.154)	-	
Thai	0.335** (0.096	0.512** (0.158)	0.132 (0.197)	0.174 (0.162)	0.681** (0.087)	0.583** (0.259)	0.689** (0.083)	0.186 (0.180)	-
U.S.	0.109 (0.553)	0.867** (0.239)	0.496 (1.414)	-.755** (0.176)	-0.085 (0.486)	0.157 (0.549)	0.714** (0.549)	-0.392 (0.560)	0.726** (0.324)

Panel D: Correlations between future domestic excess return and future foreign dividend news.

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	0.687** (0.122)	-							
Japan	-0.040 (0.160)	-0.081 (0.132)	-						
Korea	0.237** (0.104)	0.034 (0.142)	0.387** (0.098)	-					
Malay	0.684** (0.068)	0.665** (0.078)	0.012 (0.149)	0.234** (0.061)	-				
Philip	0.494** (0.089)	0.635** (0.081)	0.089 (0.147)	0.066 (0.144)	0.624** (0.083)	-			
Singap	0.690** (0.057)	0.632** (0.075)	0.327** (0.114)	0.153 (0.113)	0.746** (0.070)	0.780** (0.044)	-		
Taiwan	0.346** (0.097)	0.373** (0.143)	0.294** (0.035)	0.299** (0.082)	0.368** (0.130)	0.559** (0.073)	0.404** (0.117)	-	
Thai	0.427** (0.077)	0.519** (0.014)	0.095 (0.156)	0.164 (0.145)	0.679** (0.084)	0.595** (0.077)	0.645** (0.060)	0.209** (0.141)	-
U.S.	0.787** (0.103)	0.785** (0.129)	0.400** (0.288)	0.110 (0.163)	0.523* (0.312)	0.572* (0.303)	0.866** (0.103)	0.478** (0.187)	0.631** (0.055)

Appendix 6.A: The estimation of components

Given the state of vector and VAR system as in Section III, and defining ι_1 as a vector whose first element is one and whose other elements are zero, the excess stock returns for the domestic country, $\tilde{e}$, can be picked out as $\iota_1' z$. Defining ι_2, ι_3, and ι_4 in an analogous manner, we pick f, r, and q out of z. Finally, the components of domestic excess stock returns, in equations (6.1) and (6.2), can be derived as follows

(A1)
$$\tilde{e}_{e,t+1} = \iota_1' \sum_{j=1}^{\infty} \rho^j A^j \omega_{t+1} = \iota_1' \rho A (I - \rho A)^{-1} \omega_{t+1},$$
$$\tilde{e}_{r,t+1} = \iota_3' \sum_{j=0}^{\infty} \rho^j A^j \omega_{t+1} = \iota_3' (I - \rho A)^{-1} \omega_{t+1},$$
$$\tilde{e}_{t+1} = \iota_1' \omega_{t+1}$$
$$\tilde{e}_{d,t+1} = \tilde{e}_{t+1} + \tilde{e}_{r,t+1} + \tilde{e}_{e,t+1}.$$

In a similar way, the components of the foreign excess stock returns, in equations (5) and (6), can be obtained as

(A2)
$$\tilde{f}_{f,t+1} = \iota_2' \sum_{j=1}^{\infty} (\rho^*)^j A^j \omega_{t+1} = \iota_2' \rho^* A (I - \rho^* A)^{-1} \omega_{t+1},$$
$$\tilde{f}_{r,t+1} = \iota_3' \sum_{j=0}^{\infty} (\rho^*)^j A^j \omega_{t+1} = \iota_3' (I - \rho^* A)^{-1} \omega_{t+1},$$
$$\tilde{f}_{q,t+1} = \iota_4' (1 - \rho^*)(I - \rho^* A)^{-1} \omega_{t+1},$$
$$\tilde{f}_{t+1} = \iota_2' \omega_{t+1},$$
$$\tilde{f}_{d,t+1} = \tilde{f}_{t+1} + \tilde{f}_{r,t+1} + \tilde{f}_{q,t+1} + \tilde{f}_{f,t+1}.$$

Appendix 6.B

Table 6.8.1: Robustness tests without instrumental variables in the VAR: 1980.01-1989.12[107]

Panel A: Covariances of excess returns

	Hong Kong	Japan	Singapore	Thailand	U.S.
Hong Kong	-				
Japan	0.121** (0.000)	-			
Singapore	0.358** (0.000)	0.065** (0.000)	-		
Thailand	0.284** (0.000)	0.070** (0.000)	0.254** (0.000)	-	
U.S.	0.027** (0.000)	0.055** (0.000)	-.011** (0.000)	0.009** (0.000)	-

Panel B: Covariances of future dividend news

	Hong Kong	Japan	Singapore	Thailand	U.S.
Hong Kong	-				
Japan	0.537** (0.024)	-			
Singapore	1.770** (0.024)	0.477** (0.019)	-		
Thailand	0.964** (0.038)	0.203** (0.013)	1.200** (0.027)	-	
U.S.	0.176** (0.011)	0.190** (0.007)	0.245** (0.008)	0.241** (0.007)	-

Panel C: Covariances of future excess returns news

	Hong Kong	Japan	Singapore	Thailand	U.S.
Hong Kong	-				
Japan	0.186** (0.012)	-			
Singapore	0.589** (0.014)	0.219** (0.011)	-		
Thailand	0.199** (0.020)	0.091** (0.007)	0.363** (0.014)	-	
U.S.	0.012** (0.004)	0.020** (0.002)	0.042** (0.003)	0.053** (0.005)	

Panel D: Covariances of future domestic excess return and future foreign dividend news

	Hong Kong	Japan	Singapore	Thailand	U.S.
Hong Kong	-				
Japan	0.416** (0.018)	-			
Singapore	1.070** (0.021)	0.296** (0.016)	-		
Thailand	0.346** (0.032)	0.099** (0.003)	0.616** (0.023)	-	
U.S.	0.180** (0.011)	0.095** (0.005)	0.266** (0.008)	0.212** (0.008)	-

[107] For Hong Kong the sample period covers 1981.01 to 1989.12.

Table 6.8.2: Robustness tests without instrumental variables in the VAR: 1990.01-1998.12

Panel A: Covariances of excess returns

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	0.642** (0.000)	-							
Japan	0.152** 0.000)	0.173** (0.000)	-						
Korea	0.336** (0.080)	0.434** (0.000)	0.358** (0.000)	-					
Malay	0.586** (0.000)	0.760** (0.000)	0.182** (0.000)	0.305** (0.000)	-				
Philip	0.550** (0.000)	0.649** (0.000)	0.183** (0.000)	0.317** (0.000)	0.724** (0.000)	-			
Singap	0.411** (0.000)	0.482** (0.000)	0.219** (0.000)	0.250** (0.001)	0.540** (0.001)	0.516** (0.001)	-		
Taiwan	0.457** (0.000)	0.433** (0.000)	0.253** (0.000)	0.379** (0.000)	0.593** (0.002)	0.606** (0.000)	0.405** (0.000)	-	
Thai	0.617** (0.000)	0.432** (0.000)	0.240** (0.000)	0.517** (0.000)	0.884** (0.000)	0.855** (0.000)	0.549** (0.000)	0.548** (0.000)	-
U.S.	-.035** (0.000)	0.025** (0.000)	0.009** (0.000)	0.006** (0.000)	-.004** (0.000)	-.011** (0.000)	-.029** (0.000)	0.008** (0.000)	-.07** (0.000)

Panel B: Covariances of future dividend news

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	2.970** (0.038)	-							
Japan	0.571** (0.016)	1.010** (0.030)	-						
Korea	1.680** (0.033)	3.230** (0.032)	1.550** (0.037)	-					
Malay	2.800** (0.045)	4.4450** (0.038)	1.160** (0.031)	2.850** (0.096)	-				
Philip	2.640** (0.035)	4.410** (0.080)	1.040** (0.040)	2.030** (0.056)	4.760** (0.116)	-			
Singap	1.700** (0.020)	2.310** (0.033)	0.967** (0.019)	1.270** (0.025)	2.640** (0.048)	2.740** (0.038)	-		
Taiwan	1.980** (0.023)	2.090** (0.057)	1.350** (0.041)	1.820** (0.041)	2.540** (0.050)	3.510** (0.069)	1.720** (0.031)	-	
Thai	2.780** (0.038)	3.630** (0.075)	1.090** (0.035)	2.740** (0.078)	4.920** (0.093)	4.680** (0.081)	2.780** (0.046)	2.530** (0.066)	-
U.S.	0.098** (0.004)	0.093** (0.010)	0.046** (0.006)	0.019** (0.001)	0.017** (0.008)	0.127 (0.001)	0.087** (0.004)	0.069** (0.006)	0.079** (0.009)

Panel C: Covariances of future excess returns news

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	0.832** (0.019)	-							
Japan	0.139** (0.008)	0.359** (0.017)	-						
Korea	0.515** (0.018)	1.250** (0.060)	0.449** (0.020)	-					
Malay	0.826** (0.025)	1.590** (0.071)	0.427** (0.018)	1.230** (0.058)	-				
Philip	0.791** (0.022)	1.7200** (0.049)	0.370** (0.023)	0.796** (0.035)	1.760** (0.070)	-			
Singap	0.441** (0.010)	0.708** (0.019)	0.276** (0.001)	0.417** (0.014)	0.808** (0.026)	0.885** (0.022)	-		
Taiwan	0.523** (0.012)	0.661** (0.032)	0.429** (0.021)	0.593** (0.023)	0.704** (0.028)	1.220** (0.039)	0.456** (0.016)	-	
Thai	0.792** (0.021)	1.270** (0.033)	0.330** (0.019)	0.963** (0.044)	1.640** (0.053)	1.550** (0.046)	0.869** (0.025)	0.716** (0.036)	-
U.S.	-.014** (0.002)	0.033** (0.004)	0.066** (0.004)	-.006** (0.003)	-.025** (0.002)	0.043** (0.004)	-.001 (0.002)	-.025** (0.002)	0.044** (0.003)

Panle D: Covariances between future domestic excess return and future foreign dividend news.

	H-K	Indon	Japan	Korea	Malay	Philip	Singap	Taiwan	Thai
H-K	-								
Indon	1.350** (0.027)	-							
Japan	0.243** (0.013)	0.741** (0.027)	-						
Korea	0.823** (0.022)	2.240** (0.084)	0.826** (0.026)	-					
Malay	1.500** (0.035)	3.020** (0.099)	0.647** (0.026)	1.940** (0.080)	-				
Philip	1.380** (0.029)	3.070** (0.065)	0.592** (0.033)	1.250** (0.049)	2.770** (0.093)	-			
Singap	0.863** (0.015)	1.480** (0.028)	0.485** (0.015)	0.707** (0.020)	1.460** (0.037)	1.660** (0.031)	-		
Taiwan	0.964** (0.019)	1.320** (0.049)	0.729** (0.033)	1.010** (0.033)	1.220** (0.043)	1.940** (0.056)	0.829** (0.024)	-	
Thai	1.500** (0.029)	2.520** (0.067)	0.568** (0.023)	1.710** (0.068)	2.940** (0.074)	2.860** (0.063)	1.560** (0.011)	1.410** (0.047)	-
U.S.	0.139** (0.004)	0.199** (0.009)	0.069** (0.005)	0.083** (0.008)	0.094** (0.005)	0.211** (0.009)	0.141** (0.004)	0.101** (0.006)	0.204** (0.008)

CHAPTER SEVEN

CURRENCY RISK IN EMERGING MARKETS

7.1 Introduction

The recent emergence of highly remunerative equity markets following the relaxation of foreign investment restrictions, and their developments in communication and trading systems has attracted the attention of academics in explaining their impressive returns. Their low correlation with the developed financial world has also intensified the interest of international fund managers as opportunities for portfolio diversification benefits. Official reports show a recent increase in the flow of funds from developed countries towards the newly established financial markets.[108] In particular, a considerable attention has been directed to the Pacific Basin capital markets. In 1996, 48 percent of the net private capital flows to all emerging economies[109] was directed to the Asian[110] capital markets.[111] Another important fact is that most of the Asian economies have adopted more flexible exchange rate regimes in the late eighties and early nineties. This could have increased the risk associated with foreign investment in their capital markets, making the choice of currency denomination an important element to the overall portfolio decision.

This paper studies the impact of liberalisation in a group of Pacific Basin financial markets. In particular, it addresses the important issue of whether the abolition of restrictions on foreign ownership affects the risk assessment of their financial assets. In addition, it includes the currency risk in international asset-pricing model. Finally, it examines if there has been an effect of capital liberalisation and the recent Asian financial crisis of mid 1997 on the volatility of the considered financial markets.

Previous capital asset-pricing models can be classified in three broad categories based on the type of risk considered in pricing expected returns: segmented markets models, integrated markets models, and partially segmented markets models.

---

[108] See e.g. Hawawini (1994) for evidence on the increasing flow of funds to new capital markets and the importance of these markets to portfolio management.

[109] See "World Economic Outlook", October 2000, published by the International Monetary Fund. The source net capital flows comprise net direct investment, net portfolio investment, and other long-term and short term-net investment flows, including official and private borrowing. Emerging markets include developing countries, countries in transition, Korea, Singapore, Taiwan Province of China, and Israel.

[110] It includes the economies of Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan Province of China and Thailand.

[111] In the same year only the portfolio investment flows to the same Asian economies was the 37 percent of the total portfolio investment flows to all emerging equity markets.

The segmented market model evaluates expected equity returns as a function of only the country-specific risk represented by stock returns variance. A classic segmented market framework is the Capital Asset Pricing Model (CAPM) of Sharpe (1964), Lintner (1965), and Black (1972), applied to one's country's data.

Within the class of asset-pricing model on integrated markets there are studies that assume that all the world capital markets are perfectly integrated, and therefore the source of their risk can be associated to the covariance of the local stock market returns with the world market returns. These include studies of a world CAPM, for example Harvey (1991); a world consumption-based model (e.g. Wheatley (1988)); world arbitrage pricing theory (e.g. Solnik (1983)); world multibetas models (e.g. Ferson and Harvey (1993, 1994a, and 1994b)); and world latent factor models (e.g. Campbell and Hamao (1992); Bekaert and Hodrick (1992); and Harvey, Solnik, and Zhou (1994)). The polar approaches have produced on the whole poor results. An alternative asset-pricing model (see Errunza, Losp, and Padmanabhan (1992)) considers a framework in which the polar segmented/integrated cases are replaced by a mild segmentation structure. While this model presents the advantage of avoiding the choice between the scenario of full segmentation and perfect integration, the framework has the disadvantage of selecting a degree of segmentation that is fixed through the time.

Errunza, Losq, and Padmanabhan's limitation (1992) has recently been overcome by the alternative studies of Bekaert and Harvey (1995) and De Santis and Imrohoroglu (1997). Bekaert and Harvey (1995) proposed a one-factor asset-pricing model that allows the conditional expected returns of a country to be affected by their covariance with a world benchmark portfolio and by the variance of the country returns. If the market was perfectly integrated then only the covariance counted; while if the market was completely segmented then the variance was the relevant measure of market risk. Bekaert and Harvey (1995) use a conditional regime-switching model to account for periods when national markets were segmented from world capital markets and when they became integrated later in the sample. They applied the model to monthly observations of equity returns of a group of emerging capital markets over the period 1975 to 1992.[112] They found that integration was

[112] For Asia the study covers the countries of Korea, Malaysia, Taiwan and Thailand.

substantial also for countries presenting extensive foreign ownership restrictions such as Korea and Taiwan.

De Santis and Imrohoroglu (1997) considering a group of emerging equity markets covering the regions of Latin America, Middle-East and Asia for the period December 1988 to May 1996, use the CAPM framework to study the stock returns and the volatilities of these capital markets under different degrees of integration. The authors start their analysis by considering the polar scenario of perfect segmentation and perfect integration. They proceed by introducing a dynamic integration version of the classic CAPM framework that assumes full market segmentation until the official liberalisation date of each capital market, and full integration thereafter. Although most of the analysed markets were legally segmented during part of the sampling period, the evidence shows that the country-specific risk is not priced. On the other hand, when generalising the model and assuming regional and global integration the world market risk is only priced for the Latin American markets but not for the other regions.

De Santis and Imrohoroglu's weak findings might be affected by two limitations in their methodology. First, in contrast to Bekaert and Harvey (1995), the date when each country switches from being fully segmented to being fully integrated is fixed and the process is irreversible. Secondly, the lack in pricing the country-specific risk might be caused by the omission of important risks, which affects the expected return of local stock markets. For example, Dumas (1994) shows theoretically, while Dumas and Solnik (1995) show empirically, that by applying the world CAPM framework with exchange risk the currency risk is priced.

Dumas (1994) notes that if Purchasing Power Parity (PPP) does not hold, the rates of inflation in the various countries, all expressed in U.S. dollars, are equal and their differences are random. On this point, Solnik shows that this is entirely reflected by the random fluctuation of each currency against the dollar. Therefore, if PPP does not hold, any investment in a foreign asset is a combination of an investment in the performance of the foreign asset and an investment in the performance of the domestic currency relative to the foreign currency. If currency risk potentially exists, one might have to answer two questions in applying international asset-pricing models. Is the currency risk priced and might its omission have affected the previous findings of CAPM applied internationally?

Regarding the first question Dumas and Solnik (1995) show that the currency risk exists. In addition, the recent work of De Santis and Gerard (1998) provides a measure of the premium related to currency risk. The authors consider a conditional version of the international CAPM including the exchange rate risk premium and apply it to equity markets and one-month Eurocurrency deposits in Germany, Japan, United Kingdom and U.S. for the period June 1973 to December 1994. The results indicate that investors require a premium for bearing currency risk.[113]

Based on the results about the importance of currency risk, our paper extends the dynamic integration conditional CAPM of De Santis and Imrohoroglu (1997) by including currency risk. We conduct our analysis by considering the same Asian Pacific countries (with the only exception of India) analysed by De Santis and Imrohoroglu (1997). In addition, we examine a more recent sample period than De Santis and Imrohoroglu (1997), which covers from January 1980 to May 2000. We propose a framework that allows for the currency risk to present a similar regime switch structure to De Santis and Imrohoroglu's (1997) dynamic integration asset-pricing model. This permits one to test if the limited relation found in De Santis and Imrohoroglu (1997) between risk and returns was due to the omission of an important component of risk, which is the exchange rate variation.

Thus, our main objective is to examine the importance of the component of currency risk in explaining the stock returns of emerging equity markets, using a framework, which allows for a regime switch in the sources of risk affecting stock returns when they are open to foreign investors. We adopt the De Santis and Imrohoroglu (1997) structure even if this model presents the limitation of assuming that the date when each country switches from being fully segmented to being fully integrated is fixed and the process is irreversible.[114]

The paper contributes to the literature as follows. It investigates if the currency risk is an important component of the returns of a group of Pacific Basin stock markets. It tests if there is a switch in the source of their market and currency risk when they are open to foreign investors. It estimates a dynamic integration asset-

[113] Carrieri (2001) repeats the same analysis of De Santis and Gerard (1998), but for France, Italy, Germany and U.K. using monthly observations for period March 1974 to August 1995. She finds that also for these European equity returns the currency risk is priced.

[114] The work of Bekaert and Harvey (1995) while allowing for time-varying integration, does not involve the addition of foreign exchange risk. Indeed, the study requires a strong assumption (such as purchasing power parity) in order to justify the use of time-varying integration model. As it is also

pricing model for the foreign exchange returns as well.[115] Finally, it examines the conditional volatility of the same stock and foreign exchange market returns, and analyses the effect of liberalisation, and the Asian financial crisis of mid 1997.

The paper is structured as follows. Section 7.2 explains the dynamic integration asset-pricing model of equity returns with and without currency risk. It also introduces the dynamic integration asset-pricing model for the currency returns. Finally, it explains the technique of estimation of their conditional variances and covariances by using a trivariate Generalised Autoregressive Heteroskedastic (GARCH) process. Section 7.3 reports the summary statistics of each variable and background information on the liberalisation of the financial markets in our sample. Section 7.4 discusses the empirical results. The final section summarises the main findings and offers some concluding remarks.

7.2 The model

7.2.1 A International CAPM with market risk

Financial literature shows that investment performance is potentially affected by the degree of exposure to market risk. In fact, most asset-pricing models postulate a relation between expected returns and some measure of risk. The static version of the Capital Asset Pricing Model (CAPM) establishes that the expected return on any asset is a linear function of the covariance between the return on that asset and the return on the market portfolio. In particular, the expected return on the equity index of country i, can be expressed as a function of its exposures using the following variation of the CAPM as suggested by De Santis and Imrohoroglu (1997)[116]

(7.1) $E_{t-1}(R_{i,t}) = m_{10,i} + m_{11,i}R_{i,t-1} + m_{15,i}h_{im,t}$,

where $h_{im,t}$ represents the conditional covariance between the return on index i and the return on the world market portfolio.

