RISK MANAGEMENT IN REINSURANCE

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A Thesis Submitted for the Degree of

Doctor of Philosophy

The City University

Mathematics Department

(Actuarial Science)

London

September 1984

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

(A) LIST OF TABLES

(B) LIST OF FIGURES

ACKNOWLEDGEMENTS

I would like to express my thanks and deep gratitude to professor Bernard Benjamin for his helpful supervision and for assistance and constant encouragement through out this research.

I am grateful also to Mr Leonard Coe for his helpful advice and assistance.

Thanks are also due to the staff of the Egyptian Reinsurance Company for providing me with the data, and to the Egyptian Government for the financial support I received.

I acknowledge with thanks the companies and the underwriters who afforeded their time and assistance in responding to my questionnaire.

I am also indebted to Mrs Carol Allen for her sympathetic assistance during this research, and to my family for their support and encouragement which has helped me greatly.

ABSTRACT

Interest in risk management has increased in recent years. Many studies concerning risk and insurance theory have appeared. These have been aimed at defining the risks and finding the most suitable methods to control them and their effects as well as minimizing the costs.

The interest of the reinsurer in risk management, and his success in limiting his risks and hence in increasing his insuring capacity and achieving a balance in his portfolio is an important starting point to overcome many of the problems which confront the insurance and reinsurance markets.

The capacity of the different insurance corporations and the markets as a whole depends on the capacity of the reinsurance markets to provide the essential covers for risks which are accepted by the insurance companies. The need to increase the capacity is not restricted only to the developing insurance markets, but it has become more important for the developed markets because of the nature of risks resulting from scientific advancement and changes in the economic, financial and social environment of insurance enterprises.

This study concerns the general framework of risk theory, risk definition, classification and measurement and of methods of risk

management in order to allow the theory and its applications to be introduced into the various fields which are beset by risk.

The study reviews the division and analyses of the risks which are confronted by the reinsurer, whether they are related to each type of primary risk or to reinsurance risk or to the political, social and economic elements in the environment.

It also studies and analyses the methods which are already used, and those which can be used by the reinsurer in managing the risks which confront him.

The study concentrates on the technical aspects of the contractual and management devices as well as the underwriting and retention decisions as the most effective methods of managing these risks. This is done by studying the factors which affect the decisions as indicated by a quantitative survey by the researcher.

KEY TO SYMBOLS AND ABBREVIATIONS

AR	Accumulation risk
BBP	Bulk of business in portfolio
BIA	British Insurance Association
CARM	Covers available in the reinsurance market
CC	Change in clauses
CCR	Ceding company retention
CCS	Change in ceding share
COC	Commission and other charges
CP	Colombia peso
CUP	Ceding company underwriting policy
CRM	The competition in reinsurance market
CRC	Cost of retrocession covers
CR	Capital and reserves
DF	Dutch Florin
DM	Deutschmark
ECC	Economic position of ceding company's country
FF	French franc
FL	Frequency of losses
FPC	Financial position of the ceding company
FR	Fluctuation in results
GAC	Geographic area of the cover
GR	Government restrictions
JY	Japanese Yen

L	Sterling Pound
LE	Egyptian Pound
LLC	Lability limits of the cover
LLR	Liability limits of risks
LTC	Limits of retrocession covers
MCT	The main currency of transactions
ME	Management expenses
MPL	Maximum probable loss
MR	Monetary restrictions
NK	Norwegian Kroner
NRC	The nature of risks covered
OSL	Outstanding losses
PA	Political aspects
PAC	Profitability of the accepted covers
PEC	Past experience of the cover
PI	Premium income
BMDP	Biomedical Computer Programs
PR	Premium rate
PRS	Personal relationship
R	The reciprocity
RC	Retrocession covers
RCR	The reinsurer's capital and reserves
RIC	Risk included in the cover
RR	Result of the reciprocity
SB	Settlement of balances
Sf	Swiss franc

SK	Swedish Kroner
TRC	Technical result of the cover
TC	Type of the cover
RRL	The reinsurer retention limits
RUP	The reinsurer underwriting policy
RWC	The relationship with the ceding company
USD	United States Dollar
YD	Yugoslavia Dinar
U/Y	Underwriting Year

CHAPTER ONE

INTRODUCTION

Insurance and reinsurance operations play a vital and important role in an era in which science and technology have developed rapidly. Insurance has contributed to, and at the same time has been affected by, the large increase in the values of the properties and in the volume of industries, finance projects and the capital invested.

It is difficult to identify the numerous variables in every society and the risk covers which the insurance corporations provide for individuals and projects, especially in the security which is supplied in return for low cost. These costs or premiums constitute by their nature a part of the costs of production, whether at the level of the project or in society, are relatively low. Also the funds, which these corporations invest in the different fields of investment, are very important for any country in implementing its develpment plan regardless of its economic system.

With the expansion of the risks to which individuals and the projects are exposed, the insurance corporations, with their limited capacity, become unable to supply protection on their own. This is why reinsurance covers are considered the most important device to which the insurance companies resort to confront the financial result

of the risks to which they are exposed, i.e. the insurance covers which are given by them to individuals and projects. It is also one of the most effective methods to increase their ability and capacity to provide new insurance covers for larger individual risks.

A dominant characteristic in the reinsurance covers offered in the international market has been the growing tendency for the individual risks to be spread among many reinsurers in different countries. A single claim may have ramifications all over the world.

Reinsurance, nowadays, carries the major burden of the very large losses due to major disasters of various kinds. These large claims may be the result of natural disasters such as earthquakes, volcano eruptions, hurricanes, or the result of risks connected with scientific and technical progress, such as nuclear power, space voyages, or the introduction of jumbojets or large tankers, and this involves the investment of billions of pounds.

For primarily national, political and economic reasons many countries, especially the developing countries, have resorted to the imposition of restrictions on insurance operations in general, and on reinsurance operations in particular. In many countries national reinsurance companies have been established. This action was aimed at increasing the national retention and restricting the outward flow of foreign currency and retaining the invested funds within the countries for their own development plans. Many of these national companies,

which are new to the field of reinsurance, initially lack experience, yet their activity is spread worldwide in the international reinsurance markets, in which the conditions and the nature of covers are developing rapidly. Therefore many of these companies with their limited means can not properly assess the overall risks attached, as the effective factors overlap and satisfactory prediction of results becomes difficult.

Owing to the international nature of reinsurance operations the reinsurers are affected by any instability in the international monetary systems. Hence any instability in the exchange rates of the various currencies arising from domestic economic problems in individual countries is a serious problem. The reinsurer is exposed to additional risks as a result of fluctuation in the values of the currencies and in their exchange rates, in addition to inflation which is widespread in the world. These risks are difficult to isolate and to assess in relation to reinsurer business.

There is an increasing tendency for large individual projects to rely on self insurance, and to go to the reinsurance market to obtain reinsurance covers. "Blind" reinsurance covers have appeared ie. those in respect of which the reinsurer lacks essential information concerning the covers in which he participates, and the risks to which he is exposed as an insurer.

All these factors operating together have created obstacles to the development of the reinsurance market and, even for the specialised reinsurer, in determining and specifying the risks which are related to reinsurance activity. These difficulties have not only forced the reinsurer to put more restrictions on his underwriting and acceptance operations, but also, to resort to the preparation of more reinsurance covers to reduce liabilities and limit the risks to which the operation is exposed.

1.1 The Purpose of The Study

This study is aimed primarily at defining the practical means and devices which can help the reinsurer to study the potential losses to which he is exposed, and to select the optimal methods to manage these risks.

This can only be done in the light of a clear and specific definition of what is meant by "risk", its classification and the methods by which risks can be identified, measured and managed within a comprehensive theory for risk and insurance embracing the variables which are manifold in the international market. It is hoped that this will lead to an increase in the capacity of the various companies and markets, as well as in their ability to face up to the large increase in insurance funds and to supply protection and security.

1.2 Outline of The Study

The thesis consists of five chapters in addition to this introductory chapter.

CHAPTER TWO: reviews the risk definitions, classifications and methods of risk management in order to reach a clear and specific definition of risk in reinsurance, which is the subject matter of the study, and which may help in identifying risks and the optimal methods to control them and limit their effects.

CHAPTER THREE: covers the main risks which face the reinsurer in the light of the risk definition and classification in chapter one. Concerning the risks related to the nature of activity, this chapter has distinguished between "follow the fortune" risks and the technical reinsurance risks. In studying risks which are related to society it has distinguished between the political, economic, social risks, and the natural risks.

CHAPTER FOUR: deals with the methods used by reinsurers to manage risks. The purpose is to assess these methods, and to review the methods which can be further developed and used for managing risks. This chapter includes a study of technical, contractual, and management means which are used to reduce the chance of risk occurrence.

CHAPTER FIVE: reviews the technical and contractual methods which reduce the severity of losses. Both retrocession covers and determination of retention are studied as the main methods for controlling the severity of losses in reinsurance business.

CHAPTER SIX: includes a review of the principal points of the study and the results and recommendations which can be inferred, and which can enable the reinsurer and reinsurance companies to conduct a practical study of risks which confront them and to effectively manage their risks.

CHAPTER TWO

RISK IN REINSURANCE

2.1 Introduction

Insurance and reinsurance enterprises, like all corporation are exposed to two kinds of risks. The first is concerned with the type of activities it undertakes, and the second with political, economic and social factors prevailing in the society in which the activities are undertaken.

It is essential, before beginning to study the risks faced by the reinsurer and the different ways of dealing with these risks, to define some terms and definitions which are related to risk and to insurance theory.

Therefore, in this chapter, attention is given to risk in general, risk definitions, determining risks, classification of risks and methods of risk management from the point of view of individuals, corporations, insurance and reinsurance enterprises

2.2 Risk Definition

Risk arises in many fields, therefore, it has many definitions. But there are inadequacies in each of these definitions. Perhaps the principal source of these inadequacies lies in the purposes for which the definitions are sought (Pfeffer, 1956). At the same time, the definition of risk varies even within insurance terminology. This has led to several contradictory definitions, and consequent difficulties in using any one of them for the purpose of all studies or for all subjects.

Although, there are obvious differences between these definitions, they can be grouped into three main categories :-

1- Definitions concerned with the material event.

2- Definitions concerned with mental state.

3- Definitions concerned with financial loss.

2.2.1 Risk as A Material Event

Some risk definitions are based on the material event which causes the loss. From this point of views, the risk is defined as; the probability of an event which results in a loss (R.S. Group, 1983); chance of loss; the possibility of loss (Riegl and Miller, 1966). These are expressed as the relative frequency of occurrence of event "E" in the sample space "S".

$$P(x) = \frac{\text{Number of occurrence of the loss provoking event}}{\text{Total number of trials}} = \frac{E}{S}$$

$$0 \leqslant P(x) \leqslant +1.0$$

Note that the event is a possibility and not a certainty, and the result must be a financial loss.

These definitions have been criticised as they depend on the probability of the event and do not take into consideration the size of loss. The probability of an event may be small but may result in a large amount of loss (Gahin, 1968). Also these definitions concern the financial loss only while there are other outcomes than financial loss (See 2.2.3).

2.2.2 Risk as A Psychological State

This group of definitions is based on the mental attitude towards risk. From this point of views risk is defined as; uncertainty (Kulp, 1928 and Willett, 1951); uncertainty regarding the loss (Denenberg, 1974); uncertainty concerning the outcome (William, 1971); the uncertainty concerning a possible loss (Dorfman, 1982). Crave (1979) defines risk as uncertainty about future loss, or, the inability to predict the occurrence or size of loss.

These definitions depend on doubt which is a mental state and is dificult to assess; it varies from person to person, for any given person from time to time, and may be lead to hesitation in making decisions.

Pfeffer (1956) distinguished between risk as a group of causes measured by probabilities and uncertainty as a state of mind relative to the facts of a specific situation, which only reflects a person's knowledge, his feeling and his strength of conviction about any given matter. Also uncertainty is nil when the probability of an event is either unity or zero, and the uncertainty is at maximum when the probabilities of occurrence and non-occurrence of a given event are equal (Pfeffer, 1956). The formula of risk according to the binomial distribution (William, 1971) is expressed by :-

$$\text{Risk} = \sqrt{n.p\,(1-p)\,/\,n}$$

$$= 0 \qquad \text{when } P = 0 \text{ or } 1$$

Where n is the number of exposure units and
p is the probability of occurrence of the event

Gahin (1968) criticised these definitions of risk as in contradiction with modern management, where the administration of projects is different from its ownership, and where the management of these projects can not depend on doubt and uncertainty in making decisions.

2.2.3 Risk as A Financial loss

In this group, risk is defined as, the probability of loss as a result of an event (Gahin, 1968); the variation in the possible outcomes that exist in nature in a given situation (William, 1971); the variation in possible outcomes of an event based on chance (Dorfman, 1982).

Gahine and Jargeisen (1971) have defined risk in this formula :-

$$R = \frac{1 + X\,(\sqrt{n} - 1)}{\sqrt{n}}$$

Where n = the number of exposure units

X = the loss ratio expected

R = The risk coefficient

Thus the risk varies inversely with the square root of the number of exposure units, but directly with loss probability.

These definitions have succeeded in linking the material event with the value of the loss, i.e. the financial loss in the scope of the probability theorem. But, it defines the risk as the financial loss only, while in some subjects, risk may have indirect financial loss, and in others it can not be expressed in terms of finance.

Therefore, the main problem facing those who are interested in risk study, are those differences in definitions related to technical, social; economic and insurance studies. Thus any definition of risk should :-

1- Contribute to the determination, assessment, and measurement of risk.

2- Express the result whether financial or not.

3- Give more attention to the factors of risk.

Taking these into consideration, risk should be defined as the potential effects of a group of factors which influence in an undesirable way the results of a specific situation. Thus, the definition is concerned with risk effects as well as risk hazards or factors, as they are the two essential elements in any study of risk. It unifies the meaning of risk as a term in the different studies; it also concentrates on studying factors of risk, and contains various concepts of other definitions as below :-

1- The suggested definition is concerned with the material event through studying various causative factors, and its undesirable effects.

2- It depends on the factors causing doubt and uncertainty, and not on the doubt and uncertainty itself. The first is subject to study and analyses, while the second is an expression of the mental state of a person taking the decision.

3- It is concerned with the financial loss, the deviation between the actual and expected results, as well as with the non-financial results.

4- The main concern of social, legal, technical and scientific studies of risk is with its causes as well as with seeking to control its existence and to limit its consequences.

5- It helps in distinguishing between risk and risk-taking, where the meaning of risk-taking is wider because it involves the chance of gain and loss, while risk is concerned solely with loss.

2.3 Definition of Risk in Insurance and Reinsurance

The writers and researcher's definitions of risk have been affected by the practical rules and regulation which are established in insurance markets. The definitions of risk as probable financial loss i.e. the probability of an event which could result in financial loss is, in fact, a definition conditioned by the financial outlook of an insurance enterprise with regard to the insured risks.

Although the scope of "risk" is wider and more general than that in insurance, nevertheless, some authors have tried to provide a separate definition of risk from the insurance point of view. Thus they define risk as a subject of insurance for individuals and properties (William, 1971). Risk is also defined as a property or an interest protected by insurance (Goshay, 1964).

Also risk is defined from an insurance and reinsurance company's point of view as; the uncertainty attached to the proposition and as to the deviation in probable results in a particular situation (William, 1971). And from the reinsurer's point of view as a group of factors which affect the result of reinsurance covers, whether good or bad (Habib, 1966).

There is confusion between the original insured risks and the risks which the insurance and reinsurance companies are exposed to as commercial enterprises. It is important to note that the concept here is not the risk of the claim and its expected amount, which concern actuaries who make calculations of the premium required to cover insurance in the long-run (on the basis of probability mathematics), but the risk of a claim in excess the expectation covered by premium ie. a loss. There is no conflict between the actuary and the underwriters, the latter, operating against market forces, decides whether to insure at all and if so what are the possibilities of an operating loss. So in the present context the occurrence of original risk was not considered a risk facing them if the losses would not exceed the premiums in any period, or when the deviation was in the direction of more profit.

The reinsurers, like the direct insurers, are concerned with the uncertainty related to future events which result in losses (Carter, 1979). They have given more attention to the factors affecting the underwriting result. Thus, the definition of risk, as the potential effects of a group of factors which influence in an undesirable way, the result is identical with the view of insurer and reinsurer enterprises with regard to the risk not on the basis of the original insurance risk covers, but in the form of undesirable deviation in the actual results from those expected and used in risk rating and making the underwriting decision.

2.4 Classification of Risk

Classifications of risks into homogeneous groups makes the detection and determination of risks easier for individuals and enterprises. This has to be done through a comprehensive study of different aspects of present and future activities and of all decisions inside the enterprise whether related to workers; production, marketing;..etc,

2.4.1 General Classifications

It is worth noting that most of the classifications of common risks which are made by authors depend, essentially, on the factors affecting occurrence of these risks and not on the basis of financial loss or material event, which is used in definitions of risk.

Willett (1951) classified risks into static and dynamic in order to distinguish between the behaviour of the social and economic environment as soures of dynamic risks and the risks of physical loss of, or damage to, property.

Kulp (1928) classified risks into general risks and particular risks for the distinction between factors related to natural, economic and political phenomena which are difficult to control, and affect individuals or society or both, and risks affecting individuals only.

William (1971) classified the risks according to the nature of the subject which is exposed to risk, i.e. property, liability, and personal risks.

At the same time Mowbry and Blanchard (1961); and Goshay (1964) tend to classify risks into pure and speculative in order to differentiate between the factors which randomly affect the enterprise activity. Then risks may be classified into :-

1- Risks related to the nature of activity, and divided into :-

i- Objective factors which are related to properties and technical aspects.

ii- Subjective factors which are associated with human nature and depend upon the character qualities and reputation, and are divided into :-

a- Moral hazards which force a person to contribute consciously to the occurrence of risk.

b- Social factors such as negligence, lack of control and bad behaviour generally.

2- Risks related to the nature of the composition of society and which are out of the control of individuals and enterprises. These can be classified into :-

i- Natural factors which are related to environment and topology, and are related to geographical composition.

ii- General factors which include economic and political risks facing society.

2.4.2 Classification of Risk in Insurance and Reinsurance

Insurance and reinsurance companies look at risk from two different angles :-

1- Original risks covered. These are classified into groups according to the following considerations :-

   i- The nature of risks and their underwriting requirement.

   ii- The size of the portfolio.

   iii- Statutory rules and regulations.

2- The classification of risk is the same from the point of view of any individual or any enterprise. In this study it is used for determining and analysing the risks faced by the reinsurer considered in chapter three.

2.5 Risk Management

Different devices have been used to eliminate natural risk and its variability. New risks are encountered by the continuous effort of man to harness the forces of nature and to secure economic development. The history of the early development of civilizations shows the concern of individuals and nations with methods of protection, and the financial and social sacrifices made for achieving this purpose.

At the beginning of the nineteenth century Fayal brought attention to the importance of risk management in projects.* This was the beginning of a demand to use scientific management skills in risk management. That was according to the principle that safety equals efficiency.

2.5.1 Risk Management Devices

Risk management devices refer to the methods used to reduce risks or their severity, whether by the individuals, projects or by societies. These methods vary according to the type of risks. Writers have attempted to classify these devices into groups each containing methods of the same nature or the same aim. But these classifications are affected by the different concepts of risk.

Salama (1972) divides these devices into three groups of policies, risk assumption, risk transfer and risk reduction. These groups do not give enough attention to the important devices. Moreover he considers the lack of detection of risk as one of risk assumption policy without planning which contradicts the function of risk management.

Goshay (1964) divides methods of treating risks into three; to transfer them, to prevent them; and to retain them. Both Carter (1979) and William (1971) have differentiated between the devices of protec-

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* He classified the activities inside the projects into six principal divisions; among them, security.

tion, prevention, and the avoidance of risk as separate devices of risk management. This fails to distinguish between risk transfer and the transfer of financial strain.

Dorfman (1982) added both self insurance and risk reduction as separate devices and considered insurance as a transfer of risk from the corporation's point of view, and as a reduction of risk from society's point of view. However, it is quite obvious that, insurance without international reinsurance is only a distribution of the financial losses over a larger number of individuals in society, which bears, in the end, the burden of the financial strain.

Gahin (1968) has classified risk management devices into two groups. The first includes the methods which affect the elements of risk, such as risk avoidance, protection, and seperating of the risk subject. The second includes methods treating the financial strain, such as risk transfer; risk combination and reserves. This classification treats the distribution of the risk subject as a separate device, when it is, in fact, one of the methods of risk protection and prevention. Also it gives more importance to self insurance than to commercial insurance.

As pointed out earlier, any comprehensive classification of risk management devices should take into consideration the following:

1- The increased importance of risk protection and prevention devices where science and technology are developing rapidly, and where there is an increase in automation in production and services.

2- The definition of risk with its two aspects, causative factors and the undesirable results.

3- Commercial insurance as an essential device.

Therefore risk management devices may be classified as follows:

2.5.1.1 Devices Affecting Risk Factors

1- Risk Avoidance

This means cancelling or transferring the activities which are causing the risk. This approach is used when risks are related to a certain activity with a high frequency or severity, and where no prevention methods are available to eliminate the risk occurrence or the result of it. Also it is used when an activity needs special experience for managing risks or to eliminate its effect. Risk avoidance is achieved in two ways :-

i- Cancellation or modification of activities. Unless the gains of activity equal or exceed the cost of its risks, it would be better not to engage in this activity or at least to modify it.

ii- Transfer of activity. When activities require special skills, in risk management, to control the relative risks, it is essential that a specialized corporation should conduct them. A construction contract is a good example of this method.

2- Risk Prevention

This refers to methods, regulations, instructions and precautions which reduce the chance of an event on the one hand, and controls the maximum loss expected on the other (Salama, 1972). Risk prevention involves the traditional methods of risk reduction and elimination (Goshay, 1964). It is more effective in protecting the society's wealth as well as in affecting the factor of risk in limiting the probability of its occurrence and in reducing the potential severity of loss. It is achieved by "analyses of the subject of risk; and human characters and their relationship" (Gahin, 1968). These devices can be divided into :-

i- Technical methods.

These methods are related to safety in using tools and machinery, and precision in the use of technical and scientific devices in the achievement of the work.

ii- Legal and regulation rules.

The human character is considered a main factor for many risks, such as theft, personal accident, ..etc. In fact, all

religions are concerned with the protection of mankind from these risks, through their orders and commandments. Therefore, Stark emphasized that the major function of the law is the prevention function (Desoki, 1965).

2.5.1.2 Methods Affecting The Severity of Results

It is not feasible to prevent risks entirely (R.S. Group, 1983) Thus the occurrence of many risks is inevitable with undesirable results. The effect of these results on firms and individuals varies according to the nature and severity of the risk. The financial effects may be handled by :-

1- Insurance

Most definitions of insurance are affected by the risk definitions and classifications. Thus insurance is defined from two aspects :

a)- The insured's point of view: Insurance is defined as: a device for transferring risk (William, 1971. and Head, 1978); a device for reduction of uncertainty (Pfeffer, 1956); protection against financial loss.

b)- The insurer and the society's point of view: Insurance is defined as; a process of spreading the strain of misfortune (Benjamin, 1977); a financial arrangement that redistributes the cost of unex-

pected losses (Dorfman, 1982); a mechanism for spreading losses over a larger number of people exposed to loss; a social device for reduction of risk (Meher, 1980; and Carter, 1979) and as an economic institution that reduces risk by combination under one management (Green, 1973). Insurance is devided into:

i- Commercial insurance.

Insurance companies are concerned with studying risks to which the individuals and other projects are exposed, as well as with preparing and rendering insurance covers to protect them from the burden of these risks. These covers are varied, therefore, the insured must study these covers to be sure that those selected are rendering the protection they needed.

ii- Mutual insurance.

This is co-operation between those who are exposed to the same risk in order to compensate the loss of any member. In recent years, there are many types of mutual organizations, profit or non profit corporations in life and general insurance with different types of business. The pool in reinsurance is considered a type of profit mutual organization.

2- Self insurance

Self insurance has long been a recognized technique of risk treatment, (Goshay, 1964). It may be defined as the reduction of severity of risks using the firm's internal fund. In recent years there has been a tendency for cooperation between large firms (the exposures) in facing risks and many captive insurance companies have been formed by groups of aviation and industrial companies, which felt that their insurance needs were not being met or the cost of commercial insurance was too high.

2.5.2 Risk Management in Reinsurance Companies

Insurance and reinsurance companies pay great attention to the risks to which they are exposed as a result of insurance business. In fact, reinsurance and retrocession covers are risk management devices used by them to confront the financial severity of risks which are included in their participation covers. Also the technical aspects, regulations, restrictions for underwriting and retention, are considered as main devices affecting the risk factors. The analysis of these devices and others are the topics of chapters four and five.

2.6 Summary

The definition of risk as a potential effect of factors, which influence in an undesirable way, the results of a specific undertaking will contribute to the understanding of different risks, whether from the point of view of individuals, or projects, or societies, or insurance and reinsurance corporations, because it concentrates on the influencing factors which are the subject matter of all risk studies.

Thus risk in this study, from the point of view of the rinsurer, is defined as the potential effects of the causative factors on the result of the reinsurance covers.

Depending on the risk factors, the risks are divided into; risks related to the nature of society, which includes natural, political, and social factors, and risks related to the nature of the activity which includes the subject factors and human factors.

With regards to risk management, the devices are classified into; methods affecting the risk factors which includes avoidance and prevention, and methods affecting the severity of results which includes insurance, deposits and reserves.

In the light of these principal concepts of risk, risk classification, and the devices of risk management, the study of risks confronted by the reinsurer will be the subject of the third chapter.

CHAPTER THREE

THE MAIN RISKS CONFRONTING THE REINSURER*

3.1 Introduction

The reinsurer has to face many risks which affect his underwriting results. Some of these risks are related to the original risks insured, and to insurance and reinsurance techniques, while many of them are related to the economic, social and political environment.

This chapter concentrates on analysing the main risks that are faced by the reinsurer and which influence reinsurance underwriting results.

Reinsurance business started as a form of co-operation between insurance companies and underwriters, with the purpose of spreading risks covered between them. Although reinsurance remained forbidden in Britain until 1764,** reinsurance contracts appeared in the second half of the seventeenth century in France and Denmark (C.I.I, 102).

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* In this study "THE REINSURER" includes the specialist reinsurance company, Lloyd's underwriters and direct insurance companies who are willing to accept reinsurance business.

** Except in the case of an insurer becoming insolvent or dying.

After the industrial revolution and the economic upheaval which followed, there occurred, a huge concentration of capital and property as well as increased complexity of industrial operations, and also consequential social changes, arising from large population growth, economic development and rapid advancement of science and technology. These changes affected every aspect of life and increased risks in local markets in every country. These markets have become exhausted and the insurance companies have become unable to provide the insurance covers required. Therefore the demand for reinsurance has increased, and more specialist reinsurance companies have been established* with private or state capital in different countries.

3.2 Function of Reinsurance

Reinsurance is the use of the market to handle very large claims which are either beyond the large of probability or occur more frequently than assumed in premium calculation or which occur very early and before adequate resources can be accumulated by the direct insurer (Benjamin, 1984). It may be defined also as; the insurance purchased by an insurance company against claims under policies it has issued (Meher,1980). The main function of reinsurance may be summarized as follows :-**

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* The formation of regional reinsurance corporations and the extension of state reinsurance corporations has been encouraged by UNCTED, to reduce their dependence on foregn insurers and to minimize the cost of external reinsurance.

** See Benjamin, (1977); C.I.I, (1982).

1- To increase the direct insurer's capacity to handle larger risks or to write new types of risk. This, in return, enables them to compete in their own and the world's markets.

2- To spread the risk throughout a wider area of the market.

3- To stabilize the insurer's operating results from year to year by reducing claims fluctuation and achieving some homogeneity of portfolios.

4- To avoid the financial strain resulting from a rapid growth of a portfolio.

5- To help and stimulate the direct insurance company to expand the volume of business it writes at a faster rate without a corresponding increase in its capital base.

3.3 Classification of Risks

In the preceding chapter risk was defined as the potential effect of a group of factors which influence, in an undesirable way, the result of reinsurance covers. these risks, for the purpose of this study, may be classified as follows :-

(A)- Risks related to the nature of insurance and reinsurance covers.

(B)- Risks related to the economic and social environment.

3.4 Risks Related to The Nature of Insurance and Reinsurance Covers.

Reinsurance contracts are concerned with providing for the insurance of liabilities which may be insured under contracts of insurance or reinsurance (Carter, 1979). But "The follow of fortune" clause as well as "Errors and Omissions" clause (Appendix No: 2) have extended the reinsurer's liability to cover other contractual risks in addition to the original risks.

3.4.1 The Original Risks

Reinsurance covers are prepared from the original underwriting policies to protect the ceding company against the fluctuation in loss experience of its portfolio as well as against the large losses which may strain its underwriting capacity.

3.4.1.1 Factors Influence The Original Risks

Although the reinsurance contract represents a separate contract apart from the original insurance contract, and differs in the parties and their obligations, the liabilities regarding premiums and claims due under the reinsurance cover are linked in one way or another with their values in the original insurance contracts. The ceding company may reduce the loss fluctuation in its portfolio by reinsurance, but instead the reinsurer is exposed to a considerable fluctuation in-

herent in the risks covered. The main factors affecting and increasing this fluctuation in the individual reinsurance cover are :-

1- The variation inherent in the nature of the risks covered.

The effects of the risk factors are rapidly changing as a result of scientific progress and the increasing and complex insurance need of the modern way of life. The additional perils which can be added to the ceding company's portfolio, such as, explosions; riots and civil commotion; malicious damage; earthquake ...etc, (in conjunction with fire policy) and liability insurance (in conjunction with accident; motor; aviation insurance) may cause a considerable increase in loss fluctuation of the portfolio, as they involve a small frequency of occurrence and a very high average claim size. These changes of risk factors which affect the loss frequency and the average amount per claim may result from (Gerathewohl, 1980) :-

i- Purely accidental deviations of actual claims experience from the experience to be expected statistically.

ii- Fluctuation of the basic probabilities applying to a risk and changes in the relevant risk factors.

iii- Incorrect or falsely applied statistics.

2- The nature of the reinsurance cover.

The bounds of liabilities differ from one kind of reinsurance cover to another and from one kind of cover to another for the same portfolio (see chapter five). The liabilities of original insurance contracts are shared between the ceding company and its reinsurers, but fluctuation in the result of each part may differ according to the nature of the risks involved (their frequencies and the average of loss), the limits of the original liabilities as well as the kind of reinsurance cover.

The ceding company should share with its reinsurers the same fortune, the same fluctuations in result. But this is not the case in all types of reinsurance covers. In surplus covers and in all non-proportion covers the number of losses attached to these treaties are less than those attached to the ceding company's retention or priority, but with maximum limits exceeding many times the ceding company's limits. This means that the reinsurer may suffer more fluctuation in losses under these covers, and needs more years to achieve a balance in its portfolio than those that are required by the ceding company on the assumption that they receive an adequate premium for each risk covered.

3- The nature of the original portfolio.

Suppose that the variance is used as a measure of risk* portfolio (Benktander, 1974 and Berliner, 1977), then in direct insurance the main parameters and the claim distribution are known, ie. number of claims n; number of policies N; the sum insured S; and the value of claims C. Using the compound distribution, the arithmetic mean of claim $\bar{C}$ and the variance σ^2 (L) have been evaluated without obtaining explicit expression for its probability function (Gray, 1967; Gillespie, 1973) where :-

$$L = \sum_{i}^{n} C_i$$

$$L = \bar{C} \cdot \bar{n}$$

$$\sigma^2(L) = \bar{C}^2 \cdot \sigma^2(n) + \bar{n} \cdot \sigma^2(C) \quad ....(3.1)$$

But, according to the definition of risk, the expected deviation of claims from risk premium could be measured by the variance of the loss ratio R ie. taking the claim's relative premium into consideration, then :-

$$R = \frac{\bar{n} \cdot \bar{C}}{\bar{S} \cdot \bar{N} \cdot t} = \frac{L}{P}$$

where t is the premium rate

---

* In this text it refers to the severity of risk.

Then $V(R) = V\left(\frac{L}{P}\right)$

$$V(R) \doteqdot \frac{(\bar{L}_T)^2}{(\bar{P}_T)^2} + \frac{\sigma^2_P}{\bar{P}^2} + \frac{\sigma^2_L}{\bar{L}^2} - 2 \cdot \left(\frac{\sigma^2_{PL}}{\bar{P}\bar{L}}\right) \quad \ldots\ldots(3.2)$$

In reinsurance the main parameters and the claim distribution for the original policies included in reinsurance covers are unknown. If $\bar{C}$ and $\bar{P}$ are the average claim and premium per cover, and n, N are the number of claims and covers respectively in the portfolio:

$$R = \frac{\bar{n} \cdot \bar{C}}{\bar{N} \cdot \bar{P}} = \frac{\bar{C}}{\bar{P}}$$

when we assume that there are claims in all covers in portifolio

then $n = N$

$$V(R) = V\left(\frac{\bar{C}}{\bar{P}}\right)$$

For any sample the variance of estimated ratio is biased (Cochran, 1971), and the biased variance of loss ratio in a portfolio with k covers over all n years:

$$V(R) \doteqdot \frac{1-f}{k \cdot \bar{P}^2} \cdot \frac{\sum_{i}^{N} (C_i - P_i)^2}{N-1} \quad \ldots\ldots(3.3)^*$$

where $f = k / N$ is the sampling fraction.

$N = n \cdot k$

That means the larger the size of portfolio k the less variance there is in loss ratio and the more homogeneous it is.

Thus the reinsurance should reduce the severity of such fluctuation mainly, by :-

1- Increasing the size of portfolio, ie. the number of reinsurance covers that are accepted; as is indicated from the last formula 3.1 ie. the greater the N the less of V(R) in the result.

2- Participating in business from different countries and classes of insurance. As the underwriting risk may differ from country to country and from class to class as well as from type of risk to another, it produces a more diversified portfolio.

3- Limiting the liabilities under his participation according to the nature of risks covered and the nature of the ceding company's portfolio . ..etc.

---

* see chapter five.

5- Arranging the necessary retrocession covers with optimal limits.

6- Ensuring that the reinsurer receives an adequate premium for all the reinsurance covers in the short-run and for each cover in the long-run.

The analysis of the first part of the questionnaire, (Appendix No:1) in the factors affecting the underwriting result using BMDP 3M-4M for factor analysis, gives results which are summarized in table 3.1 and which indicate that:-

1- The factors stated explain 73.7% of the underwriting result variation.

2- The risks included in the cover and the premium rate are the important variables influencing the results. They explain 47.8 % of the variation.

3- Some 26.3 % of the variation may be due to random fluctuation.

TABLE (3.1)

FACTOR ANALYSIS RESULTS

VARIABLES INFLUENCE REINSURANCE COVERS

NO	VARIABLE	FREQUENCES					MEAN	STANDERD DEVIATION	COEFFICIENT OF VARIANCE	VARIANCE EXPLAINED	COMULATIVE OF VARIANCE %
		MISS	1	2	3	4					
1	RIC	0	1	11	19	102	3.66923	0.65163	0.17759	2.1149	30.21
7	PR	2	0	3	30	98	3.73077	0.49475	0.13262	1.2355	47.83
4	CCR	1	3	23	55	51	3.14615	0.79837	0.25376	0.9545	61.33
3	LLC	1	1	18	65	48	3.20000	0.70875	0.22148	0.9025	74.24
2	PEC	0	3	16	66	48	3.18462	0.73437	0.23060	0.6880	84.07
6	TC	3	8	10	48	64	3.27692	0.88059	0.68720	0.5898	92.49
5	GAC	0	8	21	53	51	3.08462	0.88076	0.28553	0.5256	100.00

The differences between the mean of the effect for each factor on both marine and non-marine business as well as on each individual branch "Y_i" were tested by one way analysis of variance using BMDP D, the alternative conclusions are :-

H_0 : $Y_1 = Y_2 = Y_3 .... = Y_i$

H_1 : not all Y's are equal.

$$F = \frac{\sum_i^n (X_i - \bar{X})^2 / g - 1}{\sum_j^k \sum_i^n (X_{ij} - X_j)^2 / \sum_i^n (N_i - 1)}$$

where X_{ij} represents the jth observation in the ith branch

$\bar{X}_i$ is the mean for branch i.

$$\bar{X} = \sum_i^n X_i \cdot N_i / \sum_i^n N_i$$

N_i represents the number of observation in ith branch.

$g - 1$ is between branch degree of freedom.

The results are summarized in table 3.2 which indicate that :-

1- For "RIC" all branches F = 3.19 (tail probability = 0.0096) which is highly significant and the hypothesis of equal effects of "RIC" factor on all branc..es is rejected. Also for marine and non-marine the value of F = 10,3 (tail probability = 0.0017) is significant and the hypothesis of equal effect of

this factor on marine & aviation and non-marine are rejected. This may be due to the nature of marine & aviation risks which tend to cause heavy losses since the sums insured are greater and the number of policies in the portfolio is smaller than in the non-marine portfolio.

2- For the "PR" factor, the value F = 4.37 (tail probability = 0.0385) is significant and the hypothesis of equality in its effect on marine and non-marine covers result is rejected. This may be due to the difference between the rating techniques in the two classes.

3- For all other factors the F values are not significant and the hypothesis of equal effects of each factor on the results for all branches is accepted. This means that the effects of each of these factors are the same on the result of each branch.