Equation (7.1) differs from the traditional CAPM in two respects. First of all, it includes an autoregressive component to take into account the effect of non-

recognised by the authors, this assumption might be unrealistic after the findings of Dumas and Solnik (1995), De Santis and Gerard (1998), and Carrieri (2001).

[115] It is important to underline that the exchange rate of all the countries considered in the paper is always expressed as number of units of U.S. dollar against one unit of the local currency. Therefore, a foreign exchange return increase represents an appreciation of the local currency and a depreciation of the U.S. dollar.

[116] De Santis and Imrohoroglu's parameterisation is based on a structure introduced by Lo and Mackinley (1988).

synchronous trading in the assets that make up a market index. This is a problem that can be particular severe in emerging markets, given their low level of liquidity. Second, it is inspired by Black's (1972) version of the CAPM, which does not include a risk-free rate.[117]

The choice of the component representing the market risk depends on the degree of financial integration of the analysed country. In fact, one can face two polar situations. In case of operating with a completed segmented capital market, the expected returns on the local market index is only associated with the country-specific risk, which is proxied by the conditional variance of its equity index returns. Under this scenario the expected return on an equity market i is expressed by rearranging equation (7.1) as follows

(7.2) $E_{t-1}(R_{i,t}) = m_{10,i} + m_{11,i} R_{i,t-1} + m_{12,i} h_{ii,t}$,

where $h_{ii,t}$ is the conditional variance of the market index of country i. In equation (7.2) it is expected to obtain a significant and positive value for coefficient $m_{12,i}$, which indicates that investors require higher expected returns when the market risk increases. In contrast, under the scenario of a full-integrated capital market, the source of risk of the expected return of country i index is completely affected by its covariance with the world market portfolio returns. This parameterisation has been reported in equation (7.1), where $h_{im,t}$ indicates the covariance between the returns of market index i and the returns of a selected world market portfolio.

However, when operating with emerging markets the degree of their integration might not be identified by one of the two polar scenarios of perfect segmentation or perfect integration. Therefore, in this case it is more appropriate to consider a dynamic integrated CAPM framework. De Santis and Imrohoroglu (1997) introduced a structure that allows in a unique model a situation of full market segmentation until the official liberalisation date, and full integration thereafter. The model is as follows

(7.3) $E_{t-1}(R_{i,t}) = m_{10,i} + m_{11,i} R_{i,t-1} + m_{12,i} h_{ii,t} DC_{i,t} + m_{15,i} h_{im,t}(1-DC_{i,t}) + \varepsilon_{i,t}$,

where DC_i is a dummy variable, which is equal to one before the opening date for market i and zero otherwise. The dynamic integration framework of equation (7.3) assumes that the price of risk is country-specific before liberalisation, which is represented by the conditional variance of market index i, $h_{ii,t}$; and world market when

[117] This feature of the model is dictated by lack of a time series on a monthly risk-free rate for the

markets become integrated, which is indicated by the covariance of the returns of market index i and the world market portfolio, $h_{im,t}$.

7.2.2 Dynamic integration ICAPM with market and currency risk

Dumas (1994) argues that if PPP does not hold, investors of diverse countries appreciate differently the real returns from the same securities. Solnik's case affirms that this is entirely reflected by the random fluctuations of each currency against the dollar, while the various rates of inflation expressed in dollar unit are equal and only the U.S. one is random. According to Dumas (1994), the expected nominal rate of return on the market index of country i, expressed in dollar units, using the international CAPM, is given as follows[118]

(7.4) $E(R_{i\$}) = ir + a\,\mathrm{cov}(R_{i\$}, X_{i\$}) + b\,\mathrm{cov}(R_{i\$}, R_m)$,

and it is expressed by using a two-factor asset-pricing model, where the two market premia are related to its covariance with the rate of appreciation of the currency of country i with respect to the U.S. dollar ($\mathrm{cov}(R_{i\$}, X_{i\$})$); and of its covariance with the dollar rate of return on the optimal portfolio held by investors of country i ($\mathrm{cov}(R_{i\$}, R_m)$). In equation (7.4), ir indicates the nominal riskless rate of return for country i. The variable $X_{i\$}$ indicates the rate of change of the spot exchange rate expressed in dollars per unit of nondollars currency of country i.

We use the two factor asset-pricing model of equation (7.4) to derive the International CAPM (ICAPM) introduced in equation (7.1) and (7.2), but including the currency risk under the scenario of perfect segmentation and perfect integration. We proceed by combining the two polar cases using De Santis and Imrohoroglu (1997) framework of equation (7.3), but again including the elements in pre and post liberalisation associated with currency risk. As reported in Appendix 7.B.1, the ICAPM version of equation (7.2) under the scenario of full segmentation is given as

$$(7.5)\ E_{t-1}(R_{i,t}) = m_{10,i} - X_{i\$,t} + \sum_{k=1}^{p} m_{11k,i} R_{i\$,t-k} + m_{12,i} h_{ii,t} + m_{13,i} h_{xx,t} + 2m_{14,i} h_{ix,t} + \varepsilon_{i,t},$$

where $R_{i,t}$ represents the rate of return on market index i expressed in local currency[119]; $X_{i\$}$ indicates the rate of change of the spot exchange rate expressed in

sample period considered in the analysis for the countries selected in this study.

[118] See Appendix 7.A for details of the derivation of this framework.

[119] As reported in equation (B.3) of appendix 7.B.1, the rate of return on market index i expressed in U.S. dollars is given by the sum of the rate of return of the same market index expressed in local

dollars per unit of nondollars currency of country i. The rate of return of equation (7.5) depends on the variance of the returns, expressed in local currency, of market index i; on the covariance of the returns, expressed in local currency of market index i with the rate of appreciation (depreciation) of the local currency respect the U.S. dollar; and the variance of the rate of appreciation (depreciation) of the local currency against the U.S. dollar.

In case of full integration, the ICAPM of equation (7.1) inclusive of currency risk becomes[120]

$$(7.6)\quad E_{t-1}(R_{i,t}) = m_{10,i} - X_{i\$,t} + \sum_{k=1}^{p} m_{11k,i} R_{i\$,t-k} + m_{15,\,i} h_{im,t} + m_{16,i}\, h_{xm,t} + m_{17,\,i} h_{ix,\,t} + m_{18,\,i} h_{xx,t} + \varepsilon_{i,\,t},$$

where $R_{i,t}$ represents the rate of return on market index i expressed in local currency; $X_{i\$}$ indicates the rate of change of the spot exchange rate expressed in dollars per unit of nondollars currency of country i. The rate of return of equation (7.6) depends on the covariance of the returns expressed in local currency, of market index i with the world market portfolio; the covariance between the world market portfolio and the rate of appreciation (depreciation) of the local currency against the U.S. dollar; the variance of the rate of appreciation (depreciation) of the local currency against the U.S dollar; and the covariance between the rate of return expressed in local currency, of market index i with the rate of appreciation (depreciation) of the local currency against the U.S. dollar.

Finally, we can derive the dynamic integration ICAPM of De Santis and Imrohoroglu (1997) of equation (7.3) inclusive of currency risk by allowing full segmentation until liberalisation (model of equation (7.5)) and perfect integration thereafter (model of equation (7.6)). The dynamic integration ICAPM process inclusive of currency risk is given as follows

currency, plus the rate of appreciation (depreciation) of the local currency against the U.S. dollar. Therefore, we write $E_{t-1}(R_{i,t})$ on the left side of equation (7.5) and $X_{i\$}$ on the right side of the same equation but with the opposite sign instead of $E_{t-1}(R_{i\$,t})$ on the left side. This is to isolate the variable of our interest that is the rate of returns on a market index i expressed in local currency.

[120] See Appendix 7.B.2 for details.

$$(7.7)\quad E_{t-1}(R_{i,t}) = m_{10,i} - X_{i\$,t} + \sum_{k=1}^{p} m_{11k,i}(R_{i,t-k} + X_{i\$,t-k})$$

$$+ \underset{(+)}{m_{12,i}h_{ii,t}DC_{i,t}} + \underset{(+/-)}{m_{13,i}h_{xx,t}DC_{i,t}} + \underset{(+/-)}{2m_{14,i}h_{ix,t}DC_{i,t}} + \underset{(+)}{m_{15,i}h_{im,t}(1-DC_{i,t})}$$

$$+ \underset{(+/-)}{m_{16,i}h_{xm,t}(1-DC_{i})} + \underset{(+/-)}{m_{17,i}h_{ix,t}(1-DC_{i,t})} + \underset{(+/-)}{m_{18,i}h_{xx,t}(1-DC_{i,t})} + \varepsilon_{1,t},$$

where $R_{i,t}$ represents the rate of return on market index i expressed in local currency; $X_{i\$}$ indicates the rate of change of the spot exchange rate expressed in dollars per unit of nondollars currency of country i; and DC_i is a dummy variable that assumes value of one before liberalisation and zero otherwise. The plus and minus below the coefficients refer to their expected signs. In estimating equation (7.7) we impose the condition that the coefficients $m_{12,i}$ and $m_{15,i}$ are positive by taking their absolute value. In fact, asset-pricing theory affirms that a higher level of country-specific or world market risk can only be compensated by higher stock returns. In contrast, since the theoretical model does not preclude prices of currency risk from being negative, a linear specification is adopted for this source of risk. The same argument is also supported for the prices of covariances of local stock returns with the U.S. stock returns and with the currency returns.

With regard to the signs of the parameters $m_{13,i}$ and $m_{18,i}$, which indicate the prices of the currency risk in pre and post liberalisation respectively, we expect these prices to be either negative or positive. While investors generally require higher returns for bearing higher risks, periods of persistent volatility of the foreign exchange markets might affect the risk appetite of foreign investors. This fact not always leads international investors to require higher risk premium. In particular, if the risky time periods coincide with periods when investors are better able to bear particular types of risk (as might be the currency one[121]). Further, if the future seems risky the investor may want to save more in the present thus lowering demand for larger premia. Hence Glosten et al. (1993) imply that both a positive and a negative relationship between current return and current variance (risk) is possible.

In our analysis we are also interested in modelling the rate of appreciation of the local currency against the U.S. dollar. In particular, we use the risk-adjusted uncovered interest rate parity (UIRP) condition introduced by Dumas (1994), to derive the structures under the scenario of full segmentation and full integration. We proceed by combining the two polar cases to obtain the dynamic integration model, which allows full segmentation before liberalisation and full integration thereafter. The rate of appreciation of the local currency against the U.S. dollar, in case of full segmentation is given as follows[122]

$$(7.8)\quad X_{i\$,t} = m_{20,i} + \sum_{k=1}^{p} m_{21k,i} X_{i\$,t-k} + m_{22,i} h_{xx,t} + m_{23,i} h_{ix,t} + \varepsilon_{2,t};$$

under the case of full integration is given as

$$(7.9)\quad X_{i\$,t} = m_{20,i} + \sum_{k=1}^{p} m_{21k,i} X_{i\$,t-k} + m_{24,i} h_{xx,t} + m_{25,i} h_{mx,t} + \varepsilon_{2,t};$$

and by the combination of equations (7.8) and (7.9), the dynamic integration process is

$$(7.10)\quad X_{i\$,t} = m_{20,i} + \sum_{k=1}^{p} m_{21k,i} X_{i\$,t-k}$$

$$+ \underset{(-)}{m_{22,i}} h_{xx,t} DC_{i,t} + \underset{(+/-)}{m_{23,i}} h_{ix,t} DC_{i,t} + \underset{(-)}{m_{24,i}} h_{xx,t}(1-DC_{i,t}) + \underset{(+/-)}{m_{25,i}} h_{mx,t}(1-DC_{i,t}) + \varepsilon_{2,t};$$

where the rate of appreciation of the local currency is associated with the risk represented by the its variance and covariance with the local market index return expressed in local currency before liberalization; and it is related with its variance and its covariance with the world market returns thereafter. The plus and minus below the coefficients refer to their expected signs.

We generally expect the coefficients $m_{22,i}$ and $m_{24,i}$ to be negative. In addition, we expect these two coefficients, indicating the effect of currency risk to the exchange rate returns, to differ in magnitude for the periods of pre and post liberalization. Economic theory suggests that situations of disequilibria in the current and capital accounts lead to exchange rate movements due to changing of the stock of net foreign assets (see e.g. Dornbush and Fisher (1980) for an explanation of the role of the Balance of Payments on the effect of exchange rate movements and associated risks). In particular, these movements are more frequent in case of negative disequilibria. In addition, another important fact is that in the studied economies local Central Banks frequently intervene in foreign exchange markets through sterilized operations to

[121] In fact, with negative currency premia, international investors might be willing to give up some of the total risk premium when the hedging value of the assets in the portfolio becomes predominant.
[122] See Appendix 7.B.3 for details on the derivation of equations (7.8), (7.9), and (7.10).

support the value of the domestic currency. These interventions can affect exchange rates by changing the relative asset supplies available to the private sector. Therefore, expectations of an appreciation of the U.S. dollar against other Pacific-Basin currencies, due to current and capital account deficits or absence of potential future Central Banks interventions might lead to speculative attacks (in particular in presence of managed exchange rate regimes) against these weaker currencies increasing volatility of the foreign exchange markets and contributing to their depreciation. As a result, an increase of the risk in the currency market generally induces a depreciation of the local currency. Historically periods of high volatility of the foreign exchange markets were generally associated with events, such as financial crises, devaluations, political news, consistent current accounts deficit and changes in monetary policy, that caused a fall of the value of domestic currencies against foreign ones (for instance, the European monetary system failure of 1992 for U.K. and Italy, the Mexican crisis of 1994, the Asian crisis of 1997, the Brazilian crisis of 1999, and the Russian crisis of 1998). Overall, we expect that while during the pre liberalization period current account disequilibria play the most important role in determining exchange rate movements; in the post liberalisation period both current and capital account disequilibria determine the level of exchange rates.[123] Therefore, because of potential different channels leading to exchange rate movements in pre and post liberalization periods, we expect that even if the coefficients $m_{22,i}$ and $m_{24,i}$ represent the price of the same source of risk to differ in magnitude.

Referring to the parameters $m_{23,i}$ and $m_{25,i}$ of equation (7.10), which help to explain if currency returns are affected by country-specific risk in pre liberalization and world market risk in the post liberalization, and to the parameters $m_{14,i}$, $m_{16,i}$ and $m_{17,i}$ of equation (7.7), which indicate if stock returns are affected by the covariance of the local stock market and the currency returns in pre liberalization and by the same variable plus the covariance between the world stock and local currency returns in post liberalization, we expected them to be either positive or negative. In particular, our attention is mainly focused on their statistically significance as indicators of the degree of integration for the studied countries. Their expected sign is based on the comprehensive discussion in paragraph 4.2.1 of this thesis. The links between stock

[123] The only case in which capital account can affect the level of foreign exchange rate is the presence of Country Funds, which have been found (see e.g. Bekaert (1995), Bekaert and Harvey (2000), and the

and foreign exchange markets can be explained by two scenarios: the "flow" approach and the "stock" approach. According to the "flow" approach, a depreciating currency positively affects the volume of exports of the country contributing to an improvement of its economic activity level and of the present value and price of firms. This leads to a negative relationship between stock and foreign exchange returns. In contrast, the "stock" approach suggests a positive relationship between stock and currency markets. For instance, an increase of domestic stock prices will increase wealth and the demand for money and consequently interest rates will go up. High interest rates in turn, will attract foreign capital, resulting in an appreciation of the domestic currency. Therefore, an increase of the link between the stock and foreign exchange markets might induce to higher currency returns. Based on these explanations, it is expected the flow approach to play the most important role in explaining stock and currency returns links in case of capital controls[124] and therefore in the sign and magnitude of the coefficients $m_{23,i}$ and $m_{14,i}$. In contrast, the stock approach is expected to be as important as the flow one in generating links between stock and foreign currency movements in post liberalization period and consequently the sign and magnitude of the coefficients $m_{25,i}$, $m_{16,i}$ and $m_{17,i}$ might be determined under both scenarios. Overall, all the five parameters might assume a either positive or a negative value.

7.2.3 The conditional variances and covariances

Financial literature provides a considerable number of studies indicating that financial time series present volatility clustering. Mandelbrot (1963) and Fama (1965) note that large changes tend to be followed by large changes - of either sign - and small changes by small changes. This phenomenon has been shown to characterize new emerging capital markets, as well. Thus, before estimating the models introduced in the previous section we tested if the variances and covariances driving the returns of equity and foreign exchange markets are time-variant.

We investigated the presence of conditional variances and covariances in three ways. First, we tested for ARCH effects on the residuals of the raw data of equity and

paper included in chaper 5) to be alternative financial instruments to enter highly restricted capital markets.

[124] As noted in chapter six, the presence of Country Funds may support a stock approach behind the links between stock and foreign exchange markets in pre liberalisation period as well.

foreign exchange returns by investigating for presence of autocorrelation on the squared returns of each variable. Secondly, we fitted the unconditional version of the framework and we performed the Ljung Box statistic test for autocorrelation on the squared standardized residuals for the first twelve order autocorrelations.[125] Finally, we performed the likelihood ratio statistic test on the estimated unconditional and conditional processes, where we tested for the null hypothesis that the coefficient of the time varying variances and covariances of the conditional model are equal to zero. In case of rejection of the null hypothesis, we concluded that the conditional structure overperforms the unconditional one and therefore that the variances and covariances are time varying.

Equations (7.7) and (7.10) require the estimation of the conditional variances of both equity market returns and of the rate of appreciation of the local currency with the U.S. dollar. They also include the covariance of the returns of equity and foreign exchange market between them and with the world market. Therefore, we need to generalize the process for the conditional second moments to a trivariate framework. In fact, the mean equation system is composed of equations (7.7) and (7.10) explaining the expected stock and exchange returns, and by a third equation representing the expected world market returns, which is defined as follows

$$(7.11)\quad E_{t-1}(R_{m,t}) = m_{30} + \sum_{k=1}^{p} m_{31k} R_{m,t-k} + m_{32} h_{mm,t} + \varepsilon_{3,t},$$

where R_m represents the rate of return of the world market portfolio; and h_{mm} indicates its variance. As for equation (7.7), we estimate the parameters of equation (7.11) by taking the absolute value of the coefficient m_{32} because we expected a higher level of return associated to a higher level of its market risk.

However, this parameter is not restricted to be the same across countries in the single country estimation. This represents a difference respect to previous studies of De Santis and Gerard (1997, 1998), and De Santis and Imrohoroglu (1997), where the authors jointly estimate the premia of risks associated with the stock returns of all the studied countries under the condition that the world market price is the same across countries as well as for the world returns. Our parameterisation also differs from Bekaert and Harvey (1995). In fact, while their implementation is limited to the

[125] This test is an alternative to the Lagrange Multiplier test proposed by Engle (1982) to evaluate the specification of a GARCH process. In a recent paper, Bollerslev and Mikkelsen (1994) show that the LB test has considerable more power in detecting model misspecifications.

world index and one country a time, it requires a two steps estimation procedure. In the first step the authors considering only the world returns, estimated the price associated with the world market risk, which they use in the second step to estimate the country-specific risk associated with the stock returns of each country. However, our model presents a complex parameterisation. In particular, not only the stock returns of each market include country-specific and world market risks, but also it requires the estimation of the price associated with the covariance of exchange rate returns and world market returns; and it also allows the covariance between local stock returns and world market returns and currency returns and world market returns to differ in pre and post liberalisation. Therefore, to operate with a more flexible model that allows us to focus on our research questions, we prefer not to restrict the world market price of risk associated with the world returns to be the same across countries in the single country estimation.

Based on the findings of works of Bera and Roh (1991), King, Sentana, and Wadhwani (1994) and more recently Login and Solnik (1995) and Karolyi and Stulz (1996), it is important to fit a framework, which also allows both covariances and correlations to be time-varying. For simultaneous estimation of the systems of equations (7.7), (7.10), and (7.11) with conditional dynamics, we use the parsimonious multivariate GARCH(p,q)-in-Mean specification where the GARCH components follow the diagonal BEKK representation of Baba, Engle, Kraft and Kroner (1990) and rearranged by Engle and Kroner (1995).[126] This is because this model guarantees positive definite conditional variance matrices without imposing any condition. In addition, the model economizes on parameters relative to other multivariate GARCH processes.[127] Under the case of a GARCH(1,1), this is specified as follows

(7.12) $H_t = AA' + BH_{t-1}B' + C\varepsilon_{t-1}\varepsilon'_{t-1}C'$,

[126] Bera and Higgins (1993) and Bollerslev et al. (1994) provide an excellent analysis of ARCH, GARCH, and related models. In addition, Bollerslev et al. (1992) present a survey of the application of the GARCH and related models in finance.

[127] Bekaert and Harvey (2000) argue that GARCH processes present the limitation of modelling conditional volatility only in fuction of past returns, and that the parameters of the volatility model are assumed to be constant. The authors in a previous paper Bekaert and Havey (1997) overcome these limits by using a framework that allows both conditional mean and variances. However, in our work we fit a GARCH model to simplify the already complex framework we are applying. In addition, GARCH processes are the most used extensively conditional volatility models and Brailsofrd and Faff (1996) show that ARCH class of models provides superior forecasts of volatility that alternative techniques.

where A, B, and C are symmetric matrices. In particular, expanding the conditional covariance matrix we have the conditional variances and covariances of the three variables as follows:

(7.13)
$$h_{ii,t} = a_{11}^2 + b_{11}^2 h_{ii,t-1} + c_{11}^2 \varepsilon_{1,t-1}^2$$

$$h_{XX,t} = a_{21}^2 + a_{22}^2 + b_{22}^2 h_{xx,t-1} + c_{22}^2 \varepsilon_{2,t-1}^2$$

$$h_{mm,t} = a_{31}^2 + a_{32}^2 + a_{33}^2 + b_{33}^2 h_{mm,t-1} + c_{33}^2 \varepsilon_{3,t-1}^2$$

$$h_{iX,t} = a_{11}a_{21} + b_{11}b_{22}h_{iX,t-1} + c_{11}c_{22}\varepsilon_{1,t-1}\varepsilon_{2,t-1},$$

$$h_{im,t} = a_{11}a_{31} + b_{11}b_{33}h_{im,t-1} + c_{11}c_{33}\varepsilon_{1,t-1}\varepsilon_{3,t-1}$$

$$h_{Xm,t} = a_{21}a_{31} + a_{22}a_{32} + b_{22}b_{33}h_{xm,t-1} + c_{22}c_{33}\varepsilon_{21,t-1}\varepsilon_{3,t-1}$$

Engle and Kroner (1995) have shown that the necessary and sufficient conditions for covariance stationarity of the trivariate GARCH model of equation (7.13) are given as $b_i b_j + c_i c_j < 1$. Another important factor is that the sum of b_{11}^2 and c_{11}^2, of b_{22}^2 and c_{22}^2, and of b_{33}^2 and c_{33}^2, represent the change in the response function of shocks to volatility per period. A value greater than unity implies that the response function of volatility increases with time and a value less than unity implies that shock decay with time (Chou, 1988); the closer to unity the value of the persistence-measure, the slower is the decay rate. Non-linear optimisation techniques are used to calculate the maximum likelihood estimates based on the Broyden, Fletcher, Goldfarb and Shanno (BFGS) algorithm. White's (1982) standard errors are reported which are robust to misspecification of the distribution of error term.[128]

7.2.4 *Liberalisation and Asian financial crisis effects on the conditional variances*

How the opening of financial markets to foreign investors affects volatility of these capital markets has been a controversial issue. On the one hand, Domowitz et al. (1997) support that capital market liberalisation can induce greater participation by foreign investors, whose entry can reduce price volatility. In fact, new investors by

[128] We have also tried the estimation by fitting a t-distribution on the vector of errors, with v degree of freedom as recommended by Engle and Bollerslev (1986) and Bollerslev (1987). However, the t-distribution gave not good results. As noted by Bera and Higgings (1993) this might be due to the fact that conditional t-distribution although it allows kurtosis to exceed 3, it assumes constant conditional kurtosis because the estimated degree of freedom v is time invariant. Therefore, we proceed by focusing on QMLE parameters.

entering the market dampen the effect of flow shocks on prices and may also make prices more efficient by increasing the precision of public information regarding fundamental values. The support for this view is given by Richards (1996), Bekaert and Harvey (1997), and Domowitz et al. (1997) who find a reduction of volatility following capital market liberalisation. However, volatility might increase because of the increase in the amount of capital flows. Kim and Singal (2000) show that volatility does not change after the opening of emerging stock markets; while Bekaert and Harvey's (2000) findings indicate that there is a small but not statistically significant increase in the volatility of stock returns following liberalisation.

Looking now at exchange rate returns, theoretical analysis tells that foreign exchange controls reduce the volatility of exchange rates (see e.g. Phylaktis and Wood (1984)). In fact, Phylaktis and Kassimatis (1997) considering a group of Pacific Basin countries found an increase in the volatility of their foreign exchange market returns after the relaxation of foreign exchange restrictions.

In addition, there is an argument supporting the view that shifts in policy in the form of a relaxation of foreign exchange restrictions has important implications for the persistence of shocks to volatility[129], i.e. whether past volatility explains current volatility. Because of this argument and of previous studies' evidence generally indicating the existence of an effect of openness on the volatility of local financial markets, we include a dummy variable on the conditional variance of stock and foreign exchange returns, which assumes the value of one before official liberalisation date and zero otherwise and that is indicated with DC_i. This is to verify if there exists an effect of liberalisation on the volatility of equity and foreign exchange markets. The same argument on the potential effect of a shift of policy on the persistence of conditional variance might be applied to the effect of the Asian financial crisis of mid 1997. Previous studies of Schwert (1990), Engle and Mustafa (1992) Choudhry (1996) on the financial crash of 1987; and of Choudhry (1995) on the great depression of 1929, show that stock volatility increased extensively after the crash or during a crisis, but it returned to lower level quite quickly after the crash period. Therefore, to examine the effects of the Asian financial crisis of mid 1997 on price volatility of PBCs' equity and foreign exchange markets, we include a dummy variable on the conditional variances of these two series, which assumes a value of

[129] See for instance Lastrapes (1989) and Lamourex and Lastrapes (1990).

one from July 1997 to February 1998[130] and that we indicate as DUM. The framework for the conditional variances and covariances becomes

(7.14)
$$h_{ii,t} = a_{11}^2 + b_{11}^2 h_{ii,t-1} + c_{11}^2 \varepsilon_{1,t-1}^2 + D1^2(1 - DC_{i,t}) + DC1^2 DUM$$

$$h_{XX,t} = a_{21}^2 + a_{22}^2 + b_{22}^2 h_{XX,t-1} + c_{22}^2 \varepsilon_{2,t-1}^2 + D2^2(1 - DC_{i,t}) + DC2^2 DUM$$

$$h_{mm,t} = a_{31}^2 + a_{32}^2 + a_{33}^2 + b_{33}^2 h_{mm,t-1} + c_{33}^2 \varepsilon_{3,t-1}^2$$

$$h_{iX,t} = a_{11}a_{21} + b_{11}b_{22}h_{iX,t-1} + c_{11}c_{22}\varepsilon_{1,t-1}\varepsilon_{2,t-1},$$

$$h_{im,t} = a_{11}a_{31} + b_{11}b_{33}h_{im,t-1} + c_{11}c_{33}\varepsilon_{1,t-1}\varepsilon_{3,t-1}$$

$$h_{Xm,t} = a_{21}a_{31} + a_{22}a_{32} + b_{22}b_{33}h_{Xm,t-1} + c_{22}c_{33}\varepsilon_{21,t-1}\varepsilon_{3,t-1}.$$

While this structure presents the advantage of investigating the existence of potential effects due to liberalisation and the Asian financial crisis on the conditional volatilities of equity and foreign exchange returns, it does not allow the identification of the sign. However, this framework allows the covariance matrix to be positive defined without imposing any condition.

7.3 Capital market characteristics

7.3.1 Data

The sample of countries examined in the paper includes: Indonesia, Korea, Malaysia, Philippines, Taiwan and Thailand.[131] The data consist of end-of-month observations of stock market index prices, and of local bilateral spot exchange rates expressed as units of U.S. dollar against one unit of each local Pacific Basin currency. The stock market index prices used are the follows: the Jakarta Stock Exchange Composite Price Index for Indonesia; the Korea Stock Exchange Composite for Korea; the Kuala Lumpur Stock Exchange Composite for Malaysia; the Philippines Stock Exchange Composite Price Index for Philippines; the Taiwan Stock Exchange Weighted - price index for Taiwan; and the Bangkok S.E.T. Price Index for Thailand.

The currencies used are: the Indonesia Ruphian, the Korean won, the Malaysian ringgit, the Philippines Peso, the Taiwanese new dollar and the Thai baht.

---

[130] The selection of this period is based on the study of chapter 4, where considering the same countries, the authors identified that the Asian crisis affected these economies for the above indicated period.

[131] It was our intention to include Hong Kong and Singapore as well. However, because Hong Kong and Singapore have completely open capital markets before the beginning of the sample period

The sample covers monthly observations for the period 1980.01 to 2000.05 for Korea, Malaysia, Taiwan and Thailand, and 1983:05 to 2000:05 and 1986:01 to 2000:05 for Indonesia and Philippines respectively. All the data are from *Datastream* database.

7.3.2 Characteristics of stock and foreign exchange returns distribution

As a preliminary data analysis we applied the unit root testing methodology of Philipps and Perron (1988) and failed to reject the null hypothesis of a unit root in the logarithmic first difference of the price index of any of the time series under analysis. The first difference of the stock price index and exchange rate of the i country is respectively defined as

(7.15) $R_{i,t} = 100(\log P_{i,t} - \log P_{i,t-1})$,

(7.16) $X_{i,t} = 100(\log ex_{i,t} - \log ex_{i,t-1})$,

where $P_{i,t}$ indicates the level of the stock prices for the index of country i, expressed in local currency, and $ex_{i,t}$ represents the bilateral spot exchange rate expressed as units of U.S. dollar against one unit of the local currency of country i.

Table 7.1 contains summary statistics for the data corresponding to stock returns and foreign exchange returns. Not surprising, the returns on the stock and foreign exchange markets have high means, which are always associated with high level of volatility. In particular, in most of the cases the standard deviation of stock returns is higher than the standard deviation of foreign exchange returns. In accordance with the literature, Panel A shows that the most volatile market is the Taiwanese one, which also presents one of the highest means. In most of the cases the data corresponding to the time series of returns on the stock and foreign exchange markets show skewness and high level of kurtosis. The Bera-Jarque test statistic strongly rejects the hypothesis of normality distributed returns for all the analysed markets.

Panel B in the Table 7.1 reports autocorrelations for the returns on both stock and foreign exchange markets. The predominant presence of autocorrelation in the return series reveals that, in our analysis, we generally need to correct for autocorrelation in the stock and currency markets induced by non-synchronous trading in the assets of the studied financial markets as suggested by Lo and MacKinley (1988). Panel C in the Table 7.1 contains the autocorrelation in the

considered in this work, we excluded these countries from our study, the major objective of which is the identification of risks under different degrees of foreign exchange restrictions.

squared returns. The presence of statistically significant autocorrelation in squared returns suggests that a GARCH parameterisation for the second moments is required. Most of the analysed market returns present autocorrelation in their squared returns with the only exception of the Indonesian and Philippines stock market returns[132], suggesting the use of conditional variance processes in estimating second moments.

7.3.3 Official liberalisation dates

In defining the dummy variable DC_i, which assumes value of one before liberalization and zero otherwise, we consider the official liberalization date as reported by the International Finance Corporation (IFC). The IFC date is based on the Investibility index, which represents the ratio of the market capitalization of stocks that foreigners can legally hold to total market capitalization. A large jump in the Index is evidence of an official liberalization. The official liberalization date (OLD) for the countries in our analysis is as follows: Korea, January 1992, when a new law was introduced allowing foreign investors to own up to 10% of domestically listed firms; Malaysia, December 1988, when foreign investors were allowed to own up to 100% of domestic firms; Taiwan, January 1991, when foreign investors were allowed to own up to 10% in any of the domestic listed companies; and Thailand, September 1987. This date corresponds to the launch of the Alien Board in the Thai stock exchange, where only securities available to foreign investors where traded. However, international investors were still facing a foreign ownership limit of 49% with a more restricted of 25% for commercial banks and finance companies.[133]

7.4 Empirical results

7.4.1 Conditional dynamic integration model on stock returns

We start our empirical analysis by estimating the conditional dynamic integration model of De Santis and Imrohoroglu (1997) for the equity stock market returns of Korea, Malaysia, Taiwan and Thailand, where the stock indices are expressed in local currency. We consider as world market portfolio the U.S. stock

[132] Because of lack of ARCH effects in the stock marekt returns of Indonesia and Philippines, we do not proceed our analysis for these two countries. In fact, in our study we are interested in estimating a model, which allows variation in the conditional risk measures.

[133] For Thailand the IFC official liberalisation date is December 1988. However, as noted by Bekaert and Harvey (2000), this date is not associated with any particular regulatory changes.

market index. The findings are reported in Table 7.2. In selecting the order of autoregressive components in the mean equation, we added lags until the residuals did not present autocorrelation. We obtained that the order is one for Korea and Taiwan; four for Malaysia and five for Thailand. In accordance with the results of De Santis and Imrohoroglu (1997), the country-specific risk and the world market risk are not priced for all countries, with the exception of Malaysia. However, in this case the estimated coefficients are really small. The results also show that the conditional second moments are appropriately described by the multivariate GARCH process. All the parameters in matrix A, B, and C are statistically significant.[134] The point estimates reveal that all the variance processes in H_t are stationary and highly persistent. The Ljung-Box statistic tests of order twelve on the standardized and squared standardized residuals show lack of autocorrelation. This indicates that the GARCH specification that we use is flexible enough to capture the dynamics of the conditional second moments. In most cases the index of kurtosis for the standardized residuals is lower that the corresponding index for the returns. However, it is still statistically significant. This suggests that the GARCH parameterization can accommodate some of the kurtosis in the data.

Based on the obtained lack of relation between expected returns and market risks that we estimated by using the De Santis and Imrohoroglu's (1997) dynamic integration model, we proceed the analysis by estimating both the unconditional and conditional version of the dynamic integration asset-pricing model including the currency risk. This is to test if the omission of this source of risk could have affected the previous findings.

7.4.2 Dynamic integration model with currency risk

To test if the importance of currency risk in the international version of asset-pricing models, we estimate the extended version of De Santis and Imrohoroglu's (1997) dynamic integration CAPM introduced in equation (7.7). In addition, we evaluate the risk-adjusted UIRP model introduced by Dumas (1994) to explain the rate of appreciation of each local currency against the U.S. dollar, introduced in equation (7.10), which allows the same dynamic integration structure as the expected equity returns. As discussed in section 7.3, we also need to include in our model a

[134] The only exeptions are the coefficients A31 and C33 for Korea.

third equation representing the expected return for the U.S. market (equation (7.11)) to estimate the conditional covariance between local equity and foreign exchange market returns and the U.S. equity returns, which represent important components of equations (7.7) and (7.10).

We start this investigation by identifying the number of autoregressive components to include in the mean equations (7.7), (7.10), and (7.11). We estimate the expected returns assuming constant variances and covariances, and we perform the Ljung-Box statistic tests of order twelve to identify the order p of AR(p) correction for non-synchronous trading. The estimated number of lags varies across the different financial markets. For instance, the Korean and Taiwanese equity market returns require only one autoregressive component; the Malaysian and Thai need four autoregressive components. On the other hand, the foreign exchange returns require nine lags for Korea and Malaysia and only three for Taiwan and Thai. The U.S. stock market return does not need the inclusion of any autoregressive component.

7.4.2.1 Specification tests

We proceed our analysis by investigating if variances and covariances in the analysed financial markets changes over time in a predictable fashion. We estimate two versions of the model composed by the three equations (7.7), (7.10) and (7.11). We refer to Model A when we assume constant conditional variances and covariances, whereas we refer to Model B when we assume that the conditional variances and covariances follow a GARCH(p,q) process. For both models, we estimate the standardized residuals ($\hat{z}_t = \hat{u}_t \hat{h}_t^{-1/2}$) and the squared standardized residuals and then, for each series, we compute the Ljung-Box (LB) statistic test the null hypothesis of no autocorrelation up to order twelve. Overall, the results in Table 7.3 support our specification.

Consider first the LB test statistic for the standardized residuals. The results show that all market returns do not present residual autocorrelation. The only exception is the Korean exchange rate is the only return series for which the null hypothesis is rejected at 10%. Consider next the LB test for the squared standardized residuals, for all the financial markets of the analysed countries, the estimated statistics obtained from Model A show some form of autocorrelation. With the exception of Taiwan, the autocorrelation disappears when the conditional variances and covariances are assumed to follow a GARCH(p,q) process.

Finally, we perform the likelihood ratio statistic test on the estimated unconditional and conditional processes, where we test for the null hypothesis that the coefficients of the time varying variances and covariances of the conditional model are equal to zero. In all the cases, the statistic tests reject the null hypothesis indicating that the conditional structure outperforms the unconditional one. Therefore, we use the parsimonious trivariate GARCH-in-Mean specification presented in equation (7.13) to estimate the system composed by the expected equity returns in local and U.S. markets and the currency returns as specified in equations (7.7), (7.10), and (7.11).

7.4.3 Conditional dynamic integration model with currency risk

When fitting GARCH(p,q) model on the conditional variances and covariances we need to estimate the orders p and q of the process. We use the Akaike and the Schwertz selection criteria to identify the best performing model for each country. We obtained that while Malaysia, Taiwan and Thailand require a simple GARCH(1,1) process; the Korean exchange rate return requires an order of two for the GARCH components p and q. The results of the trivariate conditional dynamic integration model inclusive of currency risk are reported in Table 7.4. In particular, Panel A includes the findings for Korea and Malaysia, and Panel B the results for Taiwan and Thailand. The results show that all GARCH parameters are highly significant. Secondly, the c_i^2 are smaller than the b_i^2, an indication that lagged variances and covariances have more weight that past innovations in explaining current variances and covariances. This implies that large market surprises induce relatively small revisions in future volatility. Third, the persistence of the conditional variance process, measured by $b_i^2 + c_i^2$, is high and often close to the Integrated GARCH model of Engle and Bollerslev (1986). According to Lamourex and Lastrapes (1990) the detected large persistence may actually represent misspecification of the variances and result from structural change in the unconditional variances of the process, as represented by changes in $a_i a_j$ in Equation (7.13). A discrete change in the unconditional variances of a process produces clustering of large and small deviations, which may show up as persistence in a fitted

GARCH model. As previously discussed in section 7.2.4, the liberalisation of the studied financial markets and the Asian financial crisis of mid 1997 could represent two potential events causing a structural change in the unconditional variances of the estimated process. This could also affect the estimation of the prices of market and currency risks determining expected stock and foreign exchange returns. Therefore, we restimate the system of equations (7.7), (7.10) and (7.11) by fitting a GARCH process on their conditional variances and covariances that allows for two structural changes. One in correspondence of capital liberalisation and the other in correspondence of the period of the Asian financial crisis. The results are reported in Table 7.5, where Panel A indicates the findings for Korea and Malaysia, and Panel B shows the results for Taiwan and Thailand.

The results show that in most of the cases there is a considerable reduction of the persistence in both stock and exchange market returns when allowing for structural changes of their variances in correspondence of liberalisation and the Asian financial crisis.[135] Secondly, the dummies variables for liberalisation and the Asian crisis are in most of the cases extremely statistically significant with the only exception of the liberalisation dummy for the currency returns in Taiwan and Thailand. In particular, the estimated coefficients show that there is a bigger effect of the Asian financial crisis than the liberalisation on the volatility of the stock and currency returns of these markets. Moreover, we identify a stronger effect on the financial markets of Thailand, followed by Korea and Malaysia, while Taiwan is the country with smaller effect. In fact, Thailand, Korea and Malaysia were amongst the countries most affected by the crash. These findings show that there is an improvement in the specification of modified model for structural changes. In addition, even if the kurtosis of the standardized residuals remains statistically different from zero and quite high for the Thai currency returns, in all cases there is a fall in the degree of leptokurtosis from that reported in Table 7.1 for the raw data. This implies that the model is correctly specified.[136] Finally, the LB statistic tests on both standardized and squared standardized residuals show absence of autocorrelation and ARCH effect on the errors indicating the goodness of the fitted GARCH process. Because of the better performance of the modified model, we concentrate the

[135] The only exceptions are represented by the Malaysian and Taiwanese stock market returns.
[136] On this point Hsieh (1989) argues that if a process is correctly specified, by Jensen's inequality, the coefficients of kurtosis of the standardized residuals should be less than the kurtosis of the raw data.

discussion of the next two sections only on the results obtained by the more general model.