TABLE (3.2)

FACTORS WHICH INFLUENCE THE RESULT OF COVERS
TEST THE EQUALITY OF THEIR EFFECT

NO	VARIABLE		BRANCHES							NON MARINE	AVI. & MARINE	'F' VALUE FOR ALL BR	'F' VALUE FOR M&NONM
			FIRE	A.	M	AVIAT	HULL	MARINE	FACULT.				
1	RIC	MEAN	3.581	3.571	3.154	3.895	4.000	3.793	3.833	3.500	3.855	3.19	10.3
		S.D.	0.807	0.690	0.899	0.315	0.000	0.491	0.408	0.787	0.399		
		T.O.P.										0.0096	0.0017
2	PEC	MEAN	3.161	3.000	3.231	3.421	3.125	3.241	3.333	3.111	3.290	0.71	2.02
		S.D.	0.735	0.903	0.725	0.607	0.641	0.636	0.816	0.797	0.637		
		T.O.P.										0.6419	0.1575
3	LLC	MEAN	3.194	3.000	3.000	3.211	3.250	3.276	3.167	3.085	3.242	0.40	1.30
		S.D.	0.910	0.877	0.816	0.713	0.886	0.591	0.983	0.874	0.694		
		T.O.P.										0.5140	0.5201
5	GAC	MEAN	3.323	2.893	2.615	3.263	3.000	3.207	3.167	3.028	3.194	1.49	1.19
		S.D.	0.653	0.956	1.387	0.733	1.069	0.726	0.753	0.964	0.765		
		T.O.P.										0.1877	0.2775
6	TC	MEAN	3.323	3.074	3.692	3.500	3.250	3.069	3.400	3.269	3.250	1.24	0.09
		S.D.	0.909	1.107	0.480	0.514	1.035	0.884	0.548	0.947	0.795		
		T.O.P.										0.2924	0.7674
7	PR	MEAN	3.839	3.741	3.846	3.632	3.875	3.607	3.333	3.803	3.623	1.54	4.37
		S.D.	0.454	0.447	0.376	0.597	0.354	0.497	0.816	0.435	0.553		
		T.O.P.										0.1696	0.0385

Using BMDP 1M for cluster analysis Figures 3.1 and 3.2 show that these variables may be classified into four clusters they are :-

The first cluster involves "RIC" and "AC" variables. This is clear from survey statistics; the severity of risks is different from country to country and from one area to another in the same country.

The second cluster involves "LLC" and "TC" variables. It is obvious from the nature of the type of covers that the limits of second surplus treaty exceeds the limits of the first surplus and the limits of excess of loss treaty exceeds the limits of the quota share treaty for the same portfolio.

The third cluster involves "CCR" and "PR" variables. This may be due to the practical tradition, that the retention of the insurers depends on the rating as a measure of the degree of risk insured.

The fourth cluster involves "PEC" which indicates that the past does not entirely explain the future.

FIGUR (3.1)

PAGE 14 UNDERWRITING RESULT

SORTED ROTATED FACTOR LOADINGS (PATTERN)

		FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4
GAC	6	0.861	0.	0.	0.
RIC	2	0.788	0.252	0.	0.
LLC	4	0.	0.871	0.	0.
TC	7	0.	0.696	0.	0.
PR	8	0.	0.	0.903	0.
CCR	5	0.	0.305	0.650	0.
PEC	3	0.	0.	0.	0.973
	VP	1.413	1.408	1.308	1.029

THE ABOVE FACTOR LOADING MATRIX HAS BEEN REARRANGED SO THAT THE COLUMNS APPEAR IN DECREASING ORDER OF VARIANCE EXPLAINED BY FACTORS. THE ROWS HAVE BEEN REARRANGED SO THAT FOR EACH SUCCESSIVE FACTOR, LOADINGS GREATER THAN 0.5000 APPEAR FIRST. LOADINGS LESS THAN 0.2500 HAVE BEEN REPLACED BY ZERO.

PAGE 5 UNDERWRITING RESULT
TREE PRINTED OVER ABSOLUTE CORRELATION MATRIX.
CLUSTERING BY MINIMUM DISTANCE METHOD.

FIG. (3.2)

HISTOGRAM OF "RIC" FOR UNDERWRITING RESULTS

```
          FIRE          ACCIDENT      MARINE        AVIATION      MOTOR         HULL          FACULTAT
          ..............*.............*.............*.............*.............*.............*.............*
MIDPOINTS
   4.600)
   4.400)
   4.200)
   4.000)............23 ............19 ............29 ............17 ......        M.......
   3.800)                            M             M
   3.600):M            M
   3.400)
   3.200)                                                          M
   3.000)....          .....         .....         ..            ...
   2.800)
   2.600)
   2.400)
   2.200)
   2.000)...           ...           .                           ....
   1.800)
   1.600)
   1.400)
   1.200)
   1.000)*
   0.800)
   0.600)
 GROUP MEANS ARE DENOTED BY M'S IF THEY COINCIDE WITH *'S, M'S OTHERWISE

MEAN          3.591         3.593         3.800         3.895         3.154         4.000         0.
STD.DEV.      0.307         0.694         0.473         0.315         0.899         0.            0.
R.E.S.D.      0.793         0.732         0.421         0.243         1.019         0.            0.
S. E. M.      0.145         0.134         0.080         0.072         0.249         0.            0.
MAXIMUM       4.000         4.000         4.000         4.000         4.000         4.000         0.
MINIMUM       1.000         2.000         2.000         3.000         2.000         4.000         0.
SAMPLE SIZE     31            27            35            19            13             8            0

      ALL GROUPS COMBINED
(EXCEPT CASES WITH UNUSED VALUES
  FOR BRANCH  )

MEAN            3.669
STD.DEV.        0.660
R.E.S.D.        0.638
S. E. M.        0.057
MAXIMUM         4.000
MINIMUM         1.000
SAMPLE SIZE       133

 ********************************* ANALYSIS OF VARIANCE TABLE *********************************
 *
 *    SOURCE                 SUM OF SQUARES      DF      MEAN SQUARE     F VALUE     TAIL PROBABILITY
 *
 *    BETWEEN GROUPS              6.2949          4          1.5737         3.94          0.0048
 *    WITHIN  GROUPS             51.1487        128          0.3996
 *
 *    TOTAL                      57.4436        132
 ************************************************************************************************
 *    LEVENE'S TEST FOR EQUAL VARIANCES          4, 128                     11.08          0.0000
 ************************************************************************************************
 *    ONE-WAY ANALYSIS OF VARIANCE
 *    TEST STATISTICS FOR WITHIN-GROUP
 *    VARIANCES NOT ASSUMED TO BE EQUAL
 *       WELCH                                   4,  48                     3.05          0.0257
 *       BROWN-FORSYTHE                          4,  58                     3.38          0.0149

  NOTE - ONLY THOSE GROUPS WITH NON-ZERO VARIANCE ARE USED IN THE
         COMPUTATIONS OF THE LEVENE, WELSH AND BROWN-FORSYTHE TESTS.
```

These results make the questionnaire data more meaningful and reduce the factors influencing the cover's result to :-

1- Risks included in the cover which explains 20.3 % of the variation.

2- Limits of liabilities which explains 20.1 %

3- The ceding company's retention which explains 18.9 %

4- Past experience which explains 14.7 %.

3.4.1.2 Catastrophic Risks

The concept of catastrophe differs according to the capability to bear the burden of its financial result.* In insurance it is defined as an event which is "sudden, without the history of periodicity normally required for the estimation of risk premium and involving amounts of claim, insurance against which would, with normal backing resources, represent a very high ruin probability" (Benjamin, 1977).

Catastrophes may be due to the natural hazards such as earthquakes; windstorm; floods;...etc, or man-made hazards such as; explosions;

---

* Swiss Re Co. in its statistics considers as a catastrophe each event which results in :-

1- Number of deaths exceeds 20
2- Extra of loss exceeds (in US$)

- 3 M. in marine
- 7 M. in aviation
- 8 M. in other branches

collapse of dam; aircraft crash;...etc (advanced group no: 148) Unfortunately both types are tending to increase. This increase may be due to the concentration of risk subjects, to extreme natural hazards and possibly to politically engendered losses growing with the development of hitherto undeveloped countries (C.I.I, 102).

Therefore the reinsurer is exposed to potential accumulation mainly because:-

1- The capacity of the national markets has not been sufficient in view of the size of the risks involved, and they have become more dependent upon reinsurance covers. Table 3.3 indicates that reinsurers have borne the major part of financial losses from major catastrophes.

2- It is impossible for the reinsurer to pinpoint the possibility of catastrophe among the areas in which he participates in risks, or where catastrophic losses are more likely to occur, with the lack of data in detail which can provide him with the essential information about the nature of risks covered.

TABLE (3.3)

Number of	Drowin volcano	Explosion Velisouf
Ceding companies	78	30
Reinsurance treaties	145	51
Countries of ceding Co.'s	8	5
Retrocession covers	262	160
Countries of reinsurers	51	46

* Source : Reinsurance (Carter, 1979).

3- The tendency of direct insurance companies to depend upon non-proportional reinsurance covers to protect their portfolios from the large losses which can occur under all types of insurance policies.

3.4.2 Risks Emanating from The Ceding Company

As has been mentioned before the reinsurer's liability under reinsurance cover is extended to cover other contractual risks in addition to the original risks. These risks are related to :-

- The ceding company policies.
- The moral hazards.

3.4.2.1 The Ceding Company Policies

The reinsurer underwriting results depends, to a large degree, on the ceding company's policies with regard to underwriting and settlements of claims. The follow of fortune clause as well as the nature of reinsurance contracts, gives the ceding company the sole rights to manage its underwriting policy without any interference from them. They follow it with regards to, not only the underwriting results for the original risks, but also to the result of deficient underwriting methods; excessive generosity in the settlement of claims; hasty overproduction and insufficient technical decision; in addition to the contractual risks, ie. risks which are related thereto; unjustified; exaggerated; fraudulent claim." (Marcionelly, 1968); and errors and omissions or mistakes in the routine operation (C.I.I., 102)

Therefore the reinsurer should give substantial consideration to ceding company's policies; the skills and experience of its underwriters, the technical ability and sound judgment of its staff. The analysis of the significant result of the second part of the questionnaire has indicated that the "CUP" is an important factor to be considered when accepting reinsurance business;* as:-

1- In 74.8 % of the reinsurer's assessments, "CUP" is a strong factor influencing their underwriting decision.

---

* Full analysis of the second part of the questionnaire is in chapter four.

2- In 25.2 % of cases reinsurers appraise it as a medium factor

3- None of the reinsurers mentioned it as a factor having a weak effect or no effect.

4- There is no significant difference between marine and non-marine underwriting in assesment of this factor's effect. This means that the above analysis applied to all branches (Fig. 3.3).

From the analysis of the survey data available for the Egyptian companies table 3.4 for the domestic business and table 3.5 for overseas business indicate that.*

1- There is no significant difference between the results of marine accident and fire business in these companies for their operations from Egyptian business.

** The technical results were used instead of only the loss ratio. From Egyptian Organisation's reports.

FIG. (3.3)

HISTOGRAM OF "CUP" FOR UNDERWRITING RESULTS

	FIRE	ACCIDENT	MARINE	AVIATION	MOTOR	HULL	FACULTAT
VAR 17 EXCLUDED VALUES							

TABULATIONS AND COMPUTATIONS WHICH FOLLOW EXCLUDE VALUES LISTED ABOVE

```
MIDPOINTS
   4.200)
   4.130)
   4.060)
   3.990)**********22 **********17 **********25 ********** ********** *****
   3.920)N
   3.850)
   3.780)                                                  N
   3.710)                          N          N                       N
   3.640)          N
   3.570)
   3.500)
   3.430)
   3.360)
   3.290)
   3.220)
   3.150)
   3.080)
   3.010)***       *********       **********  *****      ***         **
   2.940)
   2.870)
   2.800)
```

GROUP MEANS ARE DENOTED BY M'S IF THEY COINCIDE WITH *'S, N'S OTHERWISE

MEAN	3.903	3.654	3.714	3.722	3.769	3.714	0.
STD.DEV.	0.301	0.485	0.458	0.461	0.439	0.488	0.
R.E.S.D.	0.223	0.579	0.519	0.517	0.463	0.553	0.
S. E. M.	0.054	0.095	0.077	0.109	0.122	0.184	0.
MAXIMUM	4.000	4.000	4.000	4.000	4.000	4.000	0.
MINIMUM	3.000	3.000	3.000	3.000	3.000	3.000	0.
SAMPLE SIZE	31	26	35	18	13	7	0

ALL GROUPS COMBINED
(EXCEPT CASES WITH UNUSED VALUES FOR BRANCH)

MEAN	3.754
STD.DEV.	0.432
R.E.S.D.	0.467
S. E. M.	0.033
MAXIMUM	4.000
MINIMUM	3.000
SAMPLE SIZE	130

ANALYSIS OF VARIANCE TABLE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F VALUE	TAIL PROBABILITY
BETWEEN GROUPS	1.0386	5	0.2077	1.12	0.3555
WITHIN GROUPS	23.0845	124	0.1862		
TOTAL	24.1231	129			
LEVENE'S TEST FOR EQUAL VARIANCES		5, 124		6.64	0.0000
ONE-WAY ANALYSIS OF VARIANCE					
TEST STATISTICS FOR WITHIN-GROUP					
VARIANCES NOT ASSUMED TO BE EQUAL					
WELCH		5, 35		1.48	0.2197
BROWN-FORSYTHE		5, 65		1.05	0.3980

NOTE - ONLY THOSE GROUPS WITH NON-ZERO VARIANCE ARE USED IN THE COMPUTATIONS OF THE LEVENE, WELSH AND BROWN-FORSYTHE TESTS.

TABLE (3.4)

THE INFLUENCE OF CEDING COMPANY UNDERWRITING POLICY

EGYPTIAN BUSINESS — TECHNICAL RESULTS

YEAR	ACCEDENT				FIRE				MARINE			
	CO.A	CO.B	CO.C	MA.T	CO.A	CO.B	CO.C	MA.T	CO.A	CO.B	CO.C	MA.T
1965	29.72	97.25	61.96	77.25	26.22	26.92	45.51	30.76	65.37	153.77	106.85	109.75
1966	124.55	78.87	81.18	87.32	48.89	82.62	132.90	81.90	110.84	171.90	78.96	126.07
1967	45.71	60.28	62.50	58.73	19.39	183.86	16.87	77.34	71.91	51.82	79.28	66.21
1968	54.81	80.13	-27.23	58.21	16.91	35.71	-5.24	19.67	51.93	158.70	82.43	106.86
1969	46.36	104.56	98.24	90.54	20.39	19.20	47.35	27.84	73.30	48.43	107.15	67.23
1970	16.62	80.63	-19.29	50.20	59.11	-53.85	54.70	8.21	28.81	53.08	26.67	38.70
1971	106.89	71.32	33.28	72.87	377.02	20.82	30.47	146.48	43.38	49.07	51.28	48.15
1972	36.35	51.89	43.54	46.57	58.05	52.66	46.97	53.10	52.74	72.97	62.62	63.48
1973	81.69	98.36	39.05	81.86	5.52	22.76	25.00	16.26	58.33	82.91	84.10	80.48
1974	44.57	50.13	32.52	56.86	24.65	4.58	30.68	18.23	59.27	79.55	51.40	67.67
1975	56.47	59.14	20.50	62.02	28.64	100.61	66.44	64.90	100.32	71.58	97.20	85.93
1976	56.02	63.19	66.34	61.85	12.04	59.96	57.60	42.61	110.72	76.05	94.72	92.79
1977	50.83	153.81	77.91	110.94	173.15	38.98	30.53	85.39	75.55	88.05	98.19	86.93
1978	14.16	20.27	28.90	16.88	120.10	90.44	140.00	108.51	80.80	101.97	84.35	90.76
1979	61.23	7.17	58.75	26.05	111.61	37.57	106.41	80.92	112.53	90.81	104.40	102.56
1980	49.05	27.08	24.96	30.74	77.29	112.31	81.99	88.30	141.53	107.98	121.76	122.38
MEAN	54.684	69.005	42.694	0.	73.686	52.197	56.761	0.	77.335	91.165	83.210	0.
VARIANCE	29.135	35.861	33.982	0.	93.355	53.848	40.613	0.	30.304	39.286	24.911	0.
F1*			0.490				1.820				1.290	
P1*			0.616				0.173				0.285	
F2*			2.530				0.460				0.750	
P2*			0.091				0.632				0.478	

(*) TR = LOSS RATIO /(1 - COMM. RATIO)
* F1 : F VALUE
* P1 : TAIL OF PROBABILITY OF F
* F2 : F VALUE OF LEVENS TEST
* P2 : TAIL OF PROBABILITY OF F2

TABLE (3.5)

THE INFLUENCE OF CEDING COMPANY UNDERWRITING POLICY

OVERSEAS BUSINESS	TECHNICAL RESULTS											
	ACCEDENT				FIRE				MARINE			
	CO.A	CO.B	CO.C	CO.D	CO.A	CO.B	CO.C	CO.D	CO.A	CO.B	CO.C	CO.D
1965	125.23	264.73	290.92	104.69	94.32	77.19	76.49	100.56	112.31	528.89	100.33	67.82
1966	78.34	163.34	1425.91	67.56	103.69	71.37	135.80	104.25	105.34	330.98	87.70	115.25
1967	29.00	108.68	92.43	157.88	94.03	175.36	86.94	92.47	106.04	264.67	97.54	-99.72
1968	103.29	191.15	54.60	-22.22	97.02	207.24	90.91	110.12	95.28	1.75	134.25	99.86
1969	176.93	156.51	115.84	-49.21	90.97	274.87	94.39	102.94	93.50	147.02	86.43	102.63
1970	132.17	208.63	123.76	178.01	94.58	346.03	90.48	115.07	99.76	245.94	99.20	107.88
1971	46.99	197.26	77.30	93.27	109.30	416.84	82.01	55.12	113.96	290.93	114.12	105.70
1972	107.55	71.73	286.42	144.31	94.62	67.64	79.65	91.41	120.26	238.26	48.19	76.42
1973	91.41	6.05	25.00	57.97	83.12	114.20	88.57	82.44	141.39	40.98	68.09	73.26
1974	63.54	-245.95	91.30	64.26	104.42	160.35	108.16	95.91	56.25	-121.91	73.31	60.98
1975	89.20	23.04	44.11	88.50	53.96	91.26	100.75	89.91	71.38	75.08	90.71	74.76
1976	109.30	10.89	58.70	64.15	98.60	112.52	96.17	116.45	161.05	76.59	86.48	94.21
1977	105.09	17.07	75.22	109.05	102.98	129.26	86.98	100.91	162.68	228.98	98.53	100.69
1978	69.14	23.17	27.87	54.98	124.47	87.03	151.50	80.32	101.20	-33.43	104.49	77.45
1979	175.06	62.94	50.08	70.92	160.76	101.95	71.68	67.07	191.41	176.28	110.67	86.91
1980	78.70	140.80	22.57	76.97	103.29	60.87	115.60	97.30	184.59	28.77	142.62	101.88
MEAN	98.809	87.502	178.877	78.818	100.633	155.874	97.255	93.891	119.775	157.486	96.416	77.874
VARIANCE	40.519	121.237	342.343	58.061	21.674	105.752	21.458	16.495	38.509	163.197	23.303	50.048
F1*			0.990				4.480				2.420	
P1*			0.404				0.007				0.075	
F2*			3.500				14.880				16.660	
P2*			0.021				0.000				0.000	

(*) TR = LOSS RATIO /(1 - COMM. RATIO)
* F1 : F VALUE
* P1 : TAIL OF PROBABILITY OF F
* F2 : F VALUE OF LEVENS TEST
* P2 : TAIL OF PROBABILITY OF F2

*

2- The results of their overseas business varies from one company to another. The variance of these results was tested and found significant in accident business and highly significant for their participation in marine and fire business.