7.4.3.1 Equity markets

One of the major objectives of our analysis is to identify if the inclusion of the currency risk improves the performance of the dynamic integration asset-pricing model of De Santis and Imrohoroglu (1997) in pricing market risk. Our findings show that in most of the cases both the country-specific market risk before liberalisation and the world market risk after liberalisation influence expected stock market returns (the only exceptions are for Korea and Thailand where we obtain that the country-specific risk is not priced[137], and for Taiwan where the world market risk is not priced[138]). In particular, the statistical significance of the coefficients corresponding to the price of the world market risk suggests that the capital markets in Korea, Malaysia and Thailand are integrated after liberalisation. These findings are in accordance with Bekaert and Harvey's (1995) results. In fact, Bekaert and Harvey (1995) observed high level of integration also for the restricted capital market of Korea. However, we noted that the world market coefficients assume small values indicating that even if these countries are integrated, there are still possibilities for gaining portfolio diversification benefits. [139,140]

An important result of our analysis is that we find that the currency risk affects expected stock returns. Moreover, this risk is priced in both pre and post liberalisation period with the exception of Thailand in post liberalisation period. This evidence is in accordance with previous studies of Dumas and Solnik (1995); De Santis and Gerald (1998) on the developed markets of U.S., Japan, U.K. and Germany; and Carrieri (2001) on the European markets of France, Germany, Italy, and U.K. In particular, the absolute value of the currency price is higher than the price of the market risk. The estimated price of currency risk is generally negative indicating that if the future seems risky due to intensive movements of the local

[137] However, for these markets the corresponding world market risk is statistically significant.
[138] However, for Taiwan the country-specific country risk is priced.
[139] In contrast with other previous findings the Taiwanese stock market returns are not affected by the world market risk.
[140] According with Carrieri (2001), the small estimated values for the world market price could also be due to the fact that after liberalisation investors require a lower premium for bearing market risk.

currency, investors may want to save more in the present thus not requiring a large premium (see Glosten et. al (1993)).[141]

Overall this evidence indicates that an international asset-pricing model without exchange rate as a source of risk would be misspecified. Therefore, the findings of De Santis and Imrohoroglu (1997) as well as of other studies that do not consider currency risk in pricing international assets might be inaccurate. Focusing on the price of the risks corresponding to the covariance between the currency and local equity returns, and the currency and the world market returns, we found that in most cases liberalisation reduces the degree of the relationship between the local stock returns and the currency returns, but that the covariance of the currency returns and U.S. stock returns becomes important. The only exception is Taiwan where the link between the currency returns and the local stock market returns remains the same; and there does not exist any relation of the local currency returns with the U.S stock market returns.[142]

The finding that currency risk affects stock market returns, in particular in the pre liberalisation period is really interesting. The importance of currency risk in explaining stock returns in pre liberalisation, when these capital markets where close to foreign investors, can be explained by two factors. First, according to the "flow" approach (discussed in section 7.2.2) the found links between stock and foreign exchange market movements can be related to the economic integration of each country with U.S., which has been found to be important for the financial integration of these countries also in presence of capital restrictions (see the study of chapter 6). Secondly, according to the "stock" approach the same links can be explained by the fact that foreign investors can enter highly restricted capital markets by using alternative financial vehicles such as Country Funds and American Depositary Receipts (ADRs) (see for example the study of chapter 5 on the same countries, Bekaert (1995), and Bekaert and Harvey (2000) on emerging equity market of Latin America, Middle-East and Asia).

[141] Bailey et a. (2000) analysing the effect of association between stock and exchange rate returns and variances on the Mexican financial markets during the peso crisis of 1994 noted that adverse exchange rate movements not only have an impact on Mexican equity prices, but appear to lead many investors to rebalance their holdings away from Mexico, causing a downward of local equity returns.

[142] It is important to underline that for Taiwan also the world market price of risk has been found statistically insignificant. However, when pricing the rate of appreciation of the local currency against the U.S. dollar, the covariance between itself and the U.S. market returns is significant. This indicates that also Taiwan present some form of integration with U.S.

In the post liberalisation period, the estimated importance of currency risk in pricing stock returns can be supported by both "flow" and "stock" channels of links between stock and foreign exchange markets movements.

Focusing on the results for the world market return, which in our case is represented by the U.S. stock returns, we obtained that the estimated price for the world market risk is generally statistically significant (the only exception is Taiwan), but small in magnitude. In addition the estimated parameter, which as discussed in section 7.2.3 is not restricted to be the same across countries in the single country estimation, assumes different values across countries. This evidence differs from the studies of De Santis and Gerard (1997, 1998), Bekaert and Harvey (1995), De Santis and Imrohoroglu (1997), and Harvey (1995a). In fact, the previous findings show that the world market risk is not priced when considering a model with constant world market price. For instance, De Santis and Gerard (1997) obtained an estimated world price of 0.025 with statistically significance only at 15 percent when considering U.S. stock returns. However, the different results might due to the fact that with the exception of Bekaert and Harvey (1995), all the mentioned previous studies jointly estimated all the countries (including the world market returns) under the restriction that this parameter is the same across different stock market returns.

7.4.3.2 Foreign exchange markets

The results for the currency returns show that there exists a statistically significant negative relationship between currency risk and exchange rate returns for the countries of Korea, Taiwan and Thailand in pre liberalization period and for Taiwan in post liberalization period. In addition, the findings indicate that the currency risk is not statistically significant in pre liberalization period for Malaysia and in post liberalization period for Korea and Thailand. Finally, the results show that investors required a higher currency return in post liberalization period for bearing currency risk in Malaysia. Overall, the evidence indicates that periods of high volatility generally correspond with a depreciation of the local currency in pre liberalization period. This effect decreases after the liberalisation of the studied capital markets. As discussed in section 7.2.2, this can be explained by the fact that expectations of a depreciation of the local currency against the U.S. dollar, which can be related to current account disequilibrium in pre-liberalisation period, and to both current and capital account disequilibria in post liberalisation, or no intervention by the domestic Central Banks in supporting the local currency, lead to speculative attacks against the weaker currencies increasing their volatility and contributing to a fall of their values. The only exception is for Malaysia where currency risk is not priced in pre liberalization and it positively affects currency returns in post liberalization period. This may be related to the established credibility of the Malaysian Central Bank of frequently intervening in the foreign exchange market to support the value of the local currency.[143]

The results also show that in post liberalisation the price corresponding to the covariance between the rate of appreciation and the world market returns is for all the countries a statistically significant component of currency returns. This once again underlines that these markets are financially integrated. Finally, also the market price for the country-specific risk before liberalisation is significant for Korea, Taiwan and Thailand, but not for Malaysia. This represents another indication that the studied stock and foreign exchange markets are linked, also in pre liberalisation period, through a "stock" and/or a "flow" channel. In fact, while economic integration of these countries with the rest of the world justifies the "flow" channel, the presence of Country Funds and ADRs supports the "stock" channel of link.

In order to test the specification of the mean returns we estimated a more general model, which included currency, country specific and world market risks for both pre and post liberalization periods and performed likelihood ratio tests to confirm the superiority of our dynamic model. In case of Korea, Taiwan and Thailand, we found that our dynamic model performs better than the most complete one, but not in the case of Malaysia (see Table 7.6 in Appendix 7.C). However, in the case of Malaysia our model prices the country specific risk as well as the world market risk, while the more general model does not underlining the superiority of our dynamic model.

[143] In correspondence of the Asian financial crisis, the Malaysian Authorities introduced capital controls from the 1st of September 1998 to the 15th of February 1999 to avoid the depreciation of the local currency.

7.5 Conclusion

In this paper, we have investigated for impact of liberalisation in the risk assessment of the financial market returns of a group of Pacific Basin countries. Our main objective was to examine if the currency risk is an important component of the expected equity returns of these countries. In addition, we were interested to identify the sources of risk behind currency returns. Furthermore, we wanted to test if there exists a switch in the source of market and currency risk of the equity and foreign exchange market returns when these economies open to foreign investors. Finally, we wanted to examine the conditional volatility of the same stock and foreign market returns. Moreover, we intended to test if their conditional variances were affected by the relaxation of capital controls and the Asian financial crisis of mid 1997.

We have examined these issues by applying a dynamic integration version of international CAPM inclusive of currency risk in pricing expected stock returns. We applied a risk-adjusted uncovered interest rate parity model allowing a dynamic integration structure in pricing currency returns. We used a parsimonious multivariate GARCH-in-Mean process in estimating the conditional dynamics of our system of equations. Our main findings are as follows:

First, we found that local equity returns are positively related to country-specific risk before liberalisation for Malaysia and Taiwan and to world market risk thereafter for Korea, Malaysia and Thailand. Moreover, we obtained that currency risk is priced in explaining local equity returns in both pre and post liberalisation. The only exceptions are for Malaysia in pre liberalization and Thailand in post liberalization period. This evidence indicates that an international asset-pricing model that does not include currency risk is misspecified. The results suggest that the weak findings of De Santis and Imrohoroglu (1997) might be due to the omission of the currency risk from their asset-pricing structure.

Secondly, we found that currency returns are related to their risk in particular in the pre liberalization period. In fact, currency risk is statistically significant for Korea, Taiwan, and Thailand in pre liberalization period and only for Taiwan in the post liberalization one. For Malaysia, currency risk is not statistically significant in the pre liberalization period, but it is in the post liberalization one. In addition, we noted that their covariance with the local stock market returns in pre liberalisation and with the world market returns in post liberalisation are important factors of exchange rate performance.

Thirdly, in accordance with Bekaert and Harvey (1995), our results indicate that the analysed Pacific Basin markets of Korea, Malaysia and Thailand are integrated. In particular, as Bekaert and Harvey (1995), we noted integration also for countries such as Korea, which had extensive capital controls during the 90s. In contrast to Bekaert and Harvey (1995) we did not find substantial integration for Taiwan. In fact, for this country the market risk is not priced in explaining local equity returns. However, when pricing the rate of appreciation of the local currency against the U.S. dollar, the covariance between itself and the U.S. market returns is significant. This might be an indicator of integration of Taiwan with U.S.

Finally, we found that the liberalisation and more intensively the Asian financial crisis of mid 1997 affected the conditional variances of the analysed stock and foreign exchange returns.

Our study has shown that currency risk is an important component in international asset-pricing model. In particular, its omission might cause inaccurate results when pricing international assets. Moreover, our work provides evidence that the Pacific Basin countries are internationally integrated. Further work should be focused on the improvement of our framework by allowing a time-varying integration structure of both market and currency risk.

Tables

Table 7.1: Summary statistics of stock and foreign exchange returns

Panel A: Summary of statistics

Country	*Mean*	*Stand Dev.*[a]	*Skewness*	*Kurtosis*[b]	*B-J*[c]	*Q(12)*[d]	*Min.*	*Max.*
Indonesia								
Stock returns	0.72	35.13	1.37**	12.41**	775.**	10.09	-39.56	69.06
	(1.01)		[0.00]	[0.00]	[0.00]	[0.60]	08.97	12.88
Exch. rate	1.07*	29.17	4.61**	43.16**	15941. **	32.5**	-34.87	80.25
returns	(1.81)		[0.00]	[0.00]	[0.00]	[0.00]	10.98	01.98
Korea								
Stock returns	0.53	28.11	0.53**	2.52**	23.6**	14.51	-26.34	36.79
	(1.44)		[0.00]	[0.00]	[0.00]	[0.27]	11.97	01.98
Exch. rate	-0.35	12.39	5.11**	55.210**	27054.8**	24.6**	-16.62	37.60
returns	(1.51)		[0.00]	[0.00]	[0.00]	[0.02]	03.98	12.97
Malaysia								
Stock returns	0.56	33.17	-0.77**	3.70**	25.8**	22.2**	-42.33	33.61
	(0.91)		[0.00]	[0.00]	[0.00]	[0.03]	10.87	09.98
Exch. rate	0.23	8.92	-0.98**	30.12**	7393.2**	13.0	-21.77	16.00
returns	(1.37)		[0.00]	[0.00]	[0.00]	[0.37]	02.98	01.98
Philippines								
Stock returns	1.27	38.49	0.34*	2.15**	14.98**	11.72	-33.44	45.37
	(1.49)		[0.08]	[0.00]	[0.00]	[0.46]	09.90	06.87
Exch. rate	0.4**	9.46	1.44**	6.79**	89.38**	6.31	-8.48	14.28
returns	(2.05)		[0.00]	[0.00]	[0.00]	[0.90]	03.98	12.97
Taiwan								
Stock returns	1.14	40.63	-0.42**	4.61**	9.04**	10.84	-53.55	43.59
	(1.51)		[0.00]	[0.00]	[0.011]	[0.54]	10.87	08.87
Exch. rate	-0.06	5.06	-0.06	7.75**	227.9**	42.8**	-7.23	7.91
returns	(0.67)		[0.68]	[0.00]	[0.00]	[0.00]	04.89	10.97
Thailand								
Stock returns	0.32	32.46	-0.16	3.28**	5.65*	23.8**	-37.65	39.78
	(0.54)		[0.30]	[0.00]	[0.06]	[0.02]	10.87	01.98
Exch. rate	0.27	11.11	0.75**	29.23**	6853.4**	22.9**	-24.68	21.78
returns	(1.30)		[0.00]	[0.00]	[0.00]	[0.03]	02.98	07.97
U.S.								
Stock returns	1.0**	14.46	-1.06**	5.64**	27.34**	7.62	-24.68	13.24
	(3.98)		[0.00]	[0.00]	[0.00]	[0.81]	10.87	01.87

Note: On all tables within parenthesis we reported the t-statistics; while within brackets we report p-values.
[a] Each standard deviation is the monthly annualised one. This is computed by multiplying by 12 the variance of the monthly data and taking the squared root of this value.
[b] Equal to zero for the normal distribution.
[c] Bera-Jarque test statistic for normality.
[d] Ljung-Box test statistic of order 12.
* and ** denote statistical significance at the 10% and 5% levels, respectively.

Panel B: Autocorrelations of stock and exchange rate returns

Country	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Lag 6
Indonesia						
Stock returns	0.138**	-0.031	-0.014	-0.003	0.018	0.078
Exch. rate returns	-0.04	0.108	-0.18**	-0.099	-0.020	0.001
Korea						
Stock returns	0.135**	-0.008	-0.035	-0.006	0.043	0.112*
Exch. rate returns	0.094	0.090	-0.081	-0.067	-0.019	0.067
Malaysia						
Stock returns	0.108*	0.113*	-0.13**	-0.054	-0.067	-0.086
Exch. rate returns	0.065	-0.005	0.043	-0.008	0.116*	-0.110*
Philippines						
Stock returns	0.195**	-0.017	-0.022	0.004	0.020	-0.019
Exch. rate returns	0.019	0.091	0.000	0.111	0.015	0.032
Taiwan						
Stock returns	0.055	-0.023	-0.056	0.051	0.029	-0.060
Exch. rate returns	0.124**	0.136**	0.170**	-0.019	0.169**	0.159**
Thailand						
Stock returns	0.124**	0.056	-0.032	-0.112*	-0.130**	0.041
Exch. rate returns	0.151**	-0.094	0.023	-0.062	0.132**	0.063
U.S.						
Stock returns	0.008	-0.062	-0.063	-0.057	0.081	-0.032

* and ** denote statistical significance at the 10% and 5% levels, respectively.

Panel C: Autocorrelations of squared stock and exchange rate returns

Country	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Lag 6
Indonesia						
Stock returns	0.001	-0.006	0.032	0.021	0.032	-0.019
Exch. rate returns	0.138**	0.013	0.034	0.189**	0.223**	0.034
Korea						
Stock returns	0.058	0.407**	0.161**	0.185**	0.137**	0.130**
Exch. rate returns	0.287**	0.068	0.170**	0.054	0.021	0.003
Malaysia						
Stock returns	0.247**	0.080	0.235**	0.037	0.044	0.183**

Exch. rate returns	0.464**	0.180**	0.083	0.221**	0.210**	0.199**
Philippines						
Stock returns	0.087	0.074	0.039	0.000	0.094	0.046
Exch. rate returns	0.160**	0.162**	0.335**	0.130*	0.148*	0.155**
Taiwan						
Stock returns	0.353**	0.502**	0.319**	0.174**	0.205**	0.150**
Exch. rate returns	0.148**	0.002	0.180**	0.200**	0.018	-0.019
Thailand						
Stock returns	0.139**	0.158**	0.172**	0.181**	0.214**	0.097
Exch. rate returns	0.334**	0.256**	0.097	0.077	0.201**	0.167**
U.S.						
Stock returns	0.060	0.050	0.008	0.032	-0.017	-0.003

* and ** denote statistical significance at the 10% and 5% levels, respectively.

Table 7.2: Conditional dynamic integration model on stock returns

Panel A: Korea & Malaysia

Coefficients	Korea		Malaysia	
M10	0.911** (15.45)		0.241** (249.4)	
M30	0.982** (4.321)		0.612** (708.33)	
M111	0.061* (1.838)		0.185** (330.2)	
M112	-		0.128** (939.7)	
M113	-		-0.166** (-931.4)	
M114	-		-0.087** (-329.8)	
M12	0.003 (0.567)		0.002** (177.0)	
M15	0.005 (0.029)		0.000** (12.50)	
M32	0.002 (0.584)		0.004** (288.3)	
A11	1.640** (12.727)		-0.021** (-625.63)	
A31	0.358 (1.174)		0.012** (765.85)	
A33	-0.449** (-5.060)		-0.022** (-754.40)	
B11	0.886** (120.46)		0.945** (5670.9)	
B33	0.987** (669.82)		0.872** (15877.4)	
C11	0.431** (49.33)		0.318** (13.03)	
C33	0.070 (1.574)		0.479** (15.47)	
$B11^2+C11^2$	0.970		0.994	
$B33^2+C33^2$	0.979		0.990	
Akaike	2102		2082	
Schwartz	2150		2141	
L-fuction value	-1037		-1024	
Residuals:	Korea	US	Malaysia	US
Skewness	0.30* [0.06]	-1.0** [0.0]	-0.52** [0.00]	-0.57** [0.00]
Kurtosis[a]	1.06** [0.00]	6.** [0.0]	2.25** [0.00]	2.11** [0.00]
Q(12)[b]	11.4 [0.49]	5.7 [0.9]	16.28 [0.18]	15.75 [0.20]
$Q^2(12)$[c]	10.14 [0.60]	9.52 [0.7]	16.64 [0.16]	6.62 [0.88]

Note: On all tables within parenthesis we reported the t-statistics; while within brackets we report p-values.
[a]Equal to zero for the normal distribution.
[b & c] Ljung-Box test statistic of order 12.
*and ** denote statistical significance at the 10% and 5% levels, respectively.

Panel B: Taiwan & Thailand

Coefficients	Taiwan		Thailand	
M10	0.038* (1.783)		0.423** (201.1)	
M30	0.036 (1.51)		0.424** (430.23)	
M111	0.000 (0.049)		-0.0001 (-0.140)	
M112	-		-0.00005 (-0.231)	
M113	-		-0.0002 (-0.385)	
M114	-		-0.054** (-272.59)	
M115	-		0.054** (206.48)	
M12	0.000 (0.048)		0.000 (0.480)	
M15	0.00 (0.251)		0.00 (1.241)	
M32	0.000 (0.137)		0.00004** (2.441)	
A11	2.229** (7.028)		-0.018** (-13.191)	
A31	2.231** (6.908)		-0.017** (-31.624)	
A33	2.231** (6.810)		-0.016** (-15.883)	
B11	0.767** (42.909)		0.956** (348.42)	
B33	0.768** (44.090)		0.956** (346.09)	
C11	0.345** (24.872)		0.236** (97.96)	
C33	0.344** (24.614)		0.235** (100.1)	
Cr1				
$B11^2+C11^2$	0.707		0.969	
$B33^2+C33^2$	0.707		0.969	
Akaike	-1169		-995	
Schwartz	-1121		-932	
L-fuction value	598.92		515	
Residuals:	Taiwan	US	Thailand	US
Skewness	0.14 [0.38]	-0.59** [0.00]	-0.00 [0.97]	-0.59** [0.00]
Kurtosis	1.33** [0.00]	2.18** [0.00]	2.37** [0.00]	2.18** [0.00]
Q(12)	11.95 [0.45]	15.96 [0.19]	21.32* [0.05]	15.96 [0.19]
$Q^2(12)$	25.62** [0.01]	7.37 [0.83]	13.47 [0.33]	7.37 [0.83]

Note: see note of Panel A.

Table 7.3: Specification tests

Country	$Q_{12}(uh^{-1/2})$		$Q_{12}(uh^{-1/2})^2$		*Likelihood Ratio test*
	Model A	*Model B*	*Model A*	*Model B*	
Korea					
Stock returns	18.29	18.07	129.5**	9.15	692.0**
	[0.11]	[0.11]	[0.00]	[0.77]	[0.00]
Ex. rate returns	16.98	21.37*	75.41**	18.59	
	[0.15]	[0.06]	[0.00]	[0.10]	
Malaysia					
Stock returns	18.50	10.50	99.43**	7.60	374.0**
	[0.10]	[0.57]	[0.00]	[0.82]	[0.00]
Ex. rate returns	15.99	12.10	65.72**	15.30	
	[0.19]	[0.44]	[0.00]	[0.23]	
Taiwan					
Stock returns	9.18	9.28	121.11**	21.41**	126.0**
	[0.69]	[0.68]	[0.00]	[0.04]	[0.00]
Ex. rate returns	19.09*	17.99	33.58**	29.43**	
	[0.09]	[0.12]	[0.00]	[0.00]	
Thailand					
Stock returns	15.38	15.34	68.05**	13.43	232.0**
	[0.22]	[0.22]	[0.00]	[0.34]	[0.00]
Ex. rate returns	18.16	17.16	80.51**	3.11	
	[0.11]	[0.14]	[0.00]	[0.99]	

Note: The first four columns contain Ljiung-Box test statistics for the standardized residuals $uh^{-1/2}$ and the standardized residuals squared $(uh^{-1/2})^2$. The statistics are computed for two models. Model A asssumes a constant variance. Model B assumes a GARCH(p,q) process for the conditional variance. Both models assume a quasi maximum likelihood distribution. The number in the tabel are p-value. The maximum order of auto-correlation is 12. The column labelled Likelihood ratio test contains the likelihood ratio test statistics and correspondent p-values of the hypothesis of conditional homoskedasticity. The test is distributed as a chi-squared with 8 degree of freedom for Korea and 6 for the rest of the countries.

Table 7.4: Conditional dynamic integration model inclusive of currency risk.
Panel A: Korea & Malaysia

Coefficients	Korea	Malaysia
M10	0.342** (10.57)	0.574 (0.800)
M20	-0.275** (-5.180)	-0.031 (-0.021)
M30	0.749** (3.063)	0.819** (3.571)
M111	0.052** (2.665)	0.073 (1.166)
M112	-	0.129** (2.876)
M113	-	-0.102** (-2.532)
M114	-	-0.031 (-0.665)
M12	0.001 (0.00)	0.014** (2.919)
M13	0.000 (0.580)	-0.547** (-2.604)
M14	3.013** (3.483)	-0.006** (-2.391)
M15	0.394** (2.119)	-0.000 (-0.681)
M16	0.350** (3.449)	-0.028 (-0.352)
M17	1.490 (1.384)	0.000 (0.378)
M18	-0.384** (-5.724)	-0.012 (-0.113)
M211	0.083** (5.812)	0.096** (5.337)
M212	0.375** (25.278)	0.122** (4.081)
M213	0.135** (21.10)	-0.000 (-0.009)
M214	0.045 (1.396)	-0.037** (-4.579)
M215	-0.014 (-0.831)	0.049 (1.595)
M216	-0.023 (-0.955)	0.040** (1.957)
M217	0.023** (3.516)	0.073** (6.703)
M218	-0.032** (-2.327)	-0.109** (-8.616)
M219	0.201** (17.653)	-0.032 (-0.402)
M22	-0.426** (-3.968)	0.002** (3.720)
M23	0.212** (4.354)	0.061 (1.404)

M24	-0.004 (-0.433)			-0.012 (-0.611)		
M25	0.956** (5.014)			0.000 (0.141)		
M32	0.016** (1.909)			0.001 (0.141)		
A11	1.273** (32.683)			2.122** (4.758)		
A21	0.337** (25.428)			0.574** (186.43)		
A22	0.008 (0.174)			-0.628** (-4.169)		
A31	1.643** (27.07)			0.612** (3.673)		
A32	0.338** (6.432)			0.213* (1.899)		
A33	-1.084** (-5. 647)			-0.566** (-3.654)		
B11	0.869** (122.6)			0.858** (56.707)		
B22	0.430** (53.94)			0.601** (20.832)		
B222	-0.078* (-1.646)			-		
B33	0.855** (93.03)			0.953** (180.85)		
C11	0.427** (81.173)			0.475** (8.719)		
C22	0.420** (7.619)			0.644** (11.348)		
C222	0.790** (100.73)			-		
C33	0.150** (4.797)			0.222** (11.936)		
$B11^2+C11^2$	0.937			0.962		
$B22^2+C22^2$	0.991[d]			0.775		
$B33^2+C33^2$	0.755			0.957		
Akaike	2321			2549		
Schwartz	2466			2687		
L fuction	-1118			-1234		
Residual	Korea	Ex rate	U.S.	Malays.	Ex. rate	U.S.
Skewness	0.22 [0.20]	-0.5** [0.02]	-0.23 [0.25]	-0.68** [0.00]	-1.07** [0.00]	-0.31 [0.13]
Kurtosis[a]	1.23** [0.00]	3.04** [0.00]	0.79* [0.06]	2.36** [0.00]	5.84** [0.00]	0.77* [0.06]
Q(12)[b]	18.07 [011]	21.37* [0.06]	6.04 [0.90]	10.50 [0.57]	12.10 [0.44]	6.28 [0.90]
$Q^2(12)$[c]	9.15 [0.77]	18.59 [0.10]	10.2 [0.59]	7.60 [0.82]	15.30 [0.23]	6.58 [0.88]

Note: On all tables within parenthesis we reported the t-statistics; while within brackets we report p-values.
[a]Equal to zero for the normal distribution.
[b & c] Ljung-Box test statistic of order 12.
[d]This is the sum of $B22^2$, $B222^2$, $C22^2$, and $C222^2$.
* and ** denote statistical significance at the 10% and 5% levels, respectively.

Panel C: Taiwan & Thailand

Coefficients	Taiwan	Thailand
M10	1.466** (15.401)	-1.493** (-2.741)
M20	0.002 (0.049)	0.196 (1.612)
M30	0.753** (6.832)	0.247 (0.961)
M111	0.062** (3.219)	0.167** (6.041)
M112	-	-0.014 (0.00)
M113	-	0.063 (0.00)
M114	-	0.055 (0.00)
M12	0.023** (2.713)	0.044** (2.735)
M13	0.060** (3.184)	-0.225** (-6.789)
M14	-0.029** (-1.968)	0.007** (4.991)
M15	0.002** (1.959)	0.003** (9.926)
M16	0.044 (0.123)	-0.015 (-1.166)
M17	-0.096** (-3.261)	0.027** (9.967)
M18	1.579** (4.600)	-0.320** (-12.858)
M211	0.039 (0.702)	-0.207** (-10.980)
M212	0.090** (2.867)	-0.202** (-5.657)
M213	0.110** (4.963)	0.102 (1.366)
M22	-0.087 (-1.458)	-0.147** (-3.487)
M23	0.005* (1.700)	-0.154 (-1.231)
M24	-0.122** (-2.182)	0.007 (1.305)
M25	0.037 (0.536)	-0.073** (-9.068)
M32	0.004 (0.682)	0.024** (3.405)
A11	2.351** (10.37)	0.034** (9.185)
A21	0.133** (4.97)	0.718** (5.632)
A22	0.006 (0.371)	0.961** (3.581)
A31	0.520**	0.453**

	(4.206)			(3.092)		
A32	0.018 (1.056)			0.015 (0.243)		
A33	-1.050** (-5.873)			1.182** (6.115)		
B11	0.905** (220.53)			0.947** (65.207)		
B22	0.996** (1449.)			-0.375** (-3.595)		
B33	0.938** (144.67)			0.929** (533.84)		
C11	0.369** (32.13)			0.199** (32.56)		
C22	0.036** (3.522)			0.520** (21.58)		
C33	0.216** (18.451)			0.184** (58.75)		
$B11^2+C11^2$	0.953			0.936		
$B22^2+C22^2$	0.993			0.411		
$B33^2+C33^2$	0.926			0.897		
Akaike	2634			2797		
Schwartz	2745			2922		
L fuction	-1285			-1362		
Residual	Taiwan	Ex rate	U.S.	Thailand	Ex. rate	U.S.
Skewness	0.18 [0.27]	0.33 [0.11]	-0.29 [0.15]	-0.35** [0.02]	-5.29** [0.00]	-0.28 [0.16]
Kurtosis[a]	1.53** [0.00]	6.71** [0.00]	0.80* [0.05]	2.98** [0.00]	48.25** [0.00]	0.80* [0.05]
Q(12)[b]	9.28 [0.68]	17.99 [0.12]	6.10 [0.91]	15.34 [0.22]	17.16 [0.14]	5.87 [0.92]
$Q^2(12)$[c]	21.41** [0.04]	29.43** [0.00]	6.41 [0.89]	13.43 [0.34]	3.11 [0.99]	6.87 [0.87]

Note: On all tables within parenthesis we reported the t-statistics; while within brackets we report p-values.
[a]Equal to zero for the normal distribution.
[b & c] Ljung-Box test statistic of order 12.
* and ** denote statistical significance at the 10% and 5% levels, respectively.

Table 7.5: Conditional dynamic integration model inclusive of currency risk, and dummies for liberalisation and Asian crisis.

Panel A: Korea & Malaysia

Coefficients	Korea	Malaysia
M10	0.533** (77.272)	-0.113 (-1.467)
M20	-0.094** (-2.857)	0.062 (0.775)
M30	-1.010** (-11.281)	0.716** (23.078)
M111	0.118** (18.400)	0.109** (40.103)
M112	-	0.107** (13.123)
M113	-	-0.093** (-12.339)
M114	-	-0.032 (-1.007)
M12	0.000 (0.011)	0.024** (2.577)
M13	0.837** (17.055)	-0.731 (-1.091)
M14	0.049 (0.719)	-0.037** (-3.306)
M15	0.013** (10.005)	0.004** (16.595)
M16	-1.021** (-16.345)	-0.011** (-4.843)
M17	0.007** (7.839)	0.008** (89.48)
M18	-0.023** (-4.785)	-0.522** (-11.98)
M211	0.221** (47.367)	0.125** (55.74)
M212	0.111** (75.789)	-0.007** (-2.838)
M213	0.037** (10.143)	-0.077** (-12.710)
M214	0.012** (3.610)	-0.070** (-36.341)
M215	0.054** (102.92)	0.059** (12.264)
M216	0.126** (115.65)	-0.054** (-8.616)
M217	-0.175** (-72.305)	0.134** (98.747)
M218	0.013** (11.286)	-0.140** (-28.577)
M219	0.243** (515.18)	-
M22	-1.482** (-15.06)	-0.110 (-1.303)
M23	0.269** (25.113)	-0.003 (-0.893)

M24	-0.004 (-0.370)	0.025** (5.124)
M25	0.028** (3.918)	0.044** (38.916)
M32	0.086** (17.394)	0.001** (2.615)
A11	-2.275** (-9.182)	-0.791** (-35.756)
A21	-0.082** (-2.912)	0.541** (64.987)
A22	0.357** (21.870)	0.594** (4.892)
A31	2.458** (19.503)	-1.003** (-9.269)
A32	0.128** (6.653)	-0.757** (-5.011)
A33	2.127** (10.634)	-1.103** (-10.797)
B11	0.760** (148.03)	0.883** (154.6)
B22	0.278** (36.550)	0.330** (99.90)
B222	0.603** (15.897)	-
B33	0.732** (69.869)	0.899** (207.45)
C11	0.419** (173.783)	0.429** (177.57)
C22	0.032** (15.683)	0.257** (438.12)
C222	0.475** (59.531)	-
C33	0.065** (2.941)	0.206** (75.12)
D1	0.130** (16.013)	0.727* (1.668)
D2	0.344** (2.046)	0.402** (27.67)
DC1	10.037** (4.216)	9.315** (25.99)
DC2	10.773** (40.308)	4.942** (47.41)
$B11^2+C11^2$	0.753	0.964
$B22^2+C22^2$	0.665[d]	0.174
$B33^2+C33^2$	0.553	0.850
Akaike	2357	2548
Schwartz	2505	2697
L fuction	-1135	-1231

Residual	Korea	Ex rate	U.S.	Malaysia	Ex. rate	U.S.
Skewness	0.59** [0.00]	-0.03 [0.83]	-1.06** [0.00]	-0.35** [0.03]	-0.04 [0.78]	-1.12** [0.00]
Kurtosis[a]	0.72** [0.02]	1.28** [0.00]	6.01** [0.00]	1.56** [0.00]	2.01** [0.00]	6.50** [0.00]
Q(12)[b]	12.36	15.54	6.05	10.56	14.13	6.11

	[0.42]	[0.21]	[0.91]	[0.57]	[0.29]	[0.91]
$Q^2(12)$[c]	10.38	16.21	9.52	5.70	12.99	6.43
	[0.58]	[0.18]	[0.66]	[0.93]	[0.37]	[0.89]

Note: On all tables within parenthesis we reported the t-statistics; while within brackets we report p-values.
[a]Equal to zero for the normal distribution.
[b & c] Ljung-Box test statistic of order 12.
[d]This is the sum of $B22^2$, $B222^2$, $C22^2$, and $C222^2$.
* and ** denote statistical significance at the 10% and 5% levels, respectively.

Panel B: Taiwan & Thaialand

Coefficients	Taiwan	Thailand
M10	3.431** (5.697)	-0.530 (-1.201)
M20	0.367** (2.513)	-0.036 (-0.168)
M30	0.674** (11.086)	0.805** (11.33)
M111	0.077** (2.359)	0.259** (6.175)
M112	-	0.063 (1.262)
M113	-	0.018 (0.387)
M114	-	-0.114** (-3.852)
M12	0.012** (3.218)	0.011 (1.611)
M13	-1.806** (-5.695)	5.824** (11.195)
M14	-0.017** (-5.083)	-0.532** (-8.417)
M15	0.000 (0.252)	0.002** (3.017)
M16	0.060 (1.189)	0.862** (7.267)
M17	-0.024** (-4.450)	-0.044** (-2.115)
M18	-0.632** (-3.165)	0.045 (0.538)
M211	0.042 (0.933)	-0.002 (-0.032)
M212	0.026 (0.943)	-0.057 (-1.323)
M213	0.113** (4.014)	-0.107** (-6.140)
M214	-	-0.099** (-3.475)
M22	-0.353** (-4.741)	0.447** (3.346)
M23	0.005** (7.591)	-0.106** (-5.440)
M24	-0.315** (-4.126)	-0.017 (-0.453)
M25	0.067** (4.151)	0.084** (14.978)

M32	0.006 (0.895)			0.017** (19.792)		
A11	-2.696** (-7.025)			-2.167** (-7.269)		
A21	-0.386** (-6.449)			-1.076** (-31.299)		
A22	0.313** (4.953)			-0.516* (-1.900)		
A31	-0.166 (-1.615)			-1.432** (-4.966)		
A32	0.011 (0.225)			1.058** (6.556)		
A33	-0.669** (-5.085)			-0.817** (-2.288)		
B11	0.834** (43.067)			0.780** (31.343)		
B22	0.909** (85.938)			0.352** (4.562)		
B33	0.963** (343.430)			0.797** (79.655)		
C11	0.508** (15.834)			0.082** (10.638)		
C22	0.042 (1.167)			0.014** (2.570)		
C33	0.223** (11.444)			0.420** (33.281)		
D1	-2.106** (-2.941)			5.177** (11.948)		
D2	0.017 (0.273)			0.009 (0.221)		
DC1	-2.397* (-1.696)			11.288** (2.476)		
DC2	-1.422** (-6.882)			11.864** (10.42)		
$B11^2+C11^2$	0.953			0.615		
$B22^2+C22^2$	0.828			0.124		
$B33^2+C33^2$	0.977			0.811		
Akaike	2579			2649		
Schwartz	2700			2784		
L fuction	-1254			-1285		
Residual	Taiwan	Ex rate	U.S.	Thailand	Ex. rate	U.S.
Skewness	0.18 [0.26]	0.70** [0.00]	-0.97** [0.00]	-0.47** [0.00]	-3.78** [0.00]	-1.51** [0.00]
Kurtosis[a]	1.03** [0.00]	5.77** [0.00]	5.21** [0.00]	2.94** [0.00]	36.2** [0.00]	9.6** [0.00]
Q(12)[b]	9.87 [0.63]	12.43 [0.41]	6.36 [0.90]	6.68 [0.88]	11.85 [0.46]	7.05 [0.85]
$Q^2(12)$[c]	12.82 [0.38]	4.92 [0.96]	6.89 [0.86]	8.89 [0.71]	0.64 [0.99]	3.97 [0.98]

Note: On all tables within parenthesis we reported the t-statistics; while within brackets we report p-values.
[a]Equal to zero for the normal distribution.
[b & c] Ljung-Box test statistic of order 12.
* and ** denote statistical significance at the 10% and 5% levels, respectively.

Appendix 7.A: Dumas (1994) international capital asset pricing model

Considering ρ_i the rate of return on security i, over a short holding period, expressed in real terms (i.e. adjusted for inflation); the classic CAPM of Sharpe (1964), Lintner (1965), and Mossin (1966) says that, in equilibrium, there must exist two numbers η and θ such that

(A.1) $$E(\rho_i) = \eta + \theta cov(\rho_i, \rho_m)$$

where ρ_m represents the real rate of return on the market portfolio. The coefficient η indicates the real riskless rate of return; and the coefficient θ can be interpreted as the market average degree of risk aversion. The real rate of return is given as

(A.2) $$\rho_i = \frac{1+R_i}{1+\pi} - 1,$$

where R_i is the nominal rate of return of asset or market index i expressed in U.S. dollar term, and π is the rate of inflation of country i expressed in U.S. dollar. Using the Ito approximation[144], and substituting equation (A.2) into equation (A.1), as in Dumas (1994), we obtain

(A.3) $$E(R_i) - E(\pi) + var(\pi) - cov(R_i, \pi) = \eta + \theta cov(R_i - \pi, R_m - \pi)$$

or rearranging the terms of equation (A.3),

(A.4) $$E(R_i) = \eta + E(\pi) - (1-\theta)var(\pi) - \theta cov(\pi, R_m) + (1-\theta)cov(R_i, \pi) + \theta cov(R_i, R_m)$$

In equation (A.4) the first four terms of the right side of the equation sum to the nominally riskless rate of return r. Hence, we can rewrite equation (A.4) as

(A.5) $$E(R_i) = r + (1-\theta)cov(R_i, \pi) + \theta cov(R_i, R_m).$$

Equation (A.5) states that risky inflation produces a separate premium in nominal returns. It is important to underline that the rate of inflation in any country may be measured in any currency. For instance considering both the expected rate of return on market index i and of inflation expressed in U.S. dollar, (A.5) becomes

(A.6) $$E(R_{i\$}) = r + (1-\theta)cov(R_{i\$}, \pi^i_\$) + \theta cov(R_{i\$}, R_m),$$

where $E(R_{i\$})$ is the nominal rate of return of country i expressed in U.S dollar and $\pi^i_\$$ is the rate of inflation of country i expressed in U.S. dollar. According to Solnik's case the randomness of the rate of inflation of country i expressed in U.S. dollar is only due to random fluctuation of the local currency of country i against the U.S. dollar[145]. Therefore, the term $cov(R_{i\$}, \pi^i_\$)$ of equation (A.6) can be substituted by the covariance between the rate of return

[144] The Ito approximation establishes that the return of an asset in currency k_p is equal to its return in currency k (R_{ik}) plus the percentage change in the value of currency k respect to currency k_p (x_k) plus $cov(R_{ik}, x_k)$.

[145] The same assumption was made by Bekaert and Harvey (1995), where the authors in calculating the real rate of return on a group for emerging equity markets expressed in U.S. dollar note that the returns in U.S eliminates the location inflation, but the U.S. inflation remains in them.

on asset (or market index) i expressed in U.S. dollar units and the rate of appreciation (depreciation) of the currency i respects to the U.S. dollar. Therefore we can rewrite (A.6) as

(A.7) $$E(R_{i\$}) = r + (1 - \theta)\mathrm{cov}(R_{i\$},X_{i\$}) + \theta\mathrm{cov}(R_{i\$},R_m),$$

with $X_{i\$}$ the rate of appreciation of currency i against the U.S. dollar.

Appendix 7.B: Dynamic integration international capital asset pricing model

The rate of return of a market index i denominated in U.S. dollar can be written as follows

(B.1) $R_{ji\$} = (1+R_{ji})(1+X_{i\$}) - 1$

where R_{ji} is the rate of return on asset j in the local currency of country i; and $X_{i\$}$ is the rate of appreciation (or depreciation) of the local currency against the U.S. dollar, where the exchange rate is expressed as units of U.S. dollar against one unit of each local currency. Equation (B.1) can be rearranged as follows

(B.2) $R_{ji\$} = R_{ji} + X_{i\$} + R_{ji}X_{i\$}$.

Because the cross-product term, $R_{ji}X_{i\$}$, is normally small, we can write (B.2) as follows

(B.3) $R_{ji\$} = R_{ji} + X_{i\$}$.