This means that the underwriting policy influences their results when they operate in an open market. The differences may be due to the experience and skills of the underwriters and to the administrative efficiency in each company.

3.4.2.2 Moral Hazards

The reinsurance contract rests on mutual confidence between the two parties and each will consider the other in regard to the financial strength, capacity and willingness to deal openly, fairly and promptly (Advanced Group no: 201, 1975). Although all essential information must be given to the reinsurer, it must be true and without representation. The ceding company and its brokers may :-

1- Give incomplete information or keep back some essential information

2- Delay their settlement of balances to the reinsurers for their investments purposes.

3- Tend to neglect the main insurance principles depending upon the protection which is provided to their portfolio, and become lax in their underwriting policy.

4- Apply biased rules in determining retention and the part ceded to reinsurers under the cover with the aim of retaining the good risks in their account.

5- Underwrites business with no attention to the interests of the reinsurers, and frequently change them for short-run advantages.

Therefore, the reinsurer should consider these factors and the financial results of their relative risks, before participating in new business.

3.4.3 Risks Associated with The Reinsurance

These risks are likely to be related to reinsurance as a commercial business and involve :-

- Accumulation risks.
- Organization risks.

3.4.3.1 Accumulation Risks

Accumulation is defined by the statement " the assumption that all risks insured are independent of each other is not correct " (Gerathewohl, 1980). Although the reinsurer attempts to consider the geographical spread, not only for his underwriting business but also, for each cover in which he participates, his ceding companies' underwriting and territory, his liability for any one risk, any one event;

or any one particular region may exceed those limits which existed to control his underwriting policy. This phenomenon may be caused by :-

1- The interference of the retrocession covers offered in the market.

2- The use of retrocession covers as a main device by reinsurers themselves to spread the large losses in their portfolios.

3- Under a blind treaty system reinsurers lack the necessary information for risks covered.

4- The substantial surplus capacity in the reinsurance market carries in its wake keen competition.

3.4.3.2 Organization Risks

The reinsurer is exposed to all other risks which relate to management activities such as " bad planning; incomplete control; lack of specialist ...etc." (Marcinelli, 1968). Or the failure in investments, political interference of the authorities, mismanagement of the company and misappropriation of its property (Pentikainen and Rantala, 1981).

3.5 Risks Related to The Nature of The Mix of Societies

Many of the risks to which different societies are exposed are transferred to the reinsurers through reinsurance and the retrocession

covers. Prolss (1948) referred to these risks as risks out of control of the parties of the reinsurance contract, which involve; inflation, transformation, technical deposits, reserves and monetary risks.

3.5.1 Economic Changes

Economic factors are considered the important factors influencing reinsurance results, and thus the underwriting decision.*

Neave (1975) referred to the complex situation in international relations and the failure of governments to regulate or control economic affairs internationally as extraneous factors creating a degree of uncertainty, unpredictability in reinsurance results and in reinsurance profitability. The main groups of economic factors influencing directly reinsurance business are :-

- Currency exchange rate fluctuations
- Inflation.
- Government economic restrictions.

3.5.1.1 Currency Exchange Rate Fluctuation

The exchange rate could be defined as the ratio of one currency to another or the value of one currency evaluated in another. It depends on internal economics as well as the trade relationship between the

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* See chapter four (4.2.1.3)

countries. It reflects the size of both demand and supply of these currencies.

Reinsurance is underwritten in different currencies, but "the sheer difficulty of keeping accounts in many currencies and in making small investments in them involve problems on a practical scale that are well-nigh insurmountable" (Craighead, 1979). Also the balances due in most currencies must be converted to any of the main internatio..al currencies at the date of payment. This must be done because of :-

1- State monetary restrictions in some countries.

2- The nature of the reinsurer's portfolio which is assumed to be balanced in the long-term. He has to use his profits from some markets to cover the losses in the others in the short term.

3- The importance of investment revenue is that it is used to cover a considerable part of losses. Thus the reinsurer needs to accumulate his funds and plan the optimal investment policies to provide the necessary cash flow and a suitable return.

4- There are a limited number of currencies which are acceptable from the different countries in settlement of balances due.*

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* Arrangements were made in london market for settlement in number of currencies, they are, DM; SF; FF; DF; JY; NK; L; AND USS.

This operation may expose the reinsurer to monetary risks, as a result of the fluctuation in the exchange rate. Tables 3.6 and 3.7 and Fig 3.4 indicate that :-

1- The fluctuation in exchange rate to S.F. has varied from currency to currency. The yearly average of these fluctuations was minimum for DM at 1.186 % and was maximum at 14.566 % forCP.

2- The annual average of fluctuation for the last eight years exceeded the same average for the first eight years for most of these currencies with maximum, for JY from -0.253 % to 6.71 %.

3- The correlaton coefficient between the fluctuation in rate of exchange and in inflation rate in the same country, for each currency as well as for all currencies* was weak, but was medium for Japanees Yen over all other currencies. That means there is no strong direct relation between inflation in one country and the rate of exchange of its currency with other currencies. This fact is very important in studying the index clause in excess of loss reinsurance covers.**

4- The values of most currencies in SF were stabled up to 1966 and tended to decrease heavily from 1970 onward, consequently increasing the effects of the exchange rate on reinsurance business.

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* Using the relationship between the rate of inflation in any country and the rate of inflation in Germany for the same year.

** See 5.4.2

TABLE (3.6)

ANUAL DEVIATICON IN RATE OF EXCHANGE

PERICD FRCM 1964 - 1978

YEAP	U.S.S. U.S.S	U.K. L	FRANCE F.F	JAPAN YEN	SWIZERLAND SWIZE.	YOGCSLAVIA DINAR	CCLCMBIA PESC	EGYPT EG.L
1964	-0.0503 6.0000	0.2013 5.0000	-0.0911 7.0000	-1.0719 14.0000	-0.0503 8.0000	-0.0503 11.0000	-0.0503 27.0000	-0.0503 3.0000
1965	-0.7239 8.4906	-1.1670 5.7143	-0.6834 5.6075	-0.0035 9.6491	-0.6549 5.5556	49.0244 15.3153	65.4601 32.2835	-0.7239 1.9417
1966	0.7292 6.9565	1.1808 4.5045	1.7566 3.5398	1.1758 12.8000	0.9391 5.2632	0.6546 15.6250	0.7292 23.8095	0.7292 3.8095
1967	-0.5501 12.1951	14.1524 2.5862	-1.4338 4.2735	-0.7147 14.8936	-0.5961 5.0000	16.5405 10.1351	-0.5501 12.5000	-0.5501 2.7523
1968	-0.0250 3.6232	1.8943 5.8824	0.7898 6.5574	-1.1853 14.1975	-0.5567 3.9683	7.1161 19.6319	-0.0250 14.1026	-0.0250 2.6786
1969	8.4011 6.2937	7.6774 4.7619	21.7650 9.2308	8.4314 9.7297	8.8043 6.8702	14.6685 14.8718	8.4011 17.6030	8.4011 3.4783
1970	1.1513 3.9474	1.4427 7.5758	0.4597 3.5211	1.0948 12.8079	1.1045 7.1429	8.1467 26.3393	1.1513 24.8408	1.1513 5.0420
1971	11.6279 3.7975	4.6812 8.4507	5.6421 6.1224	-1.7325 5.6769	1.2565 8.6667	22.2841 6.0071	51.8140 29.8469	11.6279 4.0000
1972	2.0612 2.4390	10.9440 7.7922	0.1271 5.7692	-2.0887 4.9587	-1.6146 3.0675	11.1981 2.6667	2.0612 3.9293	2.0612 1.5385
1973	18.4610 2.9762	19.7126 9.6386	8.8223 7.2727	9.8314 11.8110	1.8250 13.6905	26.8677 5.8442	8.7054 19.2817	6.6094 8.3333
1974	12.1577 11.5607	10.9590 15.3846	5.8685 13.5593	43.2614 24.2958	-12.1823 16.7539	29.2810 11.0429	22.9421 21.0777	12.1577 12.5874
1975	-8.0854 9.3264	6.6796 24.2857	-7.2168 11.4428	-22.6057 11.6147	-5.1905 8.0717	6.0109 15.7459	-3.2532 24.7382	-8.0854 11.1801
1976	11.0076 5.6872	31.8524 16.8582	22.9844 10.2679	7.9297 9.3909	3.8048 10.3734	21.8434 3.3413	12.4385 11.4376	11.0076 11.7318
1977	12.2090 6.2780	0.3573 16.0656	6.2260 8.9069	-8.0254 8.3527	-8.4008 9.7744	17.2757 8.5450	13.5262 15.1601	12.2090 11.0000
1978	15.1532 7.5949	7.9150 8.1921	2.3040 9.2937	-6.6300 3.4261	-6.7259 8.9041	24.3751 11.9149	16.1895 -66.7212	15.1532 12.1622
X_1	2.5700 6.4130	3.7579 5.5595	3.5256 5.7316	0.7493 11.7193	1.2808 6.3083	14.7981 14.8657	15.8663 22.7483	2.5700 3.338
X_2	9.3240 6.2075	11.6376 13.3335	5.5947 9.0794	2.4925 9.9408	-3.4035 9.9128	20.1420 8.1385	15.5529 7.3438	7.8426 9.068
X_T	5.5683 5.5683	7.8989 7.8989	4.4880 4.4880	1.8445 1.8445	-1.2159 -1.2159	17.1491 17.1491	13.3027 13.3027	4.7782 4.778
	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0001

*

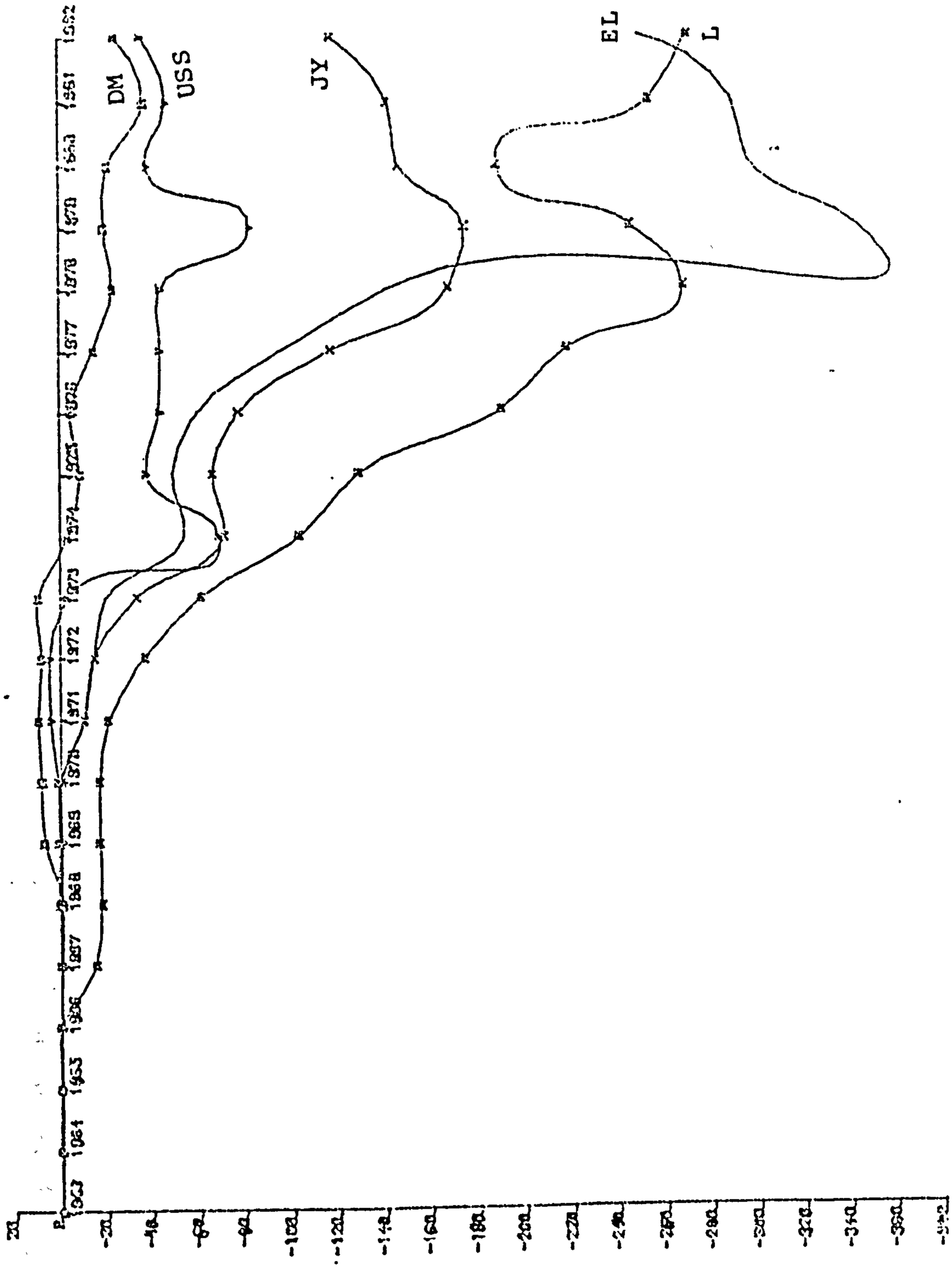
TABLE (3.7)
ANUAL FLUCTUATION IN RATE OF EXCHANGE
PERIOD FROM 1964 - 1978

		U.S.A.		U.K.		GERMANY		FRANCE		JAPAN		SWIZERLAND		YOGOSLAVIA		COLOMBIA		EGYPT	
CURR.		U.S.S	INF	L	INF	D.M.	INF	F.F	INF	YEN	INF	SWIZE.	INF	DINAR	INF	PESO	INF	EG.P.	INF
USS	X1	0.	6.413	1.294	-0.706	-2.334	0.567	0.904	-0.568	-1.647	5.032	-1.158	-0.022	12.076	8.058	12.833	15.465	0.	-2.817
	X2	0.	6.207	2.558	6.703	-8.002	-0.859	-3.220	2.722	-6.388	3.493	-11.168	3.520	10.022	1.809	5.750	1.218	-1.251	2.693
	cr	0.	0.215	0.161	0.269	-0.061	0.125	0.031	0.026	0.674	0.813	-0.589	-0.741	-0.110	0.070	0.257	0.284	-0.357	-0.129
SP	X1	-0.999	0.870	0.	5.559	-3.433	1.281	-0.117	0.189	-2.739	5.891	-2.232	0.723	10.893	8.828	12.170	16.253	-0.999	-2.386
	X2	-1.559	-6.153	0.	13.333	-9.849	-6.968	-5.203	-3.611	-8.055	-2.890	-13.135	-2.832	8.137	-4.464	4.422	-5.553	-2.796	-3.643
	cr	0.075	-0.200	0.	0.278	0.406	0.320	0.371	-0.045	0.612	0.646	0.229	-0.599	0.172	0.140	0.224	0.188	0.328	0.003
FF	X1	2.570	-0.328	3.758	-1.191	0.	6.910	3.526	-1.011	0.749	4.618	1.281	-0.482	14.798	7.443	15.866	14.822	2.570	-3.256
	X2	9.324	0.972	11.638	7.731	0.	5.213	5.595	3.698	2.493	4.461	-3.403	4.465	20.142	2.804	15.553	1.757	7.843	3.695
	cr	-0.060	-0.217	0.390	0.297	0.	0.213	0.176	0.322	0.493	0.645	-0.545	-0.406	-0.319	-0.255	0.119	0.134	0.500	0.489
DM	X1	-0.693	0.684	0.581	-0.134	-2.994	1.140	0.	5.732	-2.425	5.709	-1.922	0.569	11.387	8.699	12.392	16.139	-0.693	-2.231
	X2	3.739	-2.641	5.857	3.873	-4.768	-3.498	0.	9.079	-2.990	0.748	-8.172	0.769	14.081	-0.868	9.725	-1.548	2.378	-0.029
	cr	-0.011	0.005	0.302	0.296	0.164	-0.051	0.	0.179	0.630	0.763	-0.165	-0.688	-0.014	-0.012	0.151	0.138	0.357	0.246
JY	X1	1.354	-4.703	3.049	-5.421	-0.656	-4.224	2.667	-5.279	0.	11.719	0.537	-4.756	14.062	2.831	15.239	10.044	1.854	-7.434
	X2	8.865	-3.206	11.373	3.265	0.304	-4.076	5.205	-0.534	0.	9.941	-3.037	0.122	19.521	-1.414	15.072	-2.741	7.517	-0.592
	cr	0.687	-0.263	0.694	0.433	0.365	-0.199	0.675	0.016	0.	0.224	0.115	-0.632	0.368	-0.073	0.151	0.030	0.754	0.215
SF	X1	1.278	0.132	2.495	-0.697	-1.186	0.569	2.107	-0.529	-0.523	5.133	0.	6.303	13.475	8.098	14.566	15.434	1.278	-2.781
	X2	13.484	-3.304	15.608	3.201	3.834	-4.190	9.440	-0.689	6.710	-0.006	0.	9.913	24.766	-1.532	19.911	-2.400	12.030	-0.730
	cr	-0.563	0.110	0.211	0.556	-0.551	-0.295	-0.165	0.700	0.159	0.579	0.	0.289	-0.400	-0.229	0.002	0.045	0.216	0.677
YD	X1	-9.411	-7.088	-6.315	-7.881	-11.610	-6.780	-8.520	-7.699	-10.945	-2.547	-10.468	-7.192	0.	14.866	0.248	7.177	-9.411	-9.821
	X2	-9.022	-1.722	-6.639	4.857	-16.409	-2.561	-11.992	0.965	-15.058	1.752	-19.256	1.759	0.	8.138	-3.857	-0.389	-10.172	0.926
	cr	-0.151	-0.412	0.209	0.145	-0.335	0.017	-0.033	-0.025	0.410	0.667	-0.447	-0.509	0.	0.225	0.297	0.287	-0.007	0.033
CP	X1	-3.309	-13.000	-6.786	-13.780	-10.335	-12.712	-7.230	-13.585	-9.596	-8.622	-9.163	-13.164	0.946	-6.097	0.	22.748	-8.309	-15.555
	X2	-4.323	19.382	-1.644	25.606	-12.046	17.204	-7.398	22.313	-10.551	21.411	-15.065	22.857	5.187	22.119	0.	7.344	-5.686	23.053
	cr	0.137	-0.195	-0.007	0.162	-0.051	-0.081	-0.067	0.066	-0.119	0.652	-0.157	-0.356	0.127	-0.024	0.	0.046	0.173	0.198
EP	X1	0.	2.995	1.294	2.150	-2.334	3.454	0.904	2.329	-1.647	8.123	-1.158	2.876	12.076	11.147	12.833	18.787	0.	3.338
	X2	1.390	-2.571	3.962	3.941	-6.829	-3.404	-1.943	0.072	-5.100	0.839	-9.974	0.827	11.533	-0.808	7.025	-1.224	0.	9.067
	cr	-0.343	-0.326	0.353	0.260	0.446	0.221	0.343	0.018	0.691	0.817	0.200	-0.637	0.055	0.000	0.335	0.299	0.	0.045

(*) X1 AVERAGE OF ANNUAL FLUCTUATION (1964-1971).
X2 AVERAGE OF ANNUAL FLUCTUATION (1971-1978).
rc CORRELATION COEFFECIENT (C; F/C) AND (C; F)
(*) C; INF CURRENCY AND INFLATION FLUCTUATION
F/C FLUCTUATION OF RATIOS OF INFLATION IN BOTH COUNTRY

FIG (3.4)

TREND OF EXCHANGE RATE TO SWF.