7. B.1 Derivation of the ICAPM under full segmentation

In case of full segmentation, the risk associated with the rate of return of the local market index i is associated with the country-specific risk, which is only affected by the variation of the domestic market index returns. Under this scenario, according to the International Capital Asset Pricing Model (ICAPM) of Dumas (1994) and Dumas and Solnik (1995) reported in equations (A.7), we can explain the rate of return on the stock market index of country i, expressed in U.S. dollar, as follows

(B.4) $R_{i\$,t} = a_i + b_i Cov(R_{i\$,t}, R_i) + c_i Cov(R_{i\$,t}, X_{i\$,t}) + \eta_{i,}$,

where the coefficient b_i captures the sensitivity of the rate of return of the stock index of country i, expressed in U.S. dollar, respect to the covariance between itself and the rate of return of the stock index of country i. Additionally, the coefficient c_i captures the sensitivity of the rate of return of the stock index of country i, expressed in U.S. dollar, to the covariance between itself and the rate of appreciation (depreciation) of the local currency respect to the U.S. dollar. Equation (B.4) can be rearrange as follows

(B.5) $R_{i\$,t} = a_i + b_i Cov(R_{i,t}+X_{i\$,t}, R_{i,t}) + c_i Cov(R_{i,t}+X_{i\$,t}, X_{i\$,t}) + \eta_{i,}$,

and

(B.6) $R_{i\$,t} = a_i + b_i Cov(R_{i,t}, R_{i,t}) + c_i Cov(X_{i\$,t}, R_{i,t}) + d_i Cov(R_{i,t}, X_{i\$,t}) + e_i Cov(X_{i\$,t}, X_{i\$,t}) + \eta_{i,}$,

and

(B.7) $R_{i\$,t} = a_i + b_i Var(R_{i,t}) + 2m_i Cov(X_{i\$,t}, R_{i,t}) + n_i Var(X_{i\$,t}) + \eta_i$,

which can be written using a symbology consistent with the one used in the rest of the paper as

(B.8) $E_{t-1}(R_{i\$,t}) = m10_i + \sum_{k=1}^{p} m_{11k,i} R_{i\$,t-k} + m_{12,i} h_{ii,t} + m_{13,i} h_{xx,t} + 2m_{14,i} h_{ix,t} + \varepsilon_{i,t}$, where $h_{ii,t}$ represents the conditional variance of the rate of return of the stock market of country i, expressed in local currency; $h_{ix,t}$ represents the conditional covariance between the rate of return of the stock market index of country i and the rate of appreciation (depreciation) of currency i; and $h_{xx,t}$ indicates the conditional variance of the rate of appreciation (depreciation) of currency i.

B.2 Derivation of the ICAPM under full integration

As for the full segmented scenario, we can use the ICAPM of Dumas (1994) and Dumas and Solnik (1995) introduced in equation (A.7), and we explain the rate of return on the stock index of country i, expressed in U.S. dollar as follows

(B.9) $R_{i\$,t} = a_i + b_i Cov(R_{i\$,t}, R_{m,t}) + c_i Cov(R_{i\$,t}, X_{i\$,t}) + \eta_{i,}$

where the coefficient b_i measures the sensitivity of the rate of return on the stock index of country i, expressed in U.S. dollar, respect to its covariance with the market portfolio rate of return; and the coefficient c_i indicates the sensitivity of the rate of return on the stock index of country i, expressed in U.S. dollar, respect to its covariance with the rate of appreciation (depreciation) of the local currency. Equation (B.9) can be rearranged as

(B.10) $R_{i\$,t} = a_i + b_i Cov(R_{i,t}+X_{i\$,t}, R_{m,t}) + c_i Cov(R_{i,t} + X_{i\$,t}, X_{i\$,t}) + \eta_{i,}$

and

(B.11) $R_{i\$,t}=a_i + b_i Cov(R_{i,t},R_{m,t}) + c_i Cov(X_{i\$,t},R_{m,t})+ d_i Cov(R_{i,t}, X_{i\$,t})+e_i Cov(X_{i\$,t},X_{i\$,t})+\eta_{i,}$

and

(B.12) $R_{j\$,t} = a_i +b_i Cov(R_{i,t},R_{m,t})+c_i Cov(X_{i\$,t},R_{m,t})+d_i Cov(R_{i,t}, X_{i\$,t}) + e_i Var(X_{i\$,t}) + \eta_{i,}$

Rearranging (B.12) as in the previous compositions we obtain

(B.13) $E_{t-1}(R_{i\$,t})=m_{10,i} + \sum_{k=1}^{p} m_{11k,i} R_{i\$,t-k} +m_{15,i} h_{im,t} +m_{16,i} h_{xm,t} + m_{17,i} h_{ix,t} +m_{18,i} h_{ix,t} + \varepsilon_{i,t},$

where $h_{im,t}$ represents the conditional covariance of the rate of return of the stock market of country i, expressed in local currency and the market portfolio return; $h_{mx,t}$ represents the conditional covariance between the rate of return of the market portfolio and the rate of appreciation (depreciation) of currency i; $h_{ix,t}$ represents the conditional covariance of the rate of return of the stock market of country i, expressed in local currency and the rate of appreciation of currency i; and $h_{xx,t}$ indicates the conditional variance of the rate of appreciation (depreciation) of currency i.

B.3 The derivation of the rate of appreciation of the local currency

Dumas (1994) argues that if the financial market is integrated, the CAPM of equation (A.5) applies to all securities. In fact equation (A.5) can be applied to explain the rate of return from a foreign currency deposit, expressed in U.S. dollar as follows

(B.14) $r_i = (1 + r^*_i)(1 + X_{i\$}) - 1$,

where r_i represents the rate of return on a currency deposit of country i, expressed in U.S. dollar; r^*_i indicates the rate of return on a currency deposit of country i, expressed in currency i; and $X_{i\$}$ is the rate of appreciation (depreciation) of the currency of country i respect to the U.S. dollar. Equation (B.14) can be rearranged as

(B.15) $r_i = r^*_i + X_{i\$} + r^*_i X_{i\$}$,

where the term $r^*_i X_{i\$}$ is a really small number and therefore it can be rewritten as follows

(B.16) $r_i = r^*_i + X_{i\$}$.

Applying equation (A.5) to explain the rate of return on a foreign currency deposit, expressed in U.S. dollar, indicated by r_i, and writing $r^*_i + X_{i\$}$ instead of r_i, gives

(B.16) $r^*_i + X_{i\$} = r + (1 - \theta)\text{cov}(X_{i\$}, \pi) + \theta\text{cov}(X_{i\$}, R_m)$,

which is a relationship between short-term nominal interest rates quoted on two different currencies or equivalently, between the short-maturity forward premia and the expected spot exchange rate. Equation (B.16) follows from viewing currency i's nominally riskless asset as a risky asset from the viewpoint of a U.S. dollar investor, and noting that, according to Dumas (1994), risks and required returns have the same equilibrium pricing structure, whether a risky asset is a stock or a foreign currency deposit. Equation (B.16) provides the deviation from the traditional UIRP, which prevails when investors are risk averse and PPP does not hold. In equation (B.16) there exists equilibrium but the equilibrium relationship between interest rates incorporates an inflation premium, which is a deviation from nominal UIRP, and the reason being that investors care about real returns. Equation (B.16) can be rearranged as follows

(B.17) $X_{i\$} = r - r^*_i + (1 - \theta)\text{cov}(X_{i\$}, \pi) + \theta\text{cov}(X_{i\$}, R_m)$.

As in the first part of this report, we assume the Solnik's special case, where the rate of inflation in country i is nonrandom, but the rate of inflation in country i but measured in dollar is random, exclusively due to the randomness in the exchange rate. Therefore, the term $\text{cov}(X_{i\$}, \pi)$ is equal to $\text{cov}(X_{i\$}, X_{i\$})$, which corresponds to $\text{var}(X_{i\$})$, where the only random component of inflation π is $X_{i\$}$. Based on this assumption, we can rewrite equation (B.17) as

(B.18) $X_{i\$} = r - r^*_i + (1 - \theta)\text{var}(X_{i\$}) + \theta\text{cov}(X_{i\$}, R_m)$.

Equation (B.18) represents the rate of appreciation of currency i in case of full integration. In the scenario of full segmentation, the component $\text{cov}(X_{i\$}, R_m)$ can be substitute by the rate of return on the local stock market, expressed in domestic currency, R_i, and it becomes

(B.19) $X_{i\$} = r - r^*_i + (1 - \theta)\ \text{var}(X_{i\$}) + \theta\text{cov}(X_{i\$}, R_i)$.

Using the same symbols we have used to derive the first equation of our model, we have that in a scenario of full segmentation, the rate of appreciation of currency i is

(B.20) $$X_{i\$,t} = m_{20,i} + \sum_{k=1}^{p} m_{21k,i} X_{i\$,t-k} + m_{22,i} h_{xx,t} + m_{23,i} h_{ix,t} + \varepsilon_{i,t};$$

where h_{xx} represents the variance of the rate of appreciation of currency i, indicated as $X_{i\$}$; and h_{ix} represents the covariance between the rate of appreciation of currency i and the rate of return on the local stock market index of country i, expressed in domestic currency.

Under the scenario of full integration, equation (B.20) becomes

(B.21) $$X_{i\$,t} = m_{20,i} + \sum_{k=1}^{p} m_{21k,i} X_{i\$,t-k} + m_{24,i} h_{xx,t} + m_{25,i} h_{mx,t} + \varepsilon_{i,t};$$

where h_{xm} is the covariance between the rate of appreciation of the currency i and the rate of return of the world market portfolio.

Appendix 7.C: General dynamic integration international capital asset pricing model

The introduced specification of the mean stock and currency returns of equations (7.7) and (7.10) respectively, can be generalised by considering a more general framework that includes market and currency risks for both pre and post liberalisation periods. Under this scenario, the specification of stock return of equation (7.7) becomes

$$\text{(B.22)}\quad E_{t-1}(R_{i,t}) = m_{10,i} - X_{i\$,t} + \sum_{k=1}^{p} m_{11k,i}(R_{i,t-k} + X_{i\$,t-k}) + \text{abs}(m_{12,i})h_{ii,t}DC_{i,t}$$
$$+ \text{abs}(m_{12^*,i}h_{ii,t})(1-DC_{i,t}) + m_{13,i}h_{xx,t}DC_{i,t} + 2m_{13^*,i}h_{ix,t}(1-DC_{i,t}) + m_{14,i}h_{xx,t}DC_{i,t}$$
$$+2m_{14^*,i}h_{ix,t}(1-DC_{i,t}) + \text{abs}(m_{15,i})h_{im,t}(1-DC_{i,t}) + \text{abs}(m_{15^*,i})h_{im,t}DC_{i,t}$$
$$+m_{16,i}h_{xm,t}(1-DC_i) + m_{16^*,i}h_{ix,t}DC_{i,t} + m_{17,i}h_{xx,t}(1-DC_{i,t}) + m_{17^*,i}h_{xm,t}DC_i$$
$$+m_{18,i}h_{ix,}t(1-DC_{i,t}) + m_{18^*,i}h_{xx,t}DC_{i,t} + \varepsilon_{1,t},$$

where all variables are defined as in equation (7.7), the parameters $m_{12^*,i}$, $m_{13^*,i}$, $m_{14^*,i}$, correspond to the parameters $m_{12,i}$, $m_{13,i}$, $m_{14,i}$, but for the post liberalisation period and the parameters $m_{15^*,i}$, $m_{16^*,i}$, $m_{17^*,i}$, $m_{18^*,i}$ correspond to the coefficients $m_{15,i}$, $m_{16,i}$, $m_{17,i}$, $m_{18,i}$, but for the pre liberalisation period.

Similarly, the specification for the currency return of equation (7.10) becomes

$$\text{(B.23)}\quad X_{i\$,t} = m_{20,i} + \sum_{k=1}^{p} m_{21k,i}X_{i\$,t-k} + m_{22,i}h_{xx,t}DC_{i,t} + m_{22^*,i}h_{ix,i}(1-DC_{i,t}) + m_{23,i}h_{xx,t}DC_{i,t}$$
$$+m_{23^*,i}h_{ix,t}(1-DC_{i,t}) + m_{24,i}h_{xx,t}(1-DC_{i,t}) + m_{24^*,i}h_{mx,t}DC_{i,t} + m_{25,i}h_{xx,t}(1-DC_{i,t})$$
$$+ m_{25^*,i}h_{mx,t}DC_{i,t} + \varepsilon_{2,t},$$

where all variables are defined as in equation (7.10), the parameters $m_{22^*,i}$, $m_{23^*,i}$ represent the coefficients $m_{22,i}$, $m_{23,i}$ in post liberalisation and the parameters $m_{24^*,i}$, $m_{25^*,i}$ represent the coefficients $m_{24,i}$, $m_{25,i}$ for the pre liberalisation period.

To test for the superiority of the reduced form of the dynamic integration international capital asset pricing model of equations (7.7), and (7.10), we perform the likelihood ratio test, which corresponds to test for the null hypothesis that the coefficients $m_{12^*,i}$, $m_{13^*,i}$, $m_{14^*,i}$, $m_{15^*,i}$, $m_{16^*,i}$, $m_{17^*,i}$, $m_{18^*,i}\, m_{22^*,i}$, $m_{23^*,i}\, m_{24^*,i}$, and $m_{25^*,i}$, of equations B.22 and B.23 are equal to zero. The test is distributed as a chisquare with 11 degree of freedom.

Table 7.6: Likelihood ratio tests

	Likelihood function value of the general model	*Likelihood function value of the reduced model*	*Likelihood Ratio test*
Korea	-1133	-1135	4
Malaysia	-1214	-1231	32**
Taiwan	-1254	-1254	0
Thailand	-1277	-1285	16

** and * indicate the statistically significance at 5% and 10% respectively.

CHAPTER EIGHT

CONCLUSION

8.1 *Introduction*

This doctoral thesis has been focused on a comprehensive examination of the behaviour of stock and foreign exchange markets for a group of eight Pacific Basin countries: Hong Kong, Indonesia, Korea, Malaysia, Philippines, Singapore, Taiwan, and Thailand. The major objective was the identification of the role played by foreign ownership restrictions on the financial linkages of these capital markets, both at intermarket and crossmarket basis. Moreover, the main purpose was to establish if the financial linkages of the considered capital markets was a consequence of their liberalisation, or if there have been alternative channels through which these financial markets became closer. It was also of interest to explore the channels of links amongst these financial markets and between these markets and those of the industrialised world. Furthermore, the thesis presents one of the first comprehensive studies, which examine the financial and economic integration of the Pacific Basin Rim both at the regional and global level, which has relevant important policy implications in establishing whether Japan or the U.S. is the dominant developed economy of the region. These issues have been examined by using four different, but interrelated approaches, in chapters 4, 5, 6 and 7.

This conclusive chapter is structured as follows. Section 8.2 includes the main conclusions for each chapter 4, 5, 6, and 7 and a discussion of the overall results. Section 8.3 refers to the implications of the findings. Finally, the last section suggests topics for further research.

8.2 *Summary and conclusion*

The first, second and third chapters presented the introduction of the thesis, the institutional background of the countries under research, and a presentation of the techniques of estimation applied in the four papers.

The main empirical body of the thesis started in the fourth chapter. This chapter includes work that examines the existence of potential long-run and short-run dynamics between stock prices and real exchange rates. The main purpose of this analysis was to verify whether these links were affected by the existence of foreign ownership restrictions. Applying the cointegration methodology, the empirical evidence indicates no long-run relationship between the real exchange rate and the local stock market in each Pacific Basin country for either the decade of the 1980's, or the decade of the 1990's, with the exception of Hong Kong. However, when investigating for the invalidity of the obtained cointegration and causality inferences due to the omission of an important "causing" variable, which in the study was chosen to be the U.S. stock prices, the results of the trivariate cointegration analysis showed that for all countries the real exchange rate and the U.S. stock prices are positively related to the domestic stock prices for the period of the 1990's. Particularly, the evidence indicates the existence of the same degree of interrelations for countries presenting different degree of capital controls.

This evidence underlines that foreign exchange restrictions have not been found to be an important determinant of the link between the domestic stock and foreign exchange markets on one hand, and between the domestic capital and world financial markets on the other hand. This suggests that free capital flow is not sufficient for international investment. As noted by Bekaert (1995) and Levine and Zervos (1996), access to market information is also important. However, the obtained presence of links during the 1990's even for countries with extensive foreign ownership restrictions indicates that markets can also be related through other channels. Therefore, the existence of foreign exchange restrictions is not a necessary condition for the isolation of domestic capital markets from world influences.

Two facts might have contributed to the integration of the Pacific Basin financial markets even in presence of extensive capital controls. First is the open character of these economies in terms of exports and imports and the substantial trade with the rest of the world. Thus, financial integration can be closely related to economic integration. Secondly, alternative financial instruments such as Country Funds could had offered a way to foreign investors for entering highly restricted equity markets increasing their integration with global markets. In fact, analysing the history of financial events that took place on the considered Pacific Basin countries, generally Country Funds were introduced much before the liberalisation of their capital markets (see Panel A of Table 2.3). For instance, in Thailand the First Country Fund was introduced in July 1985, while the first form of openness of its capital market corresponds to September 1987, when the Alien Board was launched and foreign investors were allowed to own up to 49% of shares of Thai companies.

Based on the findings of the first paper, reported in the fourth chapter, the research proceeds with a second work, included in the fifth chapter, which investigates the role of Country Funds as financial vehicles providing a channel for the financial integration of restricted capital markets. Using the multivariate cointegration analysis in the autoregressive and moving average form, the existence of potential financial links amongst the considered Pacific Basin countries with U.S. and Japan and the presence of potential drivers of the system are investigated. Moreover, the recursive-based estimation is applied to explore the beginning of integration and its evolution over the period 1980-1998. The results for the first part of the period indicate that the relaxation of foreign ownership restrictions is not sufficient for attracting international investment and for strengthening the interrelations of these countries with U.S. and Japan. On the other hand, the findings show strong financial links for Taiwan and Thailand with both Japan and U.S., during the first sub-period in which foreign restrictions were in place. Furthermore, the evidence of the recursive analysis detects that the first form of their integration corresponds to the period of the introduction of First Country Funds. This highlights that Country Funds are alternative financial instruments used by international investors to access restricted capital markets and that they contribute to an increase of the financial links of the entered domestic markets with world markets. Finally, the estimated common trends mechanisms show that neither Japan, nor the U.S. has a dominant influence in the Pacific Rim. Plotting the permanent component of each market, which corresponds to the common trend, and the actual stock price behaviour, we find that the difference of the two – the transitory component – to be substantial for Taiwan and U.S. in the post 1996 period, thus showing that international investors are exploiting short-term diversification opportunities.

Overall these findings show that international investors have opportunities for portfolio diversification by investing in most of the Pacific Basin countries. In fact, while the results for the open economies show that although the linkages have increased in recent years, there is room for long-term gains by investing in these markets; the results for the semi-open economies show that although long-term diversification benefits from exposure to these markets might be limited, short-run benefits might exist due to substantial transitory fluctuations.

After having verified that Country Funds are a potential channel for linking stock markets even when there are foreign ownership restrictions, the thesis proceeds to investigate the contribution of economic integration in the financial integration of the Pacific Basin capital markets. This analysis, that represents the third paper in the thesis, is included in the sixth chapter. Using a log-linear approximate asset-pricing framework of Campbell (1991) and rearranged by Ammer and Mei (1996), the real and financial links at the regional and global level, are simultaneously estimated by analysing the covariance of the components of excess returns on national stock markets over the period 1980-1998. The findings indicate that at the regional and global level and for all sub-periods that financial integration is accompanied by economic integration. Therefore, this evidence suggests that economic integration provides a channel for financial integration, which explains, at least partly, the high degree of financial integration found in this analysis and in previous work, such as the one of Bekaert and Harvey (1995), for this region even in the presence of foreign ownership restrictions. The findings of this analysis confirm the results of the first and second work of this thesis. In fact, once again it is shown that foreign exchange restrictions do not isolate the Pacific Basin capital markets from world influences.

Finally, chapter eight includes the fourth paper of the thesis, which represents an alternative approach to examining if the degree of financial integration of the considered Pacific Basin countries with the global markets is related to the extent of their capital controls. In particular, the importance of the currency risk in pre and post liberalisation in pricing stock market returns is investigated. The study uses a dynamic integration capital asset-pricing model that allows expected equity returns to be related to a country-specific risk before liberalisation and to the world market risk thereafter. The findings indicate that stock returns are positively related to country-specific risk before liberalisation for Malaysia and Taiwan and to world market risk thereafter for Korea, Malaysia and Thailand. In addition, the results show that currency risk is priced for Korea, Taiwan and Thailand in pre liberalisation and only for Taiwan in the post liberalisation period. Finally, the evidence indicates that the analysed Pacific Basin markets are integrated. In particular, in accordance with Bekaert and Harvey (1995) and with the other three papers of this doctoral thesis, integration is again found also for countries such as Korea, which had extensive capital controls during the 90s.

In each analysis, the effects of the recent Asian financial crisis of mid 1997 has also been tested, not only for the robustness of the estimated relationships, but also to identify if this event contributes to the increase of the financial integration of the Pacific Basin capital markets at the regional and the global level. Overall, the results indicate that the Asian crisis has some effects on the links amongst the studied capital markets. There have been some financial markets that have been more hit, such as Thailand, Indonesia and Korea, and others that have been little affected such as Taiwan. In particular, it has been found that the Asian crisis while it has reduced the economic integration of the Pacific Basin countries at the global level, it has increased their economic and financial integration at the regional level. Furthermore, this evidence indicates that there was a strong economic and financial integration of these countries at regional level prior to the crisis providing an explanation for its contagion effect.

Concluding, the four different analyses composing this doctoral thesis underline that capital controls do not isolate this region from world influences. In addition, the research identifies that economic integration and Country Funds contribute to the financial integration of these countries. The results also indicate the presence of links between their stock and foreign exchange markets. In particular, they show that the currency risk is priced in domestic equity returns. Another interesting evidence is that neither Japan, nor the U.S., dominates the Pacific Basin Rim. Some countries present closer links with the U.S., for instance Thailand, and others with Japan, for example Korea and Taiwan.

8.3 Policy implications of the thesis

This doctoral thesis represents a comprehensive analysis of the stock and foreign exchange markets of a group of Pacific Basin countries. The selection of the countries has been based on considering economies located in the same geographical region but with differences in the degree of foreign ownership restrictions in their capital markets. This is to identify the role of capital controls in isolating their financial markets from the world influences. This research comes at a time when many countries, and especially the Pacific Basin economies, are contemplating the reintroduction of foreign exchange restrictions on international capital flows in the aftermath of the Asian crisis. The thesis shows that capital controls fail in their role to isolate the studied economies from external shocks. Moreover, the evidence indicates that financial links between these markets and global markets are fostered through other channels. In fact, it has been verified that the presence of alternative financial instruments used by foreign investors to enter restricted equity markets contribute to an increase in their integration with the rest of financial world. It has also been noted that the open character of the Asian economies in terms of exports and imports and the substantial trade with Japan and the U.S. induces strong economic links that provide a channel for their financial integration. Therefore, this thesis suggests to local Monetary Authorities to adopt alternative policies to achieve economic and financial stability for their countries. Capital controls are not appropriate instruments to isolate markets from shocks coming from the rest of the world. In addition, the analysis indicates that care should be taken in implementing exchange rate policies since stock and foreign exchange markets are closely linked.

The thesis also shows a considerable degree of economic and financial integration amongst the Pacific Basin countries and with Japan and the U.S. in the period prior to the Asian crisis of mid 1997. These substantial links during periods of normality might suggest that this region should be considered as a potential candidate for the creation of an Economic Union with a common currency. Even if in the region there is still lack of political consensus when thinking in terms of a common monetary system, the natural characteristics of this area combined with the importance of their external sectors, which operated as "engine of growth" during their impressive economic expansion of the 80s and 90s, represent strong reasons to think for the creation of a community union. On this point, the finding of this thesis suggests that these countries present a degree of economic and financial links that make this discussion realistic. More important, arguments point out by this thesis might be used as an incentive for the beginning of the process.

The thesis has also implications for international portfolio diversification. The analysis of stock market linkages amongst the Pacific Basin countries indicates that international investors have opportunities for portfolio diversification by investing in most of these markets. In addition, the results for the semi-open economies as Taiwan and Thailand show that short-run benefits might exist due to substantial transitory fluctuations.

On the other hand, even if this evidence recommends international fund managers to consider these capital markets when looking for portfolio diversification benefits, they should care of the performance of the exchange rate. In fact, the thesis indicates that currency movements can be sources of return and risk.

8.4 *Further research*

This doctoral thesis has produced some tentative results with regard to the role of foreign exchange restrictions on the financial integration of a group of Pacific Basin countries. In addition, it has clarified the channels that contribute to the integration of these economies with Japan and the U.S. even in presence of strong extent of capital controls. As more data become available a more accurate picture will emerge. In fact, further research should be focused on using alternative methods used by this research in measuring the financial integration. For instance, future work might use American Deposit Receipts not only to verify the role of this instrument in contributing to an increase of financial links between markets, but also as an alternative method in estimating the degree of financial integration.

Further research on the Pacific Basin Rim should perform the same investigation conducted in this research, but including China in the sample countries. This analysis, which possibility is based on future data availability, should be conducted to identify the integration of this new emerging economy at the regional and at the global level, in particular after that foreign investors have been allowed to own shares, at least in part, of Chinese firms. In addition, the main finding of the thesis regarding the importance of economic integration and the presence of Country Funds for financial integration, as well as regarding the existence of potential links between stock and foreign exchange markets needs to be tested for other emerging stock markets. In particular, a similar study should be conducted on the Middle East and East Europe emerging regions.

Bibliography

Aggarwal, R. 1981, "Exchange Rates and Stock Prices: A Study of the US Capital Markets under Floating Exchange Rates", *Akron Business and Economic Review*, Fall, 7-12.

Arshanapalli, B. and J. Doukas, 1993, "International stock market linkages: evidence from the pre- and post-October 1987 period", *Journal of Banking and Finance*, 17, 193-208.

Ammer, J. and J. Mei, 1996, "Measuring international economic linkages with stock market data", *Journal of Finance*, 51, 1743-1763.

Anderson, T.W., 1984, *An Introduction to multivariate statistical analysis*. Second edition (New York: John Wiley & Sons).

Baba, Y., R.F. Engle, D. Kraft and K.F. Kroner, 1990, "Multivariate simultaneous generalised ARCH", *Mimeo*, Department of Economics, University of California, San Diego.

Bailey, W., K. Chan and Y.P. Chung, 2000, "Depositary receipts, country funds, and the Peso crash: the intraday evidence", *Journal of Finance*, 55, 6, 2693-2717.

Bailey, W. and J. Jagtiani, 1994, "Foreign Ownership Restrictions and Stock prices in the Thai Capital Market", *Journal of Financial Economics*, 36, 57-87.

Baillie R.T. and T. Bollerslev, 1989 "The message in daily exchange rates: a conditional-variance tale", *Journal of Business & Economic Statistics*, 7, 3, 297-305.

Baillie, R.T. and T. Bollerslev, 1990, "A multivariate generalised ARCH approach to modelling risk premia in forward foreign exchange rate markets", *Journal of International Money and Finance*, 16, 109-124.

Baillie, R. T. and P.C. Mchanon, 1989, *The foreign exchange market: theory and econometric evidence*. (Cambridge: Cambridge University Press).

Baillie, R.T. and R.J. Myers, 1991 "Bivariate GARCH estimation of the optimal commodity futures hedge", *Journal of Applied Econometrics*, 6, 109-124.

Bekaert, G., 1995, "Market integration and investments barriers in emerging equity markets", *World Bank Economic Review*, 9, 75-107.

Bekaert, G. and C.R., Harvey, 1995, "Time-Varying world market integration", *Journal of Finance*, 50, 2, 403-444.

Bekaert, G. and C.R., Harvey, 1997, "Emerging equity market volatility", *Journal of Financial Economics*, 43, 29-77.

Bekaert, G. and C.R. Harvey, 1998a, “Capital flow and the behaviour of emerging market equity returns”, *NBER Working Paper*, 6669, July 1998.

Bekaert, G and C.R. Harvey, 1998b, "Dating the integration of world equity markets", *NBER Working Paper* 6724.

Bekaert, G. and C.R. Harvey, 2000, "Foreign Speculation and Emerging Equity Markets", *Journal of Finance*, 55, 2, 565-613.

Bekaert, G, C.R. Harvey and R.L. Lumsdaine, 1998, "Dating the integration of world equity markets", *National Bureau of Economic Research*, Working Paper No. 6724.

Bekaert, G. and R. Hodrick, 1992, ""Characterizing predictable components in excess returns on equity and foreign exchange markets", *Journal of Finance*, 47, 467-509.

Bekaert, G. and M.S. Urias, 1999, “Is there a free lunch in emerging market equities?, *The Journal of Portfolio Management*, Spring, 83-95.

Bentely, P., 1986, "World guide to exchange control regulations", *Euromoney Series*. (Longwood Publishing Group).

Bera, A.K., P. Garcia and J-S Roh, 1990, "Estimation of time-varying hedge ratios for agricultural commodities: BGARCH and random coefficient approaches", *Mimeo*, Department of Economics, University of Illinois at Urbana-Champaign.

Bera, A.K. and M.L. Higgins, 1993 "ARCH models: properties, estimation and testing", *Jouranl of Economic Surveys*, 4, 305-362.

Bera, A.K. and J-S Roh, 1991, "Specification test for a linear regression model with ARCH process", *Mimeo*, Department of Economics, University of Illinois at Urbana-Champaign.

Beveridge, S. and C.R. Nelson, 1981, "A new approach to decomposition of economic time series into permanent and transitory components with particular attention to measurement the 'Business Cycle'", *Journal of Monetary Economics*, 7, 151-174.

Bhoocha-Oom, A. S.R. and Stansell, 1990, “A Study of International Financial Market Integration: an Examination of the U.S., Hong Kong and Singapore markets”, *Journal of Business Finance & Accounting*, 17, 2, 193-212.

Black, F., 1972, "Capital market equilibrium with restricted borrowing", *Journal of Business*, 45, 444-455.

Bohn, H. and L.L. Tesar, 1998, “U.S. Portfolio investment in Asian capital markets”, in *Managing Capital Flows and Exchange Rates* edited by Reuven Glick, 1998.

Bollerslev, T., 1986, "Generalized Autoregressive Conditional Heteroscedasticity", *Journal of Econometrics*, 31, 307-327.

Bollerslev, T., 1987, "A conditional heterosckedastic time series model for speculative prices and rates of return", *Review of Economics and Statistics*, 69, 542-547.

Bollerslev, T., 1990, "Modelling the coherence in short run nominal exchange rates: A multivariate generalized ARCH approach", *Review of Economics and Statistics*, 72, 498-505.

Bollerslev, T., R.Y. Chou and K.F. Kroner, 1992 "ARCH modelling in finance", *Journal of Econometrics*, 52, 5-59.

Bollerslev, T, R. Engle and D. Nelson, 1994, "ARCH models" in (Eds) R. Engle and D. McFadden, *Handbook of Econometrics*, Volume IV, Elsevier Science B.V., Amsterdam, The Netherlands, pp. 2961-3038.

Bollerslev, T., R.F., Engle and J.M. Wooldridge, 1988, "A capital asset pricing model with time varying covariances", *Journal of Political Economy*, 96, 1, 116-131.

Bollerslev, T. and H. Mikkelsen, 1994, "Modeling and Pricing Long-Memory in Stock Market Volatility", working paper, University of Southern California.

Bollerslev, T. and J.M. Wooldridge, 1992, "Quasi-maximum likelihood estimation and inference in dynamic models with time-varying covariance", *Econometric Reviews*, 11, 143-172.

Bosner-Neal, C. and V.V. Roley, 1994, "Are Japanese Interest Rate Too Stable?", *Journal of International Money and Finance*, 13, 291-318.

Bossaerts, P., 1998, "Common nonstationary components of asset prices", *Journal of Economic Dynamics and Control*, 12, 347-364.

Box, G. and D. Pierce, 1970, "Distribution of autocorrelations in autoregressive moving average time series models", *Journal of the American Statistical Association*, 65, 1509-1526.

Brady Commission (1988), "Report of the Presidential Task Force on Market Mechanisms", US Government Printing Office, Washington DC.

Brailsford, T.J. and R. Faff, 1996, "The coevolution of the real and financial sectors in the growth process", *World Bank Economic Review*, 10, 371-396.

Branson, W.H., 1983, "Macroeconomic Determinants of Real Exchange Rate Risk", in R.J. Herring (ed.), *Managing Foreign Exchange Rate Risk*. (Cambridge: Cambridge University Press).

Brown S.J. and T. Otsuki, 1993, "Risk Premia in Pacific-Basin Capital Markets", *Pacific-Basin Finance Journal*, 1, 235-261.

Calvo, S. and C.M. Reinhart, 1996, "Capital Flows to Latin America: Is there Evidence of Contagion Effects", in G. Calvo, M. Goldstein and E. Hochreiter, (eds)

Private Capital Flows to Emerging Markets after the Mexican Crisis, Washington, DC:IIE.

Calvo, G. L. Leiderman and C. Reinhart, 1993, "Capital inflows and real exchange rate appreciation in Latin America: the role of external factors", *IMF Staff Papers*, 40, 1, 108-151.

Campbell, J.Y., 1991, "A variance decomposition for stock returns", *Economic Journal*, 101, 157-179.

Campbell, J.Y. and J. Ammer, 1993, "What moves the stock and bond markets? A variance decomposition for long-term asset returns", *Journal of Finance*, 48, 1, 3-37.

Campbell, J.Y. and Y. Hamao, 1992, "Predictable Stock Returns in the United States and Japan: A Study of Long-Term Capital Market Integration", *Journal of Finance*, 47, 43-69.

Campbell, J.Y., A.W. Lo and A.C. Mackinlay, 1997, *The econometrics of financial markets*, (Princeton: Princenton University Press).

Campbell, J.Y. and R.J. Shiller, 1987, "Cointegration and Tests of Present Value Models", *Journal of Political Economy*, 95, 1062-1088.

Campbell, J.Y. and R.J. Shiller, 1988, "The Dividend-Price Ratio and Expectation of Future Dividends and Discount Factors", *Review of Financial Studies*, 1, 3, 195-228.

Canova, F. and C. Dellas, 1993, "Stock returns and real activity: a structural approach", *European Economic Review*, 39, 981-1015.

Canova, F. and G. DeNicole, 1995, "Stock Markets and Real Activity: A Structural Approach", *European Economic Review*, 39, 981-1015.

Canova, F. and J. Marrinan, 1998, "Sources of propagation of international output cycles: commom stocks or transmission?", *Journal of International Economics*, 46, 133-166.

Caporale, G.M. and N. Pittis, 1997, "Causality and Forecasting in Incomplete Systems", *Journal of Forecasting*, 16, 425-437.

Carrieri, F., 2001, "The effects of liberalisation on market and currency risk in the European Union", *Europan Financial Management*, 7, 2, 259-290.

Chang, E., C.S. Eun and R. Kolodny, 1995, "International Diversification through Closed-end Country Funds", *Journal of Banking and Finance*, 19, 1237-1263.

Chen, N. and F. Zhang, 1997, "Correlations, Trades, and Stock Returns of the Pacific-Basin Markets", *Pacific-Basin Finance Journal*, 5, 559-557.

Cheung, Y.W. and K.S. Lai, 1993, "Finite sample sizes of Johansen's likelihood ratio tests for cointegration", *Oxford Bulletin of Economics and Statistics*, 55, 313-328.

Cheung Y.W. and L.K. Ng, 1998, "International Evidence on Stock Market and Aggressive Economic Activity", *Journal of Empirical Evidence*, 5, 281-296.

Chinn, M.D. and W.F. Maloney, 1996, "Financial and Capital Account Liberalisation in the Pacific Basin: Korea and Taiwan during the 1980's", *University of California Santa Cruz, Working Paper 352.*

Choi, J.J., H. Takato, and N. Takezawa, 1998, "Is foreign exchange risk priced in the Japanese stock market?", *Journal of Financial and Quantitative Analysis,* 33, 361-382.

Chou, R., 1988, "Volatility persistence and stock valuation: some empirical evidence using GARCH", *Journal of Applied Econometrics*, 3, 279-294.

Choudhry, T., 1995, "Integrated-GARCH and non-stationary variance: evidence from European stock markets during the 1920s and 1930s", *Economics Letters*, 48, 55-59.

Choudhry, T., 1996, "Stock market volatility and the crash of 1987: evidence from six emerging markets", *Journal of International Money and Finance*, 15, 6, 969-981.

Chow, E.H., W.Y. Lee and M.S. Solt, 1997, "The Exchange Rate Risk Exposure of Asset Returns", *Journal of Business*, 70, 105-123.

Chuhan, P., 1994, "Are Institutional Investors and important source of portfolio investment in emerging markets?, *World Bank Working Paper N. 1243.*

Chuhan, P., S. Claessens and N. Mamingi, 1995, "Equity and bond flows to Latin America and Asia: the role of global and country factors", *World Bank Policy Research Working Paper No. 1160,* Washington, D.C.

Cornell, B., 1983, "The Money Supply Announcement Puzzle: Review and Interpretation", *American Economic Review*, 73, 644-657.

Cowitt, P.P. ed., *World Currency Yearbook*, Currency Data and Intellingence, Inc. Brooklyn, New York, varies issues from 1984 to 1991.

Cuthbertson, K., 1996, *Quantitative financial economics: stocks, bonds and foreign exchange*. (Chichester: Wiley).

Davidson, R. and J.G. MacKinnon, 1995, *Estimation and Inference in Econometrics*. Second edition. (Oxford University Press).

De Santis, G. and B. Gerard, 1997, "International asset pricing and portfolio diversification with time-varying risk", *Journal of Finance*, 52, 5, 1881-1911.

De Santis, G. and B. Gerard, 1998, "How big is the premium for currency risk", *Journal of Financial Economics*, 48, 375-412.

De Santis, G. and S. Imrohoroglu, 1997, "Stock returns and volatility in emerging financial markets", *Journal of International Money and Finance*, 16, 4, 561-579.

Dickey, D. and Fuller, W.A., 1979, "Distribution of the estimates for autoregressive time series with a unit root", *Journal of the American Statistical Association*, 74, 427-431.

Dickey, D. and Fuller, W.A., 1981, "Likelihood ratio statistics for autoregressive time series with a unit root", *Econometrica*, 49, 1057-1072.

Dickey, D. and Pantula, S., 1987, "Determining the order of differencing in autoregressive processes", *Journal of Business and Economic Statistics*, 15, 455-461.

Diebold, F.X., 1988, *Empirical modelling of exchange rate dynamics*, Springer-Verlag, New York.

Diwan, I., V. Errunza and L.W. Senbet, 1993, "Country Funds for emerging economies", ", in *Portfolio Investment in Developing Countries*, edited by S. Claessens and S. Gooptu, World Bank Discussion Paper N. 228.

Diwan, I., and B. Hoekman, 2000, "Competition, complementarity and contagion in East Asia", in P.R. Agenor, M. Miller, D. Vines & A. Weber (eds), *The Asian Financial Crisis* (Cambridge UP).

Dolado, J.J. and H. Lutkepohl, 1996, "Making Wald tests for cointegrated VAR systems", *Econometric Reviews*, 15, 369-386.

Domowitz, I., J. Glen and A. Madhavan, 1997, "Market segmentation and stock prices: evidence from an emerging market", *Journal of Finance*, 52, 1059-1086.

Domiwitz, I. and C.S. Hakkio, 1985, "Conditional variance and the risk premium in the foreign exchange market", *Journal of International Economics*, 19, 47-66.

Dornbusch, R. and and S. Fisher, 1980, "Exchange Rates and the Current Account", *American Economic Review*, 70, 960-971.

Dooley, M.P. and D.J. Mathieson, 1994, "Exchange Rate Policy, International Capital Mobility, and Monetary Policy Instruments", in *Exchange Rate Policy and Interdependence: Perspective from the Pacific-Basin*, R. Glick and M.M. Hutchison, eds. (Cambridge, New York) 68-95.

Dumas, B., 1994, "A test of the international CAPM using business cycles indicators as instrumental variables", in J. Frankel, Ed.,: *The internationalisation of equity markets*, University of Chicago Press, Chicago, 23-50.

Dumas, B. and B. Solnik, 1995, "The world price of foreign exchange risk", *Journal of Finance*, 50, 445-479.

Dwyer, G.P. and R.W. Hafer, 1988, "Are National Stock Markets Linked?", *Federal Reserve Bank of St. Louis Review*, 70, 3-14.

Edwards, S. and M. Khan, 1985, "Interest Rate Determination in Developing Countries: A Conceptual Framework", *IMF Staff Papers*, 32, 377-403.

Emerging Stock Markets Factbook, International Corporate Finance publications, varies issues from 1987 to 1999.

Enders, W., 1995, *Applied Econometric Time Series*. (John Wiley & Sons).

Enders, W., 1996, *RATS Handbook for Econometric Time Series*. (John Wiley & Sons).

Engle, F.E., 1982, "Autoregressive Conditional Heteroscedasticity with estimates of the variance of United Kingdom inflation", *Econometrics*, 50, 987-1008.

Engle, R.F and T. Bollerslev, 1986, "Modelling the persistence of conditional variances", *Econometric Reviews*, 5, 1-50, 81-87.

Engle, R.F. and C.W.J Granger, 1987, "Cointegration and error correction: representation, estimating and testing", *Econometrica*, 55, 251-276.

Engle, R.F., C.W.J. Granger, and D. Kraft, 1986, "combining competing forecasts of inflation using a bivariate ARCH model", *Journal of Economic Dynamics and Control*, 8, 151-165.

Engle, R.F and K.F., Kroner, 1995 "Multivariate simultaneous generalised ARCH", *Econometric Theory*, 11, 122-150.

Engle, R.F., D.M. Lilien, and R.P. Robbins, 1987, "Estimating time varying risk premia in the term structure: the ARCH-M model", *Econometrica*, 55, 391-408.

Engle, R.F. and C. Mustafa, 1992, "Implied ARCH models from options prices", *Journal of Econometrics*, 52, 267-287.

Erb, C.B., C.R. Harvey and T.E. Viskanta, 1996a, "Expected returns and volatility in 135 countries", *Journal of Portfolio Management*, 22, 46-58.

Erb, C.B., C.R. Harvey and T.E. Viskanta, 1996b, "Political risk, economic risk and financial risk", *Financial Analysts Journal*, Nov/Dec, 29-46.

Errunza, V.R., E. Losq and P. Padmanabhan, 1992, "Tests of integration, mild segmentation and segmentation hypotheses", *Journal of Banking and Finance*, 16, 949-972.