As a matter of fact, the exchange rate fluctuation has created many risks for the reinsurer and has affected both reinsurance activities and technique. Neave (1973) emphasized that the instability in exchange rates certainly qualifies as a major modern problem confronting reinsurers. These problems will be analysed in this chapter* from the point view of its affect on :-

1- The technical results.

2- The balances due.

3- Liabilities limits

4- Retrocession covers.

5- Statistical survey.

3.5.1.1.1 Exchange Rate as An Influence on Technical Results

The technical result is the ratio of gross claims to its relative net premium for the same period. This result and other underwriting statistics for individual treaties are preferably produced in the original currency. The sixth part of the questionnaire (F-3) indicates that 69.7 % of reinsurers produce the technical result after converting the original currencies to their national currency. Also in the case of the covers with more than one currency, these currencies must be converted to one currency to review its results. In practice the exchange rate used in converting the original currencies is based on its value at one of the following :-

---

* The methods that should be used to manage its relative risks are analysed in chapter four (4.2) and chapter five (5.3).

1- The date of each transaction.

2- A fixed rate for each calendar year (or quarter year).

3- The date of deriving the results.

4- A fixed rate for each underwriting year.

The first two methods are the traditional methods used under clerical system, where the same document in the national currency is used for all the other financial and statistical purposes. While the third is the method currently most used. Craighead (1979) considers the fourth method the most logical solution to use (for Lloyds where the accounts are closed normally at the end of the third year).

Therefore, as a result of exchange rate fluctuations "it is not uncommon for technical results to look bad in original currency but, when each payment is converted into the reinsurer's domestic currency to appear profitable" (Neave, 1973). It is important in studying the effects of these fluctuation on the reinsurer's underwriting, renewal decisions and their underwriting results, to differentiate between two main systems in reinsurance covers. They are :-

1- Clean cut year system.

In this system the portfolio is treated as a whole for one year regardless of the date of policy issue or the date of loss, ie. all transactions during the year are binding in the reinsurance accounts. Therefore these accounts include claims and premium portfolios "in"

and "out" for the outstanding losses and unexpired premium respectively, in addition to the ordinary accounts for written premium paid claims and other charges.

This means, for a limited period, limited accounts are rendered for the Cover. Consequently the fluctuation in results will depend on the fluctuation in exchange rates in the short-run (usually two years). It then becomes a special case of the underwriting year system (the first two years).

2- Underwriting year system.

In this system, the reinsurer's liabilities for the policies issued during his participation year are continued as long as the underwriting year is being kept open and until all liabilities have expired. It is clear from table 3.13 that most of the premiums are due to the reinsurers during the first year of the covers while most of the claim amounts are due from the reinsurers in later years. Subsequently, for any given underwriting year most of the premiums are converted by one exchange rate and most of the claims may be converted into different rates.

To investigate the differences in results which are due only to the method used or those due to the technical approach in the reinsurance market, we can formulate these methods for this study as follows:

let P_{ij} Net premiums for i^{th} year in j^{th} currency

L_{ij} Total claims (losses + claim expenses)

R_{ij} Loss reserves or withdrawal portfolio

P_{Rnj} Premium reserves or premium withdrawal portfolio

t Month of the transaction.

The first methods used the accumulation figures in national currency (the converted currency) from the previous years, L_T, P_T, E_T then :-

$$TR_n = \frac{L_{T,n-1} + \sum_j^k [L_{rnj} \cdot R_{nj} + \sum_t^{nt} L_{tj} \cdot R_{tj}]}{P_{T,n-1} + \sum_j^k [P_{rnj} \cdot R_{nj} + \sum_t^{nt} (P_{tj} - E_{tj}) \cdot R_{tj}]} \quad \ldots(3.4)$$

When t increase to one year then R_{tj} is subestituted by R_{nj} This derives to :-

$$TR_n = \frac{L_{T,n-1} + \sum_j^k [(L_{rnj} + \sum_t^{nt} L_{tj}] \cdot R_{n-1,j}}{P_{T,n-1} + \sum_j^k [- P_{rnj} + \sum_t^{nt} (P_{tj} - E_{tj})] \cdot R_{n-1,j}}$$

Using L over a period years, it derives to :-

$$TR_n = \frac{\sum_j^k \left[L_{rnj} \cdot R_{n-1,j} + \sum_t^{nt} \left(L_{tj} \cdot R_{n-1,j} \right) \right]}{\sum_j^k \left[-P_{rn} \cdot R_{n-1,j} + \sum_t^{nt} \left(P_{tj} - E_{tj} \right) + R_{n-1,j} \right]} \quad \ldots(3.5)$$

Which expresses the second method. And if the value of R_{ij} fixed overall accounts up to the date of deriving results then :-

$$TR_n = \frac{\sum_j^k \left(L_{rnj} + \sum_t^{nt} L_{tj} \right) \cdot R_{nj}}{\sum_j^k \left[-P_{rnj} + \sum_t^{nt} \left(P_{tj} - E_{tj} \right) \right] \cdot R_{nj}} \quad \ldots(3.6)$$

When the rate fixed per each underwriting year ie.

Substituting R_{nj} in the above formula, it derives to :-

$$TR_n = \frac{\sum_j^k \left(L_{rnj} + \sum_t^{nt} L_{tj} \right) \cdot R_{yj}}{\sum_j^k \left[-P_{rnj} + \sum_t^{nt} \left(P_{tj} - E_{tj} \right) \right] \cdot R_{yj}} \quad \ldots(3.7)$$

Due to the differences in construction of these formulae, the variation in results will depends on :-

i- The fluctuation in exchange rate.

ii- The value of P, L, E which are included in each account.

iii- The period of accounts.

iV- The balance due and time of settlement.

V- The currencies used in accounts.

For analysing these methods and their effects on results, we examine the variations, which are due to the method used and test their deviations from the actual results (formula 4.1) distinguishing between :-

1- The covers with one original currency.

2- The covers with more than one currency.

1- <u>The covers with one original currency</u>.

Table 3.8, Fig 3.5 and Fig 3.6 represent the deviations in results for the U/Y cover in DM as original currency and L as converted currency which indicate that :-

i- There was a considerable change in exchange rate from year to year, between L and DM.

ii- The results from the third and fourth methods are identical, which are due to the fixed rate used over all account items whatever the difference in the rates used in each case.

iii- The profitability of the same cover is different from method to method. These differences were tested and found to be significant for most currencies which reflects the effect of changes in the exchange rate and on the type of formula used i.e. non- random fluctuation.

iv- The degree of such significance is very high when the fluctuation in exchange rate is significant and vice versa. As these differnces were found to be highly significant except for USS which has had nonsignificant changes in its value towards L during the period of study.

v- If we assume the reinsurer is interested in the result of the original risks covered then each of the third and fourth method introduce these results which differ considerably from the results from method one and two; in this example it reached about 30 % in some years.

TABLE (3.3)

THE TECHNICAL RESULTS ACCORDING TO THE USED METHOD

	ORIGINAL CURRENCY										CONVERTED CURRENCY				£.
U/Y	C/Y	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
	D. RITE	-1.04	0.53	3.38	12.76	17.57	20.55	12.52	27.02	9.56	15.70	-6.27	-16.55	22.63	4.65
1969	EQ. 3.4	90.66	75.64	71.47	70.93	73.96	77.60	72.85	75.03	75.86	74.64	73.11	73.11	73.11	73.11
	EQ. 3.5	90.66	74.88	69.95	67.74	69.71	71.77	68.97	69.73	71.49	70.12	69.58	69.58	69.58	69.58
	EQ. 3.6	90.66	75.45	70.37	67.54	67.69	67.73	64.38	64.24	64.25	63.53	63.12	63.12	63.12	63.12
	EQ. 3.7	90.66	75.45	70.37	67.54	67.69	67.73	64.38	64.24	64.25	63.53	63.12	63.12	63.12	63.12
1970	EQ. 3.4	0.	70.10	67.37	62.89	72.71	77.23	77.23	81.60	76.58	70.28	69.83	69.23	69.73	69.98
	EQ. 3.5	0.	70.10	66.33	59.36	67.06	69.59	71.27	73.24	71.00	64.93	65.29	65.03	64.33	64.94
	EQ. 3.6	0.	70.10	66.16	58.43	62.99	62.84	61.62	61.78	59.34	56.73	56.67	56.66	56.61	56.65
	EQ. 3.7	0.	70.10	66.16	58.43	62.99	62.84	61.62	61.78	59.34	56.73	56.67	56.66	56.61	56.65
1971	EQ. 3.4	0.	0.	97.30	84.63	83.70	89.10	83.73	87.66	83.25	83.47	81.26	78.11	79.94	80.24
	EQ. 3.5	0.	0.	97.30	79.60	77.79	80.51	83.00	79.78	78.47	77.90	78.77	76.69	74.24	75.92
	EQ. 3.6	0.	0.	97.30	77.77	72.83	72.24	70.48	67.51	65.04	64.32	63.95	63.62	63.49	63.45
	EQ. 3.7	0.	0.	97.30	77.77	72.83	72.24	70.48	67.51	65.04	64.32	63.95	63.62	63.49	63.45
1972	EQ. 3.4	0.	0.	0.	132.28	109.67	114.66	112.94	116.02	115.67	109.17	106.71	104.52	106.47	106.53
	EQ. 3.5	0.	0.	0.	132.28	106.99	108.86	110.40	110.33	113.22	105.73	105.47	104.05	102.11	102.35
	EQ. 3.6	0.	0.	0.	132.28	99.49	96.20	92.90	91.19	90.05	86.39	85.70	85.47	85.47	85.44
	EQ. 3.7	0.	0.	0.	132.28	99.49	96.20	92.90	91.19	90.05	86.39	85.70	85.47	85.47	85.44
1973	EQ. 3.4	0.	0.	0.	0.	121.65	99.85	107.57	118.95	114.40	114.62	116.12	112.48	104.36	105.04
	EQ. 3.5	0.	0.	0.	0.	121.65	95.10	108.19	114.65	115.14	113.85	121.07	119.24	103.48	106.81
	EQ. 3.6	0.	0.	0.	0.	121.65	85.35	88.05	89.21	84.98	83.22	84.62	84.58	78.92	78.90
	EQ. 3.7	0.	0.	0.	0.	121.65	85.35	88.05	89.21	84.98	83.22	84.62	84.58	78.92	78.90
1974	EQ. 3.4	0.	0.	0.	0.	0.	101.64	105.83	118.26	120.87	123.90	121.91	117.74	115.94	116.[illegible]
	EQ. 3.5	0.	0.	0.	0.	0.	101.64	115.63	121.12	130.59	132.10	136.56	134.27	126.38	129.33
	EQ. 3.6	0.	0.	0.	0.	0.	101.64	96.83	96.93	96.34	95.58	95.44	95.36	92.62	92.53
	EQ. 3.7	0.	0.	0.	0.	0.	101.64	96.83	96.93	96.34	95.58	95.44	95.36	92.62	92.53
1975	EQ. 3.4	0.	0.	0.	0.	0.	0.	111.33	122.40	124.73	127.35	126.49	122.59	125.16	125.14
	EQ. 3.5	0.	0.	0.	0.	0.	0.	111.33	111.79	123.92	124.25	130.15	128.41	125.78	125.77
	EQ. 3.6	0.	0.	0.	0.	0.	0.	111.33	102.36	101.36	98.94	99.67	99.72	99.71	99.70
	EQ. 3.7	0.	0.	0.	0.	0.	0.	111.33	102.36	101.36	98.94	99.67	99.72	99.71	99.70
1976	EQ. 3.4	0.	0.	0.	0.	0.	0.	0.	124.40	108.83	118.83	118.17	113.57	114.64	114.65
	EQ. 3.5	0.	0.	0.	0.	0.	0.	0.	124.40	121.07	127.94	136.81	134.47	125.90	125.91
	EQ. 3.6	0.	0.	0.	0.	0.	0.	0.	124.40	101.98	104.28	105.93	106.00	103.13	103.14
	EQ. 3.7	0.	0.	0.	0.	0.	0.	0.	124.40	101.98	104.28	105.93	106.00	103.13	103.14
1977	EQ. 3.4	0.	0.	0.	0.	0.	0.	0.	0.	123.88	110.95	110.58	106.90	108.61	109.30
	EQ. 3.5	0.	0.	0.	0.	0.	0.	0.	0.	123.88	107.05	116.29	115.19	109.45	112.56
	EQ. 3.6	0.	0.	0.	0.	0.	0.	0.	0.	123.88	100.38	103.71	104.42	102.41	102.33
	EQ. 3.7	0.	0.	0.	0.	0.	0.	0.	0.	123.88	100.38	103.71	104.42	102.41	102.33
1978	EQ. 3.4	0.	0.	0.	0.	0.	0.	0.	0.	0.	128.15	100.86	91.06	92.26	92.61
	EQ. 3.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	128.15	114.96	106.08	98.64	101.33
	EQ. 3.6	0.	0.	0.	0.	0.	0.	0.	0.	0.	128.15	104.94	100.16	96.81	96.52
	EQ. 3.7	0.	0.	0.	0.	0.	0.	0.	0.	0.	128.15	104.94	100.16	96.81	96.52
1979	EQ. 3.4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	121.00	93.39	101.81	100.[illegible]
	EQ. 3.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	121.00	101.07	95.00	96.27
	EQ. 3.6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	121.00	105.63	104.61	102.[illegible]3
	EQ. 3.7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	121.00	105.63	104.61	102.[illegible]3

FIG. (3.5)

HISTOGRAM OF "RC" FOR THE RESULTS IN ONE CURRENCY

```
          METHOD1                    METHOD2                    METHOD3
          .........................*.........................*.........................*
MIDPOINTS
 130.000)
 120.000)
 110.000)
 100.000)
  90.000)
  80.000)
  70.000)
  60.000)
  50.000)
  40.000)*                         ******                     **********************
  30.000)**********************     **********************     *********
  20.000)**********                **********                 H********
  10.000)H*********                *                          *************
   0.    )*******************      H***************          ****************************
 -10.000)****************          **********************     ******
 -20.000)*********                ************
 -30.000)*                        *****
 -40.000)                         *                          *
 -50.000)*                                                   *
 -60.000)
 -70.000)*
 -80.000)
 -90.000)
-100.000)
GROUP MEANS ARE DENOTED BY M'S IF THEY COINCIDE WITH *'S, M'S OTHERWISE

MEAN          5.335                4.748                     15.933
STD.DEV.     19.975                20.662                    21.176
R.E.S.D.     20.735                22.879                    21.543
S. E. M.      2.096                 2.166                     2.220
MAXIMUM      36.843                39.705                    93.035
MINIMUM     -67.653               -38.788                   -58.161
SAMPLE SIZE      91                    91                        91

      ALL GROUPS COMBINED
(EXCEPT CASES WITH UNUSED VALUES
  FOR METHOD  )

MEAN              8.672
STD.DEV.         21.170
R.E.S.D.         22.235
S. E. M.          1.281
MAXIMUM          93.035
MINIMUM         -67.653
SAMPLE SIZE         273

********************************** ANALYSIS OF VARIANCE TABLE **********************************
*
*  SOURCE                 SUM OF SQUARES      DF      MEAN SQUARE      F VALUE      TAIL PROBABILITY
*
*  BETWEEN GROUPS          7211.9816           2      3605.9908          8.49            0.0003
*  WITHIN  GROUPS        114690.5017         270       424.7796
*
*  TOTAL                 121902.4834         272
*************************************************************************************************
*  LEVENE'S TEST FOR EQUAL VARIANCES        2, 270                       0.54            0.5823
*************************************************************************************************
*  ONE-WAY ANALYSIS OF VARIANCE
*  TEST STATISTICS FOR WITHIN-GROUP
*  VARIANCES NOT ASSUMED TO BE EQUAL
*     WELCH                                 2, 180                       8.22            0.0004
*     BROWN-FORSYTHE                        2, 269                       8.49            0.0003

NUMBER OF INTEGER WORDS OF STORAGE USED IN PRECEDING    PROBLEM    1732
CPU TIME USED      9.681 SECONDS
```

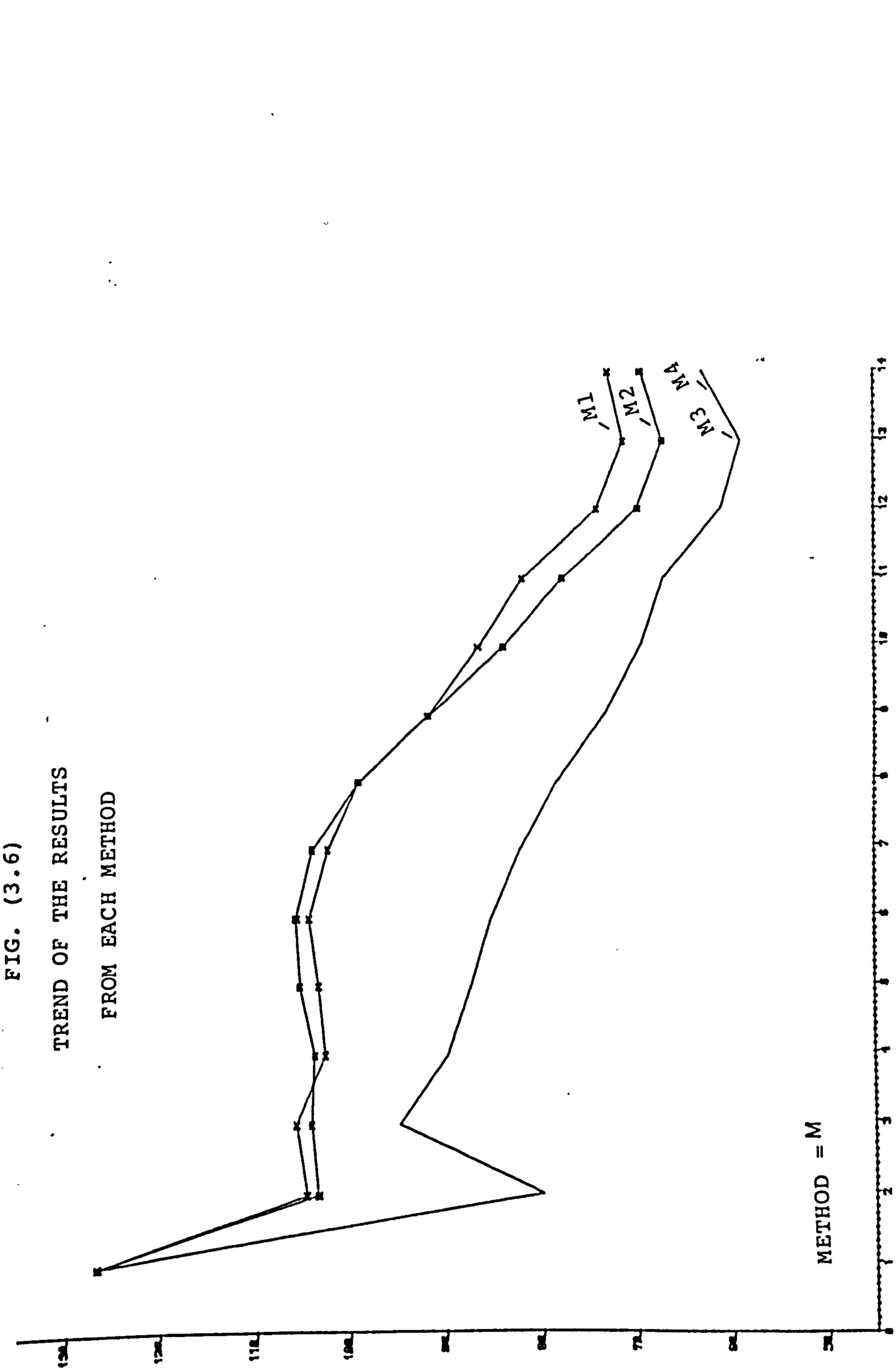


FIG. (3.6)

TREND OF THE RESULTS

FROM EACH METHOD

2- <u>The covers with more than one currency.</u>

Table 3.9 and FIG 3.7 represent the deviation in results for an U/Y cover in SF; DM as original currencies and L as converted currency which indicate that :-

i- The results from the third method become slightly different from those from the fourth method which is due to the differences in the degree of fluctuation for each currency.

ii- There is a change in the results from method three even when there is no change in the accounts item as a result of a change in the rate of exchange from year to year.

iii- The variation in results of all methods where tested and found highly significant (Figure 3.8) for most of groups of currencies used except for USS which is due to its random fluctuation.

iV- There is no significant effect of changing the ratio of commission or retained reserves.

V- The results obtained the first two methods are very close and the same is for the results from the third and fourth methods.

Vi- The fluctuation in the rate of exchange differs from currency to currency. Then the fluctuation in their values and the volume of business in each, as well as the balance, will affect the technical results.

TABLE (3.9)

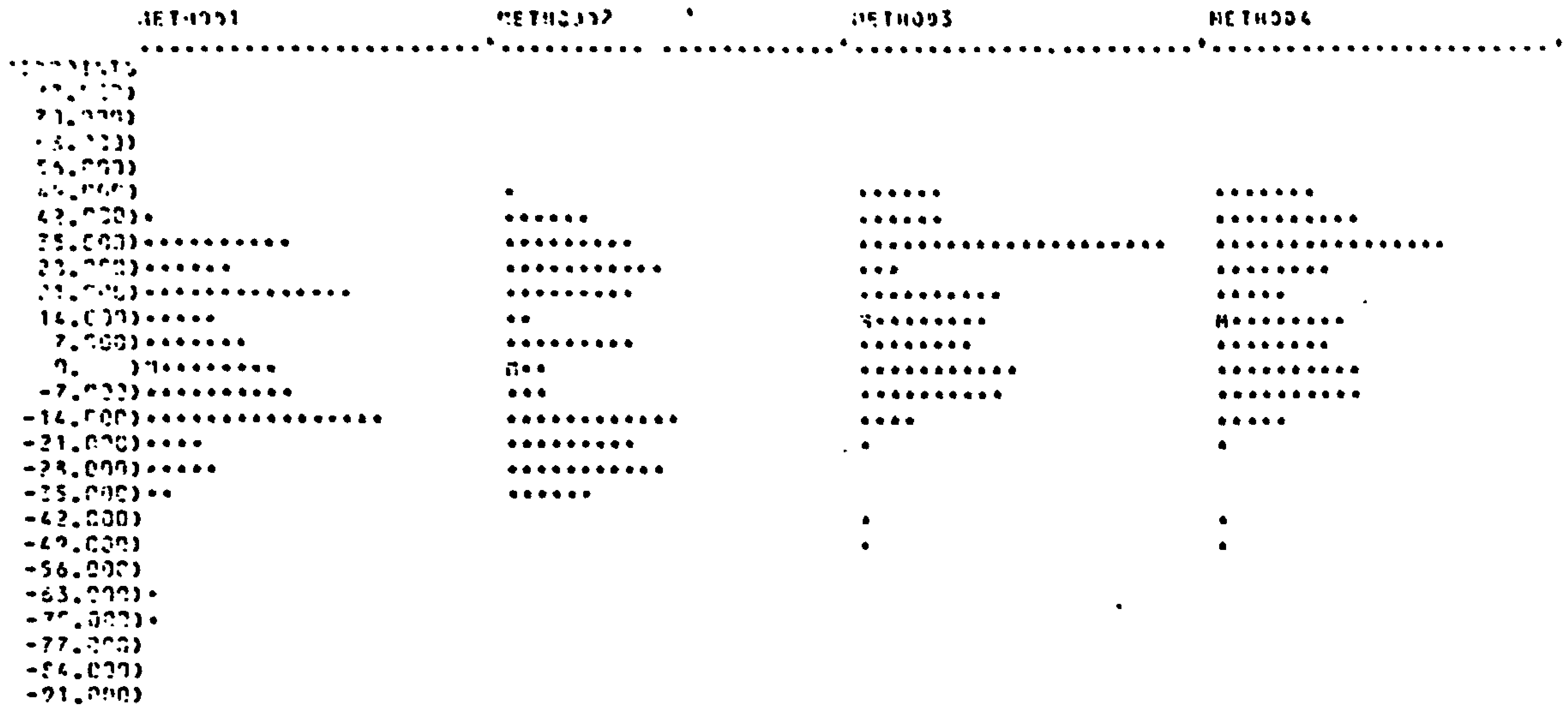
THE TECHNICAL RESULTS ACCORDING TO THE USED METHOD

ORIGINAL CURRENCY W.F. AND D.M. — CONVERTED CURRENCY : £

U/Y	C/Y	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
	D. RATE	-1.04	0.35	3.38	12.76	17.57	20.35	12.52	27.02	9.56	15.70	-0.22	-16.55	22.63	4.65
1969	EQ. 3.4	80.33	68.09	67.81	67.64	71.12	76.36	71.69	75.66	76.67	77.91	76.70	76.70	76.70	76.70
	EQ. 3.5	81.02	68.31	67.08	65.13	67.18	71.33	68.55	70.01	73.31	73.76	73.39	73.39	73.39	73.39
	EQ. 3.6	80.33	25.77	66.37	63.71	63.59	65.01	61.63	61.69	61.93	62.00	61.64	61.56	61.60	61.77
	EQ. 3.7	81.02	68.36	66.71	63.99	63.94	64.96	61.46	61.62	61.67	61.73	61.42	61.42	61.42	61.42
1970	EQ. 3.4	0.	64.61	61.60	57.50	66.30	70.69	70.07	74.07	69.93	64.27	63.88	63.34	63.78	64.01
	EQ. 3.5	0.	64.67	60.24	54.27	61.53	63.76	64.70	66.50	64.83	59.36	59.70	59.47	58.65	59.43
	EQ. 3.6	0.	64.61	59.93	53.33	57.57	57.63	56.67	56.65	54.94	52.81	52.64	52.69	53.05	53.01
	EQ. 3.7	0.	64.67	60.06	53.36	57.69	57.39	55.91	56.07	54.04	51.69	51.63	51.63	51.58	51.62
1971	EQ. 3.4	0.	0.	87.80	77.91	80.82	85.75	85.57	87.75	82.79	83.84	81.82	79.10	80.73	80.99
	EQ. 3.5	0.	0.	87.90	73.30	74.74	78.04	80.53	79.13	78.63	78.62	79.84	78.77	76.81	78.27
	EQ. 3.6	0.	0.	87.80	71.51	69.48	69.03	67.56	65.56	63.06	62.70	62.37	62.50	62.51	62.46
	EQ. 3.7	0.	0.	87.90	71.49	69.52	68.74	67.10	65.33	62.63	62.23	61.96	62.20	62.10	62.07
1972	EQ. 3.4	0.	0.	0.	114.37	94.66	99.26	98.48	101.19	99.91	94.52	92.72	90.72	92.37	92.46
	EQ. 3.5	0.	0.	0.	114.12	91.91	94.11	96.16	95.83	97.54	91.31	91.44	90.09	88.45	89.07
	EQ. 3.6	0.	0.	0.	114.37	85.39	84.15	82.20	80.14	79.53	76.97	76.24	76.11	77.04	76.86
	EQ. 3.7	0.	0.	0.	114.12	85.41	82.77	80.40	78.72	77.23	74.19	73.76	73.50	73.51	73.49
1973	EQ. 3.4	0.	0.	0.	0.	122.42	101.89	108.83	118.64	114.55	115.59	117.00	113.60	106.69	107.28
	EQ. 3.5	0.	0.	0.	0.	122.40	98.63	110.59	115.30	116.60	116.24	122.87	121.28	107.42	110.32
	EQ. 3.6	0.	0.	0.	0.	122.42	87.66	89.86	90.17	86.14	84.79	86.17	86.15	80.87	80.90
	EQ. 3.7	0.	0.	0.	0.	122.40	87.99	90.14	90.29	86.38	85.25	86.57	86.57	81.69	81.67
1974	EQ. 3.4	0.	0.	0.	0.	0.	100.43	101.16	113.60	115.42	118.85	117.37	113.22	109.74	110.21
	EQ. 3.5	0.	0.	0.	0.	0.	100.29	109.52	115.20	123.45	125.53	129.97	127.49	118.23	120.80
	EQ. 3.6	0.	0.	0.	0.	0.	100.43	92.94	93.45	92.87	92.75	92.74	92.49	89.12	89.01
	EQ. 3.7	0.	0.	0.	0.	0.	100.29	92.25	92.98	92.06	91.87	91.99	91.65	87.57	87.52
1975	EQ. 3.4	0.	0.	0.	0.	0.	0.	105.45	128.30	131.75	134.50	130.91	127.01	127.84	129.24
	EQ. 3.5	0.	0.	0.	0.	0.	0.	105.16	115.69	130.76	130.67	133.97	133.05	127.53	129.08
	EQ. 3.6	0.	0.	0.	0.	0.	0.	105.45	106.28	106.24	103.53	102.65	103.16	101.49	102.33
	EQ. 3.7	0.	0.	0.	0.	0.	0.	105.16	106.33	106.72	104.32	103.07	103.70	102.00	103.03
1976	EQ. 3.4	0.	0.	0.	0.	0.	0.	0.	125.27	106.40	116.09	114.98	110.28	112.42	113.05
	EQ. 3.5	0.	0.	0.	0.	0.	0.	0.	125.24	119.95	126.53	134.13	131.64	124.69	125.46
	EQ. 3.6	0.	0.	0.	0.	0.	0.	0.	125.27	100.35	102.98	104.12	104.02	102.37	102.76
	EQ. 3.7	0.	0.	0.	0.	0.	0.	0.	125.24	100.27	102.83	103.97	103.62	102.20	102.69
1977	EQ. 3.4	0.	0.	0.	0.	0.	0.	0.	0.	138.46	121.96	117.52	111.31	113.14	113.80
	EQ. 3.5	0.	0.	0.	0.	0.	0.	0.	0.	139.65	118.22	123.65	121.14	113.82	116.63
	EQ. 3.6	0.	0.	0.	0.	0.	0.	0.	0.	138.46	111.29	110.90	110.57	107.79	107.49
	EQ. 3.7	0.	0.	0.	0.	0.	0.	0.	0.	139.65	112.87	111.76	111.39	109.19	108.69
1978	EQ. 3.4	0.	0.	0.	0.	0.	0.	0.	0.	0.	159.71	114.97	102.24	104.88	105.45
	EQ. 3.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	161.74	128.78	116.91	110.84	113.26
	EQ. 3.6	0.	0.	0.	0.	0.	0.	0.	0.	0.	159.71	119.11	111.42	108.61	108.62
	EQ. 3.7	0.	0.	0.	0.	0.	0.	0.	0.	0.	161.74	119.62	111.96	110.50	110.30
1979	EQ. 3.4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	119.61	90.31	96.76	98.25
	EQ. 3.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	119.65	96.16	91.03	93.75
	EQ. 3.6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	119.61	102.54	102.22	100.28
	EQ. 3.7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	119.65	102.33	101.99	100.12

FIG. (3.7)

HISTOGRAM OF RESULTS



GROUP MEANS ARE DENOTED BY M'S IF THEY COINCIDE WITH *'S, N'S OTHERWISE

	METHOD1	METHOD2	METHOD3	METHOD4
MEAN	2.959	3.123	17.123	17.402
STD.DEV.	22.305	25.202	21.313	21.574
R.E.S.D.	24.044	28.579	22.851	23.355
S. E. M.	2.371	2.642	2.234	2.272
MAXIMUM	42.503	45.727	47.356	48.419
MINIMUM	-70.325	-24.133	-59.464	-49.903
SAMPLE SIZE	91	91	91	91

ALL GROUPS COMBINED
(EXCEPT CASES WITH UNUSED VALUES
FOR METHOD)

MEAN	10.152
STD.DEV.	23.795
R.E.S.D.	25.459
S. E. M.	1.247
MAXIMUM	45.419
MINIMUM	-70.325
SAMPLE SIZE	364

ANALYSIS OF VARIANCE TABLE

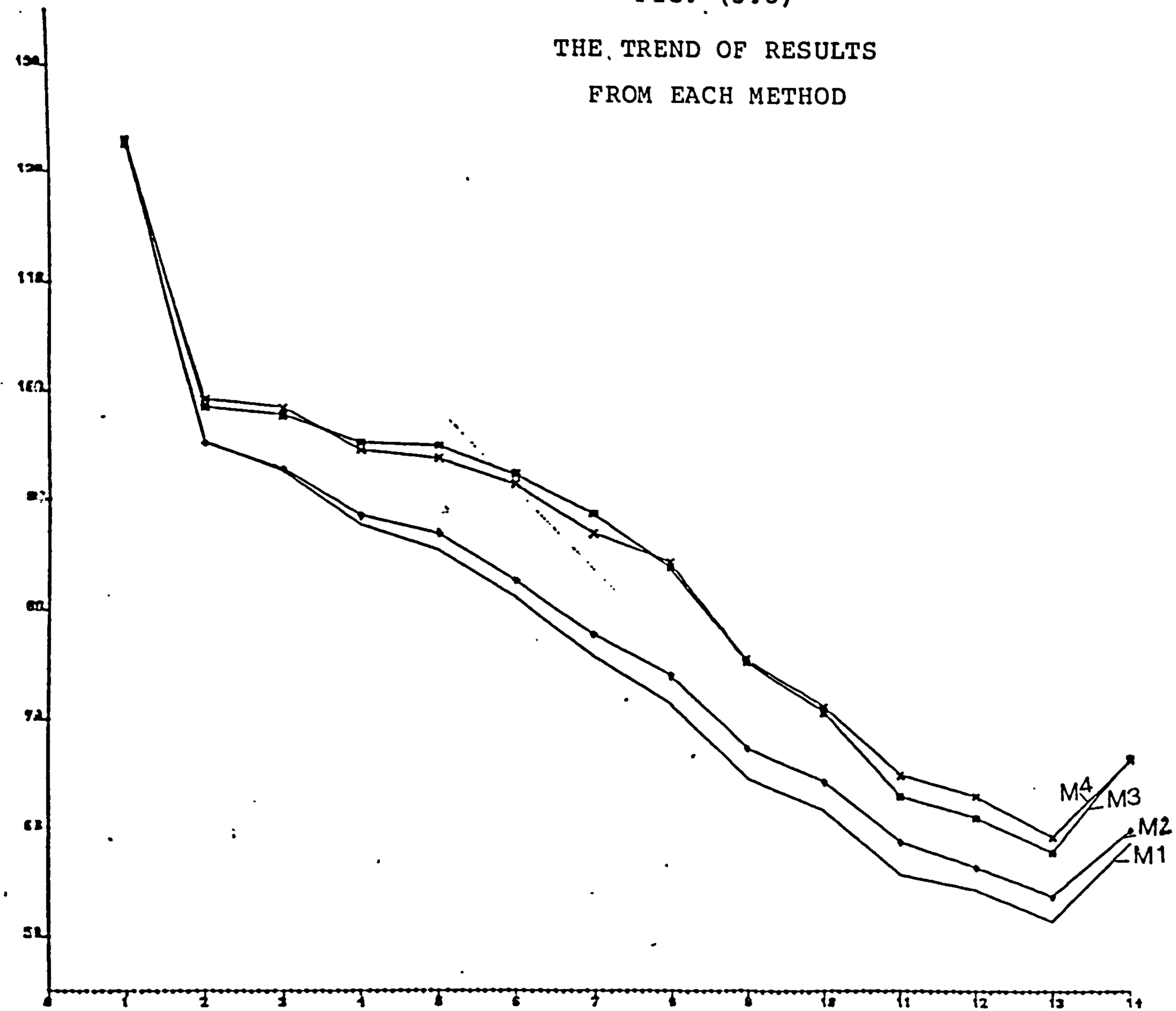
SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F VALUE	TAIL PROBABILITY
BETWEEN GROUPS	18409.3337	3	6136.4446	11.81	0.0000
WITHIN GROUPS	187130.1369	360	519.8059		
TOTAL	205539.4707	363			
LEVENE'S TEST FOR EQUAL VARIANCES		3, 360		3.12	0.0261
ONE-WAY ANALYSIS OF VARIANCE TEST STATISTICS FOR WITHIN-GROUP VARIANCES NOT ASSUMED TO BE EQUAL					
WELCH		3, 200		11.30	0.0000
BROWN-FORSYTHE		3, 355		11.81	0.0000

NUMBER OF INTEGER WORDS OF STORAGE USED IN PRECEDING PROBLEM 2245
CPU TIME USED 11.739 SECONDS

FIG. (3.8)

THE TREND OF RESULTS

FROM EACH METHOD



3.5.1.1.2 Exchange Rate Influence on Balances Due

The balance due under reinsurance covers in most currencies is converted to one of the main currencies always using the rate of exchange at the date of transaction. Then for any underwriting year, most of the premiums are settled in an exchange rate and most claims are settled in a different exchange rate.* Therefore the ratio of actual paid claims to the actual premium received (ie. after taking the financial aspects into consideration) would be different from both the results in original and in converted currencies.