Errunza, R.F., L. Senbet and K. Hogan, 1998, "The pricing of country funds from emerging markets: theory and evidence", *International Journal of Theoretical and Applied Finance*, 1, 111-143.

Eun, C.S. and S. Shim, 1989, "International transmission of stock market movements", *Journal of Financial and Qualitative Analysis*, 24, 241-256.

Euromoney annual report, The World stock exchange, varies issues from 1987 to 2000.

Exchange rate arrengements, International Monetary Fund annual publications, varies issues from 1973 to 2000.

Fama, E., 1965, "The behavior of stock market movements", *Journal of Business*, 38, 1749-1778.

Fama, E.F., 1981, "Stock Returns, Real Activity, Inflation and Money", *Journal of Political Economy*, 84, 545-565.

Fama, E.F. and K.R. French, 1988, "Dividend yields and expected stock returns", *Journal of Financial Economics*, 22, 3-25.

Faruquee, H. 1992, "Dynamic Capital Mobility in Pacific-Basin Developing Countries", *Staff Papers, International Monetary Fund* 39, 706-717.

Fernandez-Arias, E. and P. Montiel, 1996, "The surge in capital inflows to developing countries: an analytical overview", *World Bank Economic Review*, 10, 51-77.

Ferson, W.E. and C.R. Harvey, 1991, "The Variation of Economic Risk Premiums", *Journal of Political Economy*, 99, 385-415.

Ferson, W.E. and C.R. Harvey, 1993, "The risk and predictability of international equity returns", *Review of Financial Studies*, 6, 527-566.

Ferson, W.E. and C.R. Harvey, 1994a, "Sources of risk and expected returns in global equity markets", *Journal of Banking and Finance*, 18, 775-803.

Ferson, W.E. and C.R., Harvey, 1994b, "An exploratory investigation of the fundamental determinants of national equity market returns, in J. Frankel, Ed.: *The International of Equity Markets*, (University of Chicago Press, Chicago, IL), 59-138.

Fleming, J.M., 1962, "Domestic financial Policies under Fixed and Floating Exchange Rates", *IMF Staff Papers*, 9, 369-380.

Frankel, J.A., 1983, "Monetary and Portfolio Balance Models of Exchange Rate Determination", in J.S. Bhandari and B. H. Putnam (eds) *Economic Interdependence and Flexible Exchange Rates*, (MIT Press, Cambridge, MA).

French, K.R., Schwert, G.W. and R.F. Stambaugh, 1987, "Expected stock returns and volatility, *Journal of Financial Economics*, 19, 3-29.

Froot, K.A., P.G.J. O'Connell and M.S. Seasholes, 1998, "The portfolio flows of international investors", I, Harvard Business School, Unpublished manuscript.

Garnaut R. and P. Drysdale, 1994, *Asian Pacific regionalism: reading in international economic relations*. (Australia: HarperEducational).

Gavin, M., 1989, "The Stock Market and exchange Rate Dynamics", Journal of *International Money and Finance*, 8, 181-200.

George, R.L., 1989, *A guide to Asian stock markets*. (Hong Kong: Longman).

Geske, R. and R. Roll, 1983, "The Fiscal and Monetary Linkage between Stock returns and Inflation", *Journal of Finance*, 38, 1-34.

Glick, R. and A.K. Rose, 1999, "Contagion and trade: why are currency crises regional?", *Journal of International Money and Finance*, 18, 603-617.

Glosten, L., R. Jagannathan and D. Runkle, 1993, "On the relation between the expected value and the volatility of the nominal excess return on stocks", *Journal of Finance*, 48, 1779-1801.

Godfrey, L., 1978, "Testing for Multicaplicative Heteroscedasticity", *Journal of Econometrics*, 8, 227-236.

Goetzmann, W.N. and P. Jorion, 1999, "Re-emerging markets", *Journal of Financial and Quantitative Analysis*, 34, 1, 60-85.

Gonzalo, J., 1994, "Comparison of five alternative methods in five alternative methods of estimating long-run equilibrium and testing", *Econometrica*, 55, 251-276.

Gonzalo, J. and C.W.J. Granger, 1995, "Estimation of common long-memory components in cointegrated systems", *Journal of Business and Economics Statistics*, 13, 27-36.

Gourieroux, C., A., Monfort and A. Trogon, 1984, "Pseudo-maximum Likelihood methods: Theory", *Econometrica*, 58, 525-542.

Granger, C.W.J., 1981, "Some proprieties of time series data and their use in econometric model specifications", *Journal of Econometrics*, 28, 121-136.

Granger, C.W.J. and P. Newbold, 1974, "Spurious regressions in econometrics", *Journal of Econometrics*, 2, 111-120.

Gregory, A.W., 1994, "Testing for cointegration in linear quadratic models", *Journal of Business and Economic Statistics*, 12, 347-360.

Gultekin, M.N., N.B. Gultekin and A. Penanti, 1989, "Capital Controls and International Capital Market Segmentation: The Evidence from the Japanese and American Stock Markets", *Journal of Finance*, 44, 849-869.

Hamao, Y., 1988, "An empirical examination of the Arbritage Pricing Theory", *Japan and World Economy*, 1, 45-62.

Hamao, Y., R. Masulis and V. Ng, 1990, "Correlations in price changes and volatility across international stock markets", *Review of Financial Studies*, 3, 281-308.

Hamilton, J.D., 1994, *Time series analysis*. (Princenton: Princenton University Press).

Hansen, L., 1982, "Large sample properties of Generalized Method of Moments Estimators", *Econometrica*, 50, 646-660.

Hansen, H. and Johansen, S., 1998 "Some tests for parameter constancy in cointegrated VAR-models", Working Paper, University of Copenhagen, Institute of Mathematical Statistics.

Hansen, B. and Phillips, P.C.B., 1990, "Estimation and inference in models of cointegration: a simulation study", *Advances in Econometrics*, 8, 225-248.

Haque, N. and P. Montiel, 1991, "Capital Mobility in Developing Countries: Some Empirical Tests", *World Development,* 19, 1391-1398.

Hardouvelis, G., 1988, "Evidence on Stock Market Bubbles: Japan, the United States and Great Britain", *Federal Reserve Bank of New York Quarterly Review*, 13, 4-16.

Harris, R.I.D., 1995, *Using Cointegration Analysis in Econometric Modelling*, Prentice Hall.

Harrison, M., 1994, *Asia-Pacific Market Securities Markets*, Longman Group, Far East.

Harvey, C.R., 1991, "The world price of covariance risk", *Journal of Finance*, 46, 11-157.

Harvey, C.R., 1995a, "Predictable risk return in emerging markets", *Review of Financial Studies*, 8, 3, 773-816.

Harvey, C.R., 1995b, "The risk exposure of emerging equity markets", *The World Bank Economic Review*, 9, 1, 19-50.

Harvey, C.R., B. Solnik and G. Zhou, 1994, "What determines expected international asset returns?", Working paper, Duke University, Durham, N.C.

Hawawini, G., 1994, "Equity price behaviour: some evidence from markets around the World", *Journal of Banking and Finance*, 18, 603-620.

Hernandez, L. and H. Rudolph, 1995, "Sustainability of private capital flows to developing countries: is a generalized reversal likely?", *World Bank Policy Research Working Paper No. 1518*. Washington, D.C.

Hsieh, D.A, 1989, "Modelling heteroskedasticity in daily foreign exchange rates", *Journal of Business and Economic Statistics*, 7, 307-317.

Hodrick, R.J., 1992, "Dividend Yields and Expected Stock Returns, Alternative Procedures erence and Measurement", *Review of Financial Studies*, 5, 357-386.

Ito, T., 1988, "Use of (Time-Domain) Vector Autoregressions to Test Uncovered Interest Parity", *Review of Economics and Statistics*, 70, 296-305.

Johansen, S., 1988, "Statistical analysis of cointegrating vectors", *Journal of Economics Dynamics and Control*, 12, 231-254.

Johansen, S., 1991, "Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models", *Econometrica*, 59, 1151-1180.

Johansen, S., 1992, "Determination of cointegration rank in the presence of a linear trend", *Oxford Bulletin of Economics and Statistics*, 54, 383-397.

Johansen, S., 1995, *Likelihood-based inference in cointegrated vector autoregressive models*. (Oxford: Oxford University Press).

Johansen, S. and K. Juselius, 1990, "Maximum likelihood estimation and inference on cointegration - with applications to the demand for money", *Oxford Bulletin of Economics and Statistics*, 52, 169-210.

Johansen, S. and K. Juselius, 1992, "Testing structural hypothesis in a multivariate cointegration analysis of the PPP and the UIP for UK", *Journal of Econometrics*, 53, 211-244.

Johansen, S. and B. Nielsen, 1993, "Asymptotics for cointegration rank tests in the presence of intervention dummies", *Manual for the simulation program DisCo*, Institute of Mathematical Statistics, University of Copenhagen.

Johnston, J. and J. DiNardo, 1997, *Econometric methods*, fourth edition. (McGraw-Hill International Editions).

Jorion, P., 1990, "The Exchange Rate Exposure of US Multinationals", *Journal of Business*, 63, 331-345.

Jorion, P., 1991, "The Pricing of Exchange Rate Risk in the Stock Market", *Journal of Financial and Quantitative Analysis*, 26, 361-376.

Juselius, K., 1994, "On the duality between long-run relations and common trends in the I(1) versus I(2) model. An application to aggregate money holdings", *Econometric Reviews*, 13, 2, 151-178.

Juselius, K., 1995, "Do purchasing power parity and uncovered interest parity hold in the long-run? - An example of likelihood inference in a multivariate times-series model", *Journal of Econometrics*, 69, 211-240.

Karolyi, G.A. and R.M, Stulz, 1996, "Why do markets move together? An investigation of U.S.-Japan stock return comovements using ADRs", *Journal of Finance*, 51, 951-986.

Kasa, K., 1992, "Common stochastic trends in international stock markets", *Journal of Monetary Economics*, 29, 95-124.

Keim, D.B. and R.F. Stambaugh, 1986, "Predicting Returns in the Stock and Bond Markets", *Journal of Financial Economics*, 17, 357-390.

Kim, E.H. and V. Singal, 2000, "Stock market openings: experience of emerging economies", *Journal of Business*, 73, 1, 25-66.

King, M., E. Sentana and S., Wadhwani, 1994 "Volatility and links between national stock markets", *Econometrica*, 62, 4, 901-933.

King, M.A. and S. Wadhwani, 1990, "Transmission of volatility between stock markets", *Review of Financial Studies*, 3, 5-33.

Kock, P.D. and T.W Kock, 1991, "Evolution in dynamic linkages across daily national stock indexes", *Journal of International Money and Finance*, 10 , 231-251.

Kreinin, M.E. and M.G. Plummer, 2001, *Economic integration and Asia: the dynamics of Regionalism in Europe, North America and the Asia-Pacific.* (Edward Elgar Publication).

Kroner, K.F. and S. Claessens, 1991, "Optimal currency composition of external debt: applications to Indonesia and Turkey", *Journal of International Money and Finance*, 10, 131-148.

Kroner, K.F. and J. Sultan, 1991, "Exchange rate volatility and time varying hedge ratios" in Rhee, s.G. and R.P. Change (eds.), *Pacific-Basin Capital Markets Research*, Vol. II. (North-Holland, Amsterdam).

Lamourex, C.G. and W.D. Lastrapes, 1990, "Persistence in variance, structural change, and the GARCH model", *Journal of Business and Economic Statistics*, 8, 225-234.

Lastrapes, W.D., 1989, "Exchange rate volatility and US monetary policy: an ARCH application", *Journal of Money, Credit and Banking*, 21, 66-77.

Lee, T.H. and Tse, Y. "Cointegration tests with conditional heteroskedasticity", *Journal of Econometrics*, 73, 401-410.

Levine, R. and S. Zervos, 1996, "Capital control liberalisation and stock market development", *Policy Research Working Paper*, No. 1622, The World Bank.

Levy, H. and M. Sarnat, 1970, "International diversification of investment portfolios", *American Economic Review*, 60, 668-675.

Lin, W-L., R.F. Engle and T. Ito, 1993, "Do Bulls and Bears Move Across International Borders? International Transmission of Stock Returns and Volatility", *Review of Financial Studies*, 3, 507-538.

Lintner, J., 1965, "The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets", *Review of Economics and Statistics*, 47, 13-37.

Ljung, G. and G. Box, 1978, "On a measure of lack of fit in time series models", *Biometrica*, 65, 297-303.

Lo, A.W. and A.C. MacKinley, 1988, "Stock market prices do not follow random walks: evidence from a simple specification test", *The Review of Financial Studies*,1, 41-66.

Login, F. and B. Solnik, 1995, "Is the Correlation in International Equity Returns Constant: 1960-1990?", *Journal of International Money and Finance*, 14, 1, 3-26.

Lutkepohl, H., 1982, "Non-causality due to Omitted Variables", *Journal of Econometrics*, 19, 367-78.

Ma, C.K. and G.W.Kao, 1990, "On Exchange Rates Changes and Stock price reactions", *Journal of Business and Accounting*, 17, 441-449.

Maddala, G.S. and In-Moo, Kim, 1998, *Unit roots, cointegration, and structural change*, (Cambridge: Cambridge University Press).

Mandelbrot, B., 1963, "The variation of certain speculative prices", *Journal of Business*, 36, 394-419.

Merton, R.C., 1973, "An intertemporal capital asset pricing model", *Econometrica*, 41, 867-887.

Merton, R.C., 1980, "On estimating the expected return on the market: an exploratory investigation", *Journal of Financial Economics*, 8, 323-361.

Mills, T.C., 1999, *The econometric modelling of financial time series*, Second edition (Cambridge: Cambridge University Press).

Mossin, J., 1966, "Equilibrium in a capital asset market", *Econometrica*, 34, 768-783.

Mundell, R.A. 1963, "Capital Mobility and Stabilisation Policy under Fixed and Flexible Exchange Rates", *Canadian Journal of Economics and Political Science*, 475-485.

Nelson, C.R. and C.I. Plosser, 1982, "Trends and random walks in macroeconomic time series", *Journal of Monetary Economics*, 10, 139-162.

Ng, A., 2000, "Volatility Spillover Effects from Japan and the US to the Pacific", *Journal of International of Money and Finance*, 19, 2, 207-234.

Osterwald-Lenum, M., 1992, "A note with quartiles of the asymptotic distribution of the maximum likelihood cointegration rank test statistics", *Oxford Bulletin of Economics and Statistics*, 54, 461-472.

Otani, I. and S. Tiwari, 1981, "Capital Controls and Interest Rate Parity", *Staff Papers, International Monetary Fund*, 28, 793-815.

Pagan, A.R. and Y.S. Hong, 1991, "Nonparametric estimation and the risk premium", in Barnett, W.A., Powell, J. and Tauchen, G. (eds), *Nonparametric and semiparametric methods in econometrics and statistics*. (Cambridge: Cambridge University Press).

Park, J.Y., 1990, "Disequilibrium inputs analysis", *Working Paper, Cornell University*.

Park, J.Y. and M.R. Phillips, 1989, "Statistical inference in regressions with integrated processes: part II", *Econometric Theory*, 5, 95-131.

Park, K.K.H. and A.W. Van Agtamel, 1993, "The World's emerging stock markets: structure, development, regulations, and opportunities".

Phillips, P.C.B., 1991, "Optimal inference in cointegrated systems", *Econometrica*, 59, 2, 283-306.

Phillips, P.C.B. and Perron, P., 1988, "Testing for unit root in time series regression", *Biometrica*, 75, 335-346.

Phylaktis, K., 1997, "Capital Market Integration in the Pacific Basin Countries: An Analysis of Real Interest Rate Linkages", *Pacific Basin Finance Journal*, 5, 195-213.

Phylaktis, K., 1999, "Capital Market Integration in the Pacific Basin Region: An Impulse Response Analysis", *Journal of International Money and Finance*, 18, 267-288.

Phylaktis, K., and Y. Kassimatis, 1997 "Black and official exchange rate volatility and foreign exchange controls", *Applied Financial Economics*, 7, 15-24.

Phylaktis, K. and G.E. Woods, 1984, "An analytical and taxonomic framework for the study of exchange controls", in *Problems of International Finance* (Macmillan, London), J. Black and G.S. Dorrance, eds, 149-166.

Private Market Financing for Development Countries, International Monetary Fund, varies issues from 1991 to 1996.

Reimers, H.E., 1992, "Cointegration of tests for multivariate co-integration", *Statistical papers*, 33, 335-359.

Reisen, H. and H. Yeches, 1993, "Time-Varying Estimates on the Openness of the Capital Account in Korea and Taiwan", *Journal of Development Economics,* 41, 285-305.

Richards, A.J., 1995, "Comovements in national stock market returns: evidence of predictability, but not cointegration", *Journal of Monetary Economics*, 36, 631-654.

Richards, A.J, 1996, "Volatility and predictability in national stock markets: how emerging and mature markets differ?, *IMF Staff Papers*, 43, 3, 461-501.

Roll, R., 1989, "The International Crash of October 1989", in Kamphuis, R.W., Jr. et al. (eds) *Black Monday and the Future of Financial Markets*, (Dow Jones-Irwin), 35-70.

Roll, R., 1992, "Industrial structure and the comparative behaviour of international stock market indices", *Journal of Finance*, 47, 1, 3-41.

Rosenberg, M.R., 1996, *Currency forecasting: a guide to fundamental and technical models of exchange rate determination*. (Irwin Professional Publishing).

Said, S. and Dickey, D., 1984, "Testing for unit roots in autoregressive-moving average models with unknown order", *Biometrica*, 71, 599-607.

Schmitt-Grohe, S., "The international transmission of economic fluctuations: effects of US business cycle on the Canadian economy", *Journal of International Economics*, 44, 257-287.

Schwarz, G., 1978, "Estimating the Dimension of a Model", *The Annuals of Statistics*, 6, 461-464.

Schwert, G.W., 1989, "Test for unit roots: A Monte Carlo investigation", *Journal of Business and Economic Statistics*, 7, 147-159.

Schwert, G.W., 1990, "Stock returns and Real Activity: A Century of Evidence", *Journal of Finance*, 45, 1237-1257.

Sharpe, W., 1964, "Capital asset prices: a theory of market equilibrium under conditions of risk, *Journal of Finance*, 32, 493-502.

Sims, C.A., J.H. Stock and M.W. Watson, 1990, "Inference in linear time series models with some unit roots", *Econometrica*, 58, 113-144.

Soenen, L.A. and E.S. Hennigar, 1988, "An Analysis of Exchange Rates and Stock Prices - The US Experience between 1980 and 1986", *Akron Business and Economic Review*, (Winter), 7-16.

Solnik, B.H., 1974, "Why do not diversify internationally rather than domestically?", *Financial Analyst Journal*, 30, 48-54.

Solnik, B., 1983, "International arbitrage pricing theory", *Journal of Finance*, 38, 449-457.

Solnik, B., 1999, *International Investment*. Fourth edition. (Addison-Wesley).

Spanos, A., 1990, "Unit roots and their dependence on the conditioning information set", *Advances in Econometrics*, 8, 271-292.

Stepthon, P.S. and K.S. Larsen, 1991, "Tests of Exchange Market Efficiency: Fragile Evidence from cointegration Tests", *Journal of International Money and Finance*, 10, 561-570.

Stock, A.H., 1987, "Asymptotic proprieties of least square estimators of cointegrating vectors", *Econometric Theory*, 55, 1035-1056.

Stock, A.H. and M.W. Watson, 1988, "Testing for common trends", *American Statistical Association*, 83, 404, 1097-1107.

Tandon, K., 1997, "External financing in emerging markets: an analysis of market responses", *Emerging Markets Quarterly*, 1, 63-74.

Taylor, M.P. and I. Tonks, 1989, "The Internationalisation of Stock Markets and the Abolition of U.K. Exchange Control", *The Review of Economics and Statistics*, 71, 332-336.

Wheatley, S, 1988, "Some tests of international equity integration", *Journal of Financial Economics*, 21, 177-212.

White, H., 1980, "A heteroskedasticity-consistent covariance matrix estimator and direct test for heteroskedasticity, *Econometrica*, 48, 817-838.

White, H., 1982, "Maximum likelihood estimation of misspecification models", *Econometrica*, 50, 1-25.

White, H., 1984, *Asymptotic theory for econometricians*. (New York: Academic Press).

Urias, M., 1994, "The impact of securities cross-listing on the cost of capital in emerging stock markets", Unpublished dissertation, Stanford University.

Wolff, C.C.P., 1988, "Exchange Rates, Innovations and Forecasting", Journal of *International Money and Finance*, 7, 49-61.

World Bank, 1993, *The Asian miracle*. (Oxford: Oxford University Press).

World Economic Outlook, International Monetary Fund Publications, varies issues 1996-2000.

Yule, G.U., 1926, "Why do we sometimes get nonsense correlations between time series? A study in sampling and the nature of time series", *Journal of the Royal Statistical Society*, 89, 1-64.