Table 4.2 shows, as an extreme case, while the balance of LE 357,000 was due to the ceding company for 1981 underwriting year, the ceding company paid to its reinsurers L 1,259,000 Thus the ceding company's losses, as a result of monetary risks for this underwriting year, was L 1,250,000. The severity of these risk depends on :-

1- The accounting period (Quarterly, Half-Yearly, Yearly)
2- Rate of exchange at the date of remittances.
3- Ratio of premium and claim in each account which influences the balance due.
4- The nature of risks covered.

---

* For many years ,in the London market, reinsurance has been handled in L; USS; CS and all other currencies have been sold for L. (Craiglead, 1979)

3.5.1.1.3 Exchange Rate Influence on Cover Limits

The reinsurer's liability begins after the priority limits in non-proportion covers and in parallel with the ceding company's liability in proportinal covers for the same risk covered. The fluctuation in exchange rate influences these limits and may increase the reinsurer's limits in the national currency or in the main currencies of the covers which leave the reinsurer unprotected for the gap caused by the cover movement in his limits.

The heavy depreciation of sterling in 1974/75 meant a substantial loss where liabilities existed in more stable currencies, particulary JY and DM and some companies estimated that they lost 20 % of their liability of about two years (Craighead, 1979).

3.5.1.1.4 Exchange Rate Influence on The Retrocession Covers

Reinsurance covers involve a part of the ceding company's inward business in different currencies. Premiums, claims and other account items, in inward business, are converted to the national currency or to the currencies of the reinsurance (or retroccession) covers using the rate at the date of transactions.

This means the premiums, claims and other items will not all be converted at the same rate of exchange. Therefore, the reinsurer may not receive unbiased premiums. Also the retrocession covers will be affected, more than other covers by the fluctuation in exchange rate.

This is because it involves more than one rate of exchange at different points of time. This influence depends on :-

1- The original currencies in the portfolio covered.
2- The fluctuation in the rate of exchange for each of the portfolio currencies.
3- The share ceded to the retrocession cover and inward business in each currency.

3.5.1.1.5 Exchange Rate Influence on The Statistical Survey

Technical and financial statistics for insurance and reinsurance are used for many purposes such as management and financial control, rating and other technical aspects and governmental and shareholder's supervision and control. For these purposes, it is usual to present statistics of one currency. Also in most countries the financial position of the reinsurer is required to be published in the national currency. Therefore all items in foreign currencies must be converted to the national currency, always by a rate of exchange, using one of the first two methods mentioned before.

Then the fluctuation in the rate of exchange used will affect the underlying statistical inference. This makes the financial analysis of the reinsurer's business more difficult as the data gives untrue indications. For instance, table 3.10 represents the trend of premium received for the overseas business by one of the Egyptian companies in

LE. The annual fluctuation in premium as well as in exchange rate for the main currencies in the portfolio, are explained and the trend of actual and statistical fluctuations are shown in FIG 3.9 which indicates that :-

1- The great increase in premiums in 1969 was due to the rate of exchange which increased officially by 80 % from 1977.

2- The annual increase in premiums in 1977 was affected by the Arab boycot from 1977.

3- The annual fluctuation in premiums in LE., clearly, is connected with the annual fluctuation in the exchange rate of the main currencies in the portfolio.

It is clear that these effects are not limited to premiums, but in fact, extend to all items in revenue accounts and balance sheet, such as net profit, the value of assets and deposits, the debtors and creditors figures. In general all financial and administration surveys may give a false indication specially when the national currency has faced a heavy depreciation.

TABLE (3.10)

EFFECTS OF EXCHANGE RATE ON SURVEY STATISTICS

CURR.	F.F.		S.F.		D.M.		$.		R	CHANGE	EARNED PREMIUM	CHANGE	ACTUAL
YEAR	R_1	H_1/R_1	R_2	H_2/R_2	R_3	H_3/R_3	R_4	H_4/R_4		%	IN EP	%	CHANGE
1965	0.0877	0.5637	0.1007	1.4895	0.1085	1.3824	1.2186	0.2872	0.2686		903		
1966	0.0878	0.5695	1.4925	0.1005	0.1093	1.3725	1.2131	0.2855	2.686	0.0	1103	22.1	22.1
1967	0.0886	0.5643	0.1005	1.4925	0.1087	1.3800	1.0466	0.3344	0.2652	-1.3	1180	7.0	8.2
1968	0.0879	0.5688	1.4805	0.1011	0.1087	1.3800	1.0367	0.3376	0.2657	0.2	1228	4.1	3.8
1969	0.0782	0.6394	0.1007	1.4985	0.1178	1.0732	1.0437	0.3353	0.2964	11.6	1786	45.4	31.8
1970	0.0788	0.6345	0.1008	1.4880	0.1192	1.2582	1.0407	0.3363	0.2690	-9.3	2008	12.4	22.6
1971	0.832	0.6009	0.1111	1.3500	0.1330	1.1277	1.1098	0.3154	0.2946	9.5	2571	28.0	18.1
1972	0.0848	0.5896	0.1152	1.3026	0.1358	1.1017	1.0211	0.3428	0.2994	1.6			
1973	0.0831	00.6017	0.1206	1.2438	0.1448	1.0359	0.9092	0.3850	0.3062	2.2	2915	13.4	11.7
1974	0.0880	0.5682	0.1541	0.9735	0.1624	0.9236	0.9190	0.3809	0.3514	14.8	3657	25.4	23.0
1975	0.0872	0.5734	0.1494	1.0041	0.1492	1.0067	0.7918	0.4422	0.3306	-6.3	4777	30.6	15.8
1976	0.0787	0.6353	0.1597	0.9393	0.1657	0.9053	0.6667	0.5250	0.3328	0.7	6799	42.8	50.0
1977	0.0832	0.6010	0.1960	0.7653	0.1859	0.8069	0.7453	0.4696	0.3784	13.7	8064	18.6	17.9
1978	0.0936	0.5342	0.2415	0.6210	0.2141	0.7006	0.7953	0.4401	0.4356	7.3	10378	28.7	15.0
1979	0.01741	0.2872	0.4430	0.3387	0.4044	0.3709	1.5556	0.2250	0.8185	87.7	20735	99.8	7.4
1980	0.1550	0.3226	0.3975	0.3774	0.3573	0.4198	1.6706	0.2095	0.7523	-6.1	25510	23.0	1.3

$$\frac{1}{R} = \frac{H_1}{R_1} + \frac{H_2}{R_2} + \frac{H_3}{R_3} + \frac{H_4}{R_4}$$

where $H_1 = 0.05$; $H_2 = H_3 = 0.15$; $H_4 = 0.35$

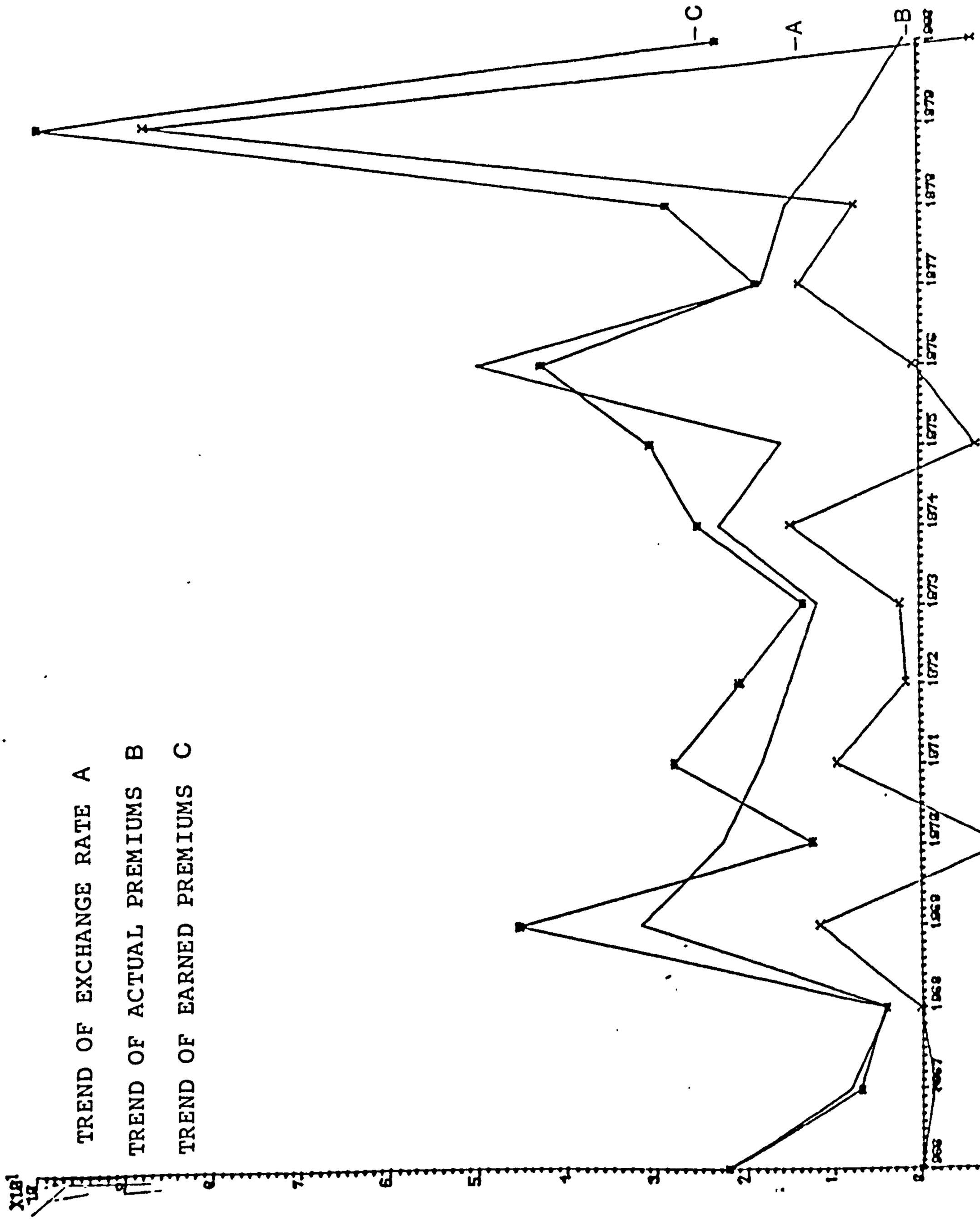
R : THE AVERAGE RATE FOR PORTFOLIO (70 %) AND 30 % FIXED rate.

$$AC_j = \{ (0.3)\, P_{j+1} + \frac{(0.7)\, P_{j+1}}{R_{j+1}} - (0.3)\, P_j - \frac{(0.7)\, P_j}{R_j} \} / \{ (0.3)\, P_j - \frac{(0.7)\, Pj}{Rj} \}$$

-93-

FIG (3.9)

SURVEY STATISTICS



3.5.1.2 Inflation

Inflation is defined in economic terms as the decreasing of monetary value in regard to the value of common commodities and services in certain markets as the result of a disequilibrium between supply and demand. A study of inflation (Munich reinsurance company, 1971) summarized the factors affecting inflation as; the increasing value of the services sector in the overall economy; the growing need for financing elaborate infrastructured measures and the rigid rates of exchange. In reinsurance, inflation affects :-

- Original risks included in the reinsurance covers.
- The reinsurer's liabilities.
- The adminstration costs

1- Risks included in the portfolio

Inflation leads to a substantial increase in the value of properties and liabilities, and consequently the risks covered and the claims due. This influence on claims differs according to the nature of the losses which can be classified into three categories :-

i- Total loss : In the cases where the entire sum insured is due, such as in personal accident, and where the loss covers all the sum insured; the insurer and reinsurer are not affected by inflation, as a pro rata clause must be applied when the loss increases the sum insured.

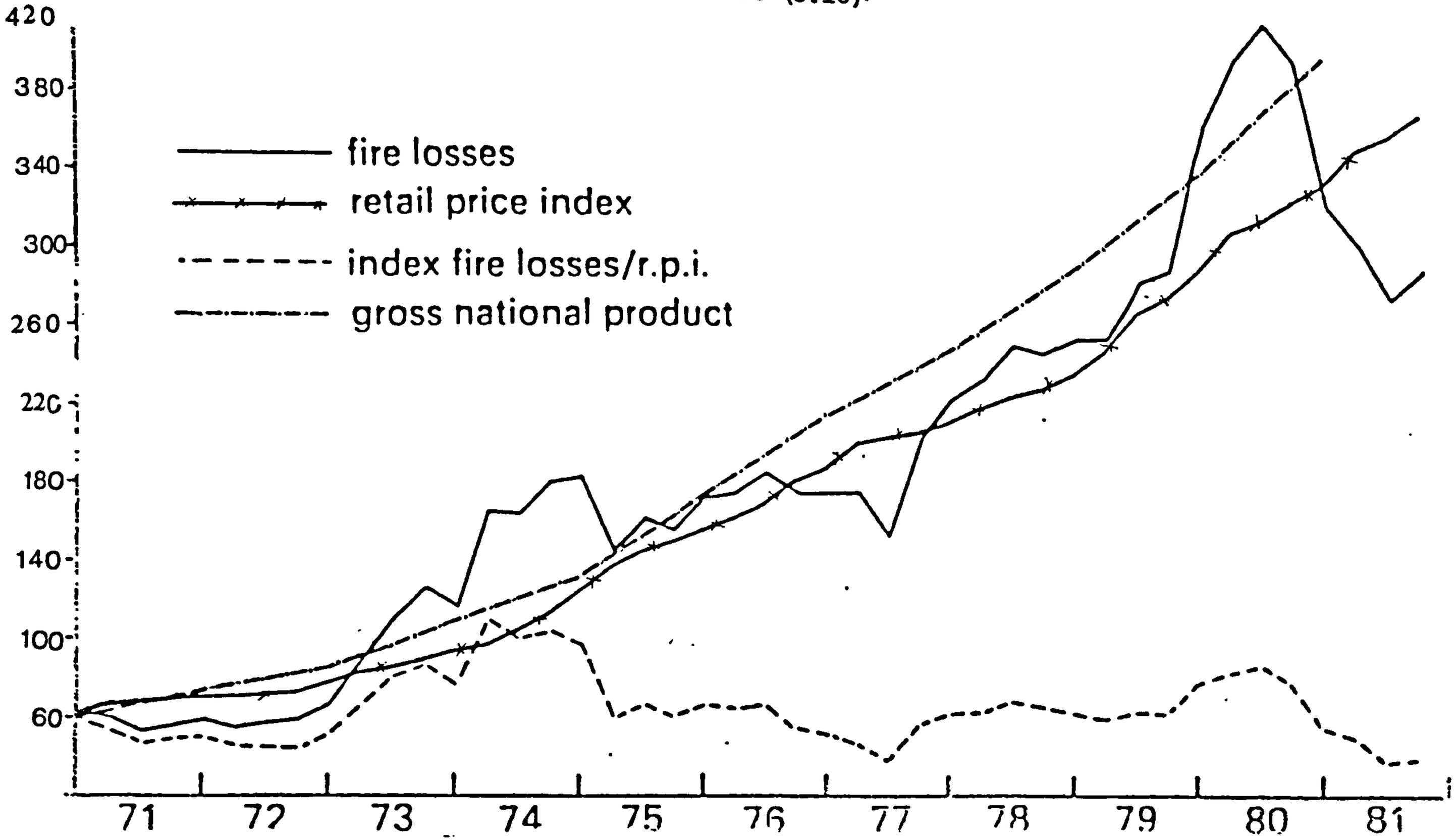
ii- Partial losses : In indemnity insurance contracts, the loss is paid up to all the sum insured only when the latter exceeds or equals the loss, otherwise, claims could be a portion of the loss occurring. In practice, it is difficult to reassess the reinsured subject at the date of an accident especially when the loss is not high, or if the evaluation is relatively expensive or if it is related to the cost of repairs.

Therefore the insurer and reinsurers may bear the effects of inflation in these cases (which are more probable to occur).

iii- Unlimited insurance : Such as liability insurance, where no sum insured is determined. Then the insurer and reinsurers must bear the burden of inflation, which tends to be increased by the court awards and the medical costs and increase in salaries.

A study by Fire Protection Association (BIA, 1978) emphasized the complete correlation between the increase of retail prices and the increase in fire claims in Britain from 1970 to 1980, Figure 3.10

FIG (3.10).



Fire losses, retail price index and gross national product indexed to 100 in 1970 to give a common base comparison. Fire losses have also been corrected for inflation using the retail price index. Source: Fire Protection Association.

2- The reinsurer's liabilities

The claims due under reinsurance covers are distributed between the ceding company and its reinsurers according to the nature of the cover, and based on :-

(A)- A fixed percentage in proportion covers.

(B)- A range of fixed amount in non-proportion covers.

(A)- A Fixed Percentage

In proportion covers, claims as well as the effects of inflation on claims are distributed between the ceding company and its reinsurers in a fixed percentage for all risks in quota share covers, and in a fixed percentage for each risk in surplus and facultative covers. This is the case until the original claims reach the maximum limits of the covers, then all the burden of inflation will be transferred to the ceding company or the reinsurers on the next limits.

(B)- A Fixed Amount

In non-proportional covers, some authors have reached the conclusion that the effects of inflation on the experience of an excess of loss treaty will always be greater than the actual rate of inflation. Table 3.11 explains their conclusion.

TABLE (3.11)

EFFECT OF INFLATION ON THE REINSURER'S LIABILITY

CEDING COMPANY DEDUCTIBLE	CLAIMS TO REINSURERS GROSS CLAIMS L 10,000	GROSS CLAIM L 11,000	TO REINSURERS %
1000	9000	10000	11.1
2000	8000	9000	12.5
3000	7000	8000	14.3
4000	6000	7000	16.7
5000	5000	6000	20.0
6000	4000	5000	25.0
7000	3000	4000	33.3
8000	2000	3000	50.0
9000	1000	2000	100.0
10000	NIL	1000	0.0

* Source : C.I.I., 1982.

Although this analysis explains the problem, it neglects the claims in both terminals of the reinsurance cover. In fact the burden of inflation in all non-proportional treaties is distributed between the ceding company and its reinsurer in different percentages or one of them may bear alone the burden. This depends on one or more of the following factors :-

1- The limit of priority for each cover.

2- The maximum limit for each cover.

3- The rate of inflation.

4- The amount of claim for each risk or event.

Define:

A	is the line of claim at the date of occurrence
B	is the line of claim paid
L	is the limits of liability
X_i	is the amount of claim
P	is the priority of the cover
M	is the maximum liability of reinsurers
Y_i	is the share of reinsurers in the claim

FIG 3.10 would indicate that :-

i- The ceding bears all the burden of inflation risk "F" where:

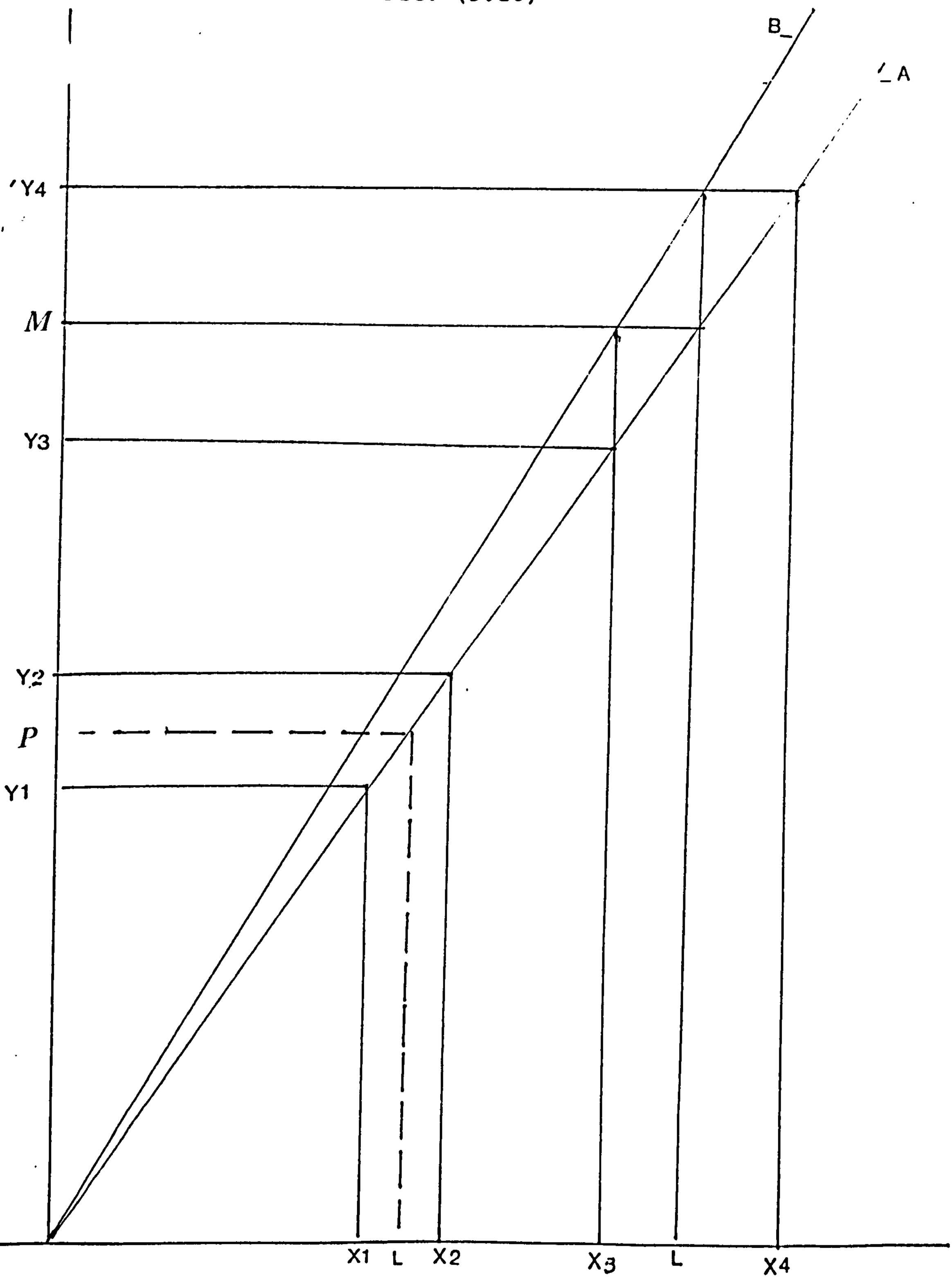
$$L < X_1 \qquad \text{with max.} \qquad F = p - y_1$$

ii- The ceding company and its reinsurers share the burden of inflation risk "F" where :-

$$X_1 < L < X_2$$

Then the ceding company share $F_1 = \dfrac{P - Y_1}{Y_2 - Y_1}$

FIG. (3.10)



and reinsurers share $$F_2 = \frac{Y_2 - P}{Y_2 - Y_1}$$

iii- The reinsurance company bears all of the inflation risk* The reinsurance company bears all the burden of inflation "F"

where $X_3 > L > X_2$ with max. $F = M - Y_3$

iV- The reinsurers on any layer and the ceding company or the reinsurers on the next layer share the burden of inflation risk "F"

where $X_3 < L > X_4$

Then reinsurers share $$F_1 = \frac{M - Y_3}{Y_4 - Y_3}$$

The ceding company share $$F_2 = \frac{Y_4 - M}{Y_4 - Y_3}$$

V- The reinsurer is not affected by the inflation risk "F"

when $L < X_4$

Therefore, it is clear that the burden of inflation risk on non-proportion reinsurance covers may be shared between the ceding company and its reinsurers and not always borne by the reinsurers alone.

---

* This is the case which is dealt in the analysis in Table 4.10

ب- The adminstration costs

Expenses are a considerable part of the premium due in insurance and reinsurance. The premium includes; the risk premium which depends on the average claims experience; and other charges such as commission and administrative costs. This is obvious from the following formula quoted by Benjamin (1977) :-

$$P = R + F_{ce} + K.p + j + I + E$$

i- As K is dependent on the premium, then the value of K.P (for this part of expenses) tends to increase with the sum insured and correspondingly with inflation.

ii- Claims expenses F_{ce} include the cost of investigating and handling of claims. Thus it is independent of premium and depends on salaries which " tend to increase faster than the premium". (Munich Re. Co., 1970). Table 3.12 indicates that the claims cost varies from one branch to another. It costs about 8 % in fire and 7.5 % of premium in general third party and 4.5 % in marine and machinary insurance. The reinsurer bears his share of these costs as well as of any increase as a result of inflation.

iii- The contribution towards fixed costs E is also independent of premiums and depends on salaries, rent, administration costs, and marketing costs ...etc. These costs for the insurer and reinsurer tend to increased by inflation.

TABLE (3.12)

APPROX. OF

THE COST FOR INVESTIGATING AND HANDLING A CLAIM

BRANCH	INVESTIGATION COSTS	HANDLING COSTS	TOTAL CLAIMS COSTS
FIRE / FLOOD	5.9	2.1	8.0
MOTOR TPL	4.2	1.8	6.0
GENERAL TPL	5.0	2.5	7.5
MARINE	2.2	2.3	4.5
MACHINERY	1.3	3.2	4.5
BURGLARY	3.2	2.3	5.5
WATER	-	-	-
PIPES	3.3	2.7	6.0
PLATE GLASS	2.2	3.8	6.0

* 1969 business report in Germany, Munich Re 1973.

3.5.1.3 Government Economic Restrictions

The regulations for insurance are extended to reinsurance business and become varied and complex. The main economic group of restrictions which may expose the reinsurers to risks which are related to :-

1- Monetary ristrictions

These restrictions and their respective rules would affect the reinsurance remittance and make difficulties for the international reinsurance market, especially when it is always changing rapidly in some countries, and this causes a delay in remittance*, more cost for reinsurers and exposes the balance due to the movement of changing rates as well as devaluation of the value of the currency.**

2- Deposits and reserves rules

Deposits and reserves refer to the funds which are retained by the ceding company from its reinsurers for their share in the outstanding losses and unexpired risks due under a certain cover. At first, after the second world war, it was retained as " additional security for due performance of the reinsurer's. The ceding company pay in return a net interest on these funds to reinsurers at a fixed rate which is always less than they would normally have the right to recieve. Therefore the reinsurer has a substantial proportion of his funds deposited with his ceding companies, which may affect the solvency and liquidity required and his revenue from investment.

---

* Some countries involve exchange control of such difficulty that payment can take a year or 18 months to be made. (Craighead, 1979)

** Some countries devalue their national currency in order to face their economic difficulties.

In fact, the revenue of these funds is a considerable factor influencing the profitability of the reinsurance covers. For instance Table 3.13 and FIG 3.12 are representative of the technical results and the revenue from investment of its funds* and would illusterate that :-

1- The fluctuation in revenue was affected by the percentage of premium received and claims paid in each year, ie. the percentage of the invested premium.

2- The invested revenue from 1963 to 1977 exceeded the technical results, even after deducting the taxes due.

3- The average of the technical results during the period 1959 to 1977 was - 2.15 (ie. a loss), while the average of the investment revenue was 10.95 % of premium. It should be 6.57 % if the tax rates were 40 % on interest.

4- For any underwriting year the percentage of premiums exceeds the percentage of claims paid in the first years, which leaves a considerable part of the premium for investment.

5- About 58.81 % of premiums were received by reinsurers instead of the 12.29 % of claims which were paid in the first year of any underwriting year.

---

* In this example the ceding company invested the funds of the the cover for the first four years of each undewriting year.

TABLE (3.13)

TECHNICAL RESULTS AND INVESTEMENT REVINUE FOR REINSURANCE COVER
1959-1977

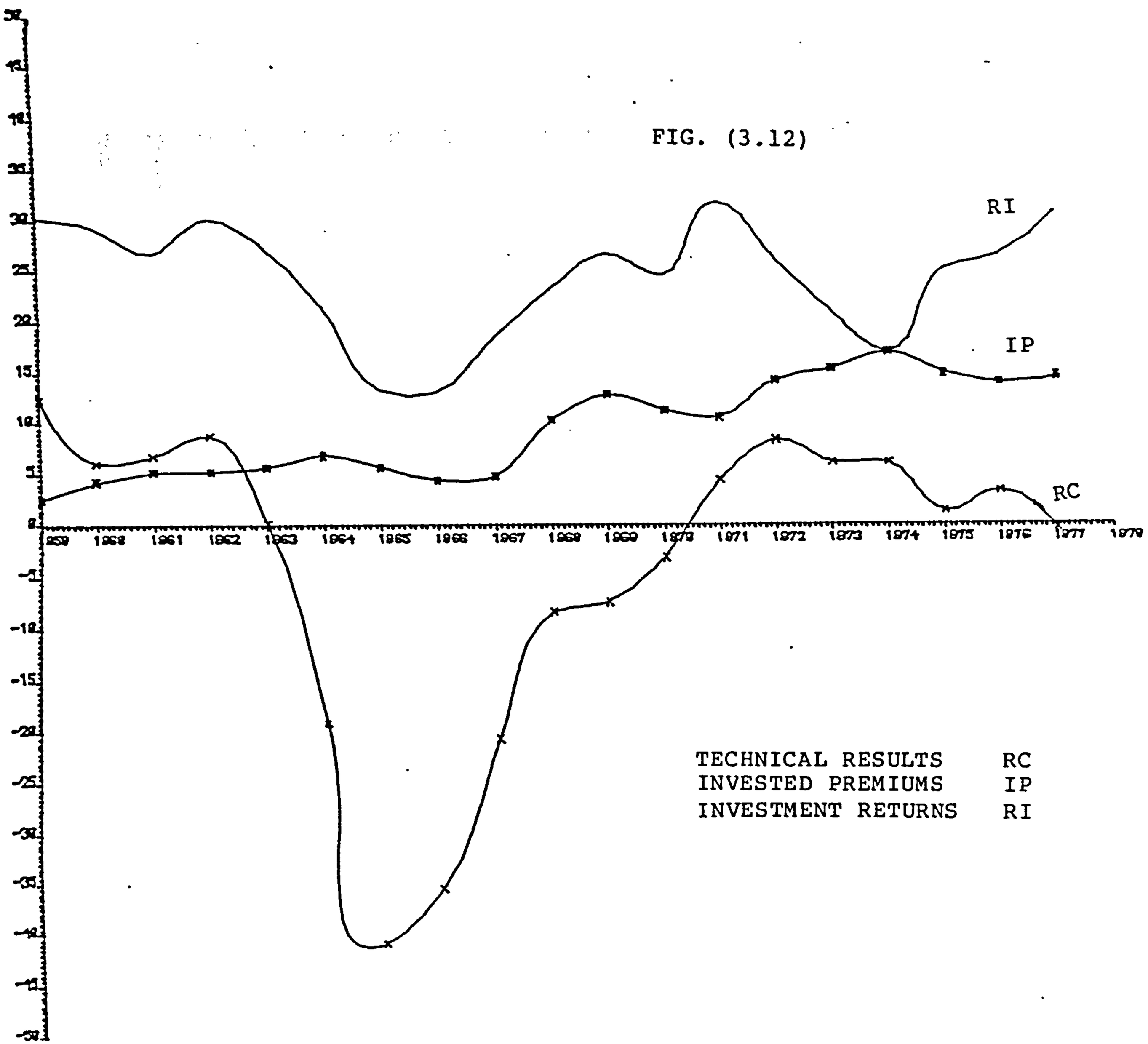
U/YEAR	1ST YEAR PREMIUM %	1ST YEAR CLAIMS %	2ND YEAR PREMIUM %	2ND YEAR CLAIMS %	3RD YEAR PREMIUM %	3RD YEAR CLAIMS %	4TH YEAR PREMIUM %	4TH YEAR CLAIMS %	TECHNICL RESULTS %	INVISTED REVINUE %	PRIMIUM INVISTED %	RATE OF INVIST. %	PRICES CHANGE %
1959	69.31	12.35	25.56	45.13	2.68	26.69	2.45	15.84	12.40	2.58	30.27	2.13	0.60
1960	69.95	9.09	26.74	50.46	2.93	27.40	0.39	13.04	6.08	4.31	29.34	3.67	1.00
1961	64.71	15.09	30.45	42.81	2.87	26.74	1.97	15.36	6.77	5.19	26.77	4.85	2.80
1962	68.28	10.16	25.88	44.73	3.59	29.39	2.25	15.73	8.71	5.25	30.14	4.36	3.90
1963	67.78	14.30	24.96	40.33	5.91	26.45	1.35	18.92	0.21	5.63	27.35	5.15	1.90
1964	62.67	11.01	22.47	37.40	5.69	24.21	9.16	27.38	-19.27	6.87	21.51	7.99	3.30
1965	56.41	12.20	25.94	38.09	8.15	26.19	9.50	23.52	-41.13	5.63	13.29	10.59	4.70
1966	51.07	13.42	31.41	38.53	15.08	32.09	2.45	15.97	-35.72	4.40	13.13	8.37	3.90
1967	50.08	9.42	38.90	43.19	9.86	30.23	1.13	17.15	-20.88	4.77	18.41	6.47	2.60
1968	58.15	15.37	34.03	37.13	9.44	29.83	-1.62	17.67	-8.45	10.26	23.29	11.02	4.70
1969	66.80	9.12	26.16	42.37	4.58	29.68	2.46	18.82	-7.49	12.85	26.71	12.03	5.40
1970	61.79	13.45	32.31	42.33	2.17	25.18	3.74	19.04	-3.12	11.29	24.70	11.43	6.40
1971	66.61	9.40	25.94	39.05	6.15	29.77	1.30	21.78	4.38	10.53	31.78	8.28	9.40
1972	60.18	11.07	23.09	38.93	7.96	26.10	8.77	23.90	8.26	14.27	26.39	13.52	7.10
1973	48.14	11.79	25.49	32.27	11.54	27.44	14.84	28.50	6.11	15.37	21.11	18.20	9.10
1974	47.45	14.60	37.60	46.52	22.68	39.25	-7.73	-0.36	6.04	17.05	17.01	25.07	16.00
1975	49.32	9.88	51.72	47.91	6.08	32.78	-7.13	9.43	1.30	14.87	25.14	14.79	24.30
1976	57.55	15.24	43.33	39.05	3.58	36.08	-4.47	9.62	3.30	13.93	26.60	13.09	16.50
1977	65.33	14.85	43.54	42.77	-4.25	25.11	-4.61	17.28	-0.42	14.56	30.77	11.83	15.80
AVERAGE	58.81	12.29	33.30	41.35	6.79	29.49	1.11	16.86	-2.15	10.95	24.64	11.11	4.62

(*)- THE AVERAGE OF PREMIUM INVISTED FOR EACH YEAR WAS CALCULATED FROM THE FOLLOWING EQUATION:

$$Iy = \left[\sum_{j=1}^{4} (Pjy - Cjy)(4.5-j) \right] . (1+Ry) /4$$

WHERE Pj AND Cj THE PERCENTAGE OF PREMIUM AND CLAIM IN THE YEARj
AND Ry THE TECHNICAL RESULTS FOR YEAR y

FIG. (3.12)



TECHNICAL RESULTS RC
INVESTED PREMIUMS IP
INVESTMENT RETURNS RI

6- The variation in percentage of both premium and claim were tested and found significant, which means that this average is a biased estimation of these percentages.

3.5.2.1 Social Risks

There is no direct relationship between reinsurers and the policy-holders. But most social risks, such as; moral hazard; change in social philosophy; the growing complexity in social life..... etc, would be transferred to the reinsurance covers and influence their underwriting results.

3.5.2.2 Political Risks

Today, corruption and wars which exist in many places in the world, are considered to have a depressing effect on the political systems and on international relationships. This is reflected in increases in the risks to which individuals and societies are exposed as well in financial results. There are many of these risks, which are included in some original insurance contracts, ie, risks such as war; strikes; etc, and also in reinsurance contracts. This is not enough to protect the insurer and reinsurers especially where the rules and regulations are the subject of continuous modification. These make it difficult for the reinsurer to predict the result of these risks in his portfolio. According to the questionnaire data 75 % of reinsurers believe that the political circumstances have a medium effect on their under-

writing decision, while 25.6 % refer to it as a weak factor influencing their decisions.

3.6 Summary

It is difficult for any individual research study to cover a full analysis of all the risks faced by any enterprise which is subject to a wide range and variability of operative factors. The main risks which confront the reinsurer as a commercial enterprise were investigated according to the general principles of risk and risk management theory (which were discussed in the second chapter).

This analysis was limited to the risks which are related directly to the reinsurance methods and was not axtended to the organization risks such as property, investment, non-reinsurance liabilities etc. The risks were classified and analysed within two main groups. The first group includes risks in respect which the factors can be controlled by the insurer or reinsurer or both, such as variation in the risk covered, risks related to the technique, risks arising from the type and conditions of the reinsurance covers. The second group includes risks in respect of which the operative factors are out of the insurer's and reinsurer's control. These involve economic, social and political risks such as inflation, changes in exchange rates, government restrictions and changes in regulations.

The analysis depended upon the opinion of those working in the field as well as on the study and investigation of the methods used and upon survey statistical material in order to determine the main risks and their main factors.

CHAPTER FOUR

REINSURANCE RISK MANAGEMENT

MEANS of CONTROL of RISK FACTORS

4.1 Introduction

Risk management may be defined as the minimize of the adverse effects of risk at minimal cost through its identification measurement and control (Meher, 1971)

The variation of factors affecting the reinsurance business create difficulties in the evaluation and assessment of the potential risks of aggregation within a given overall portfolio. Also the growing complexity of insured risk and the tendency of the direct insurers to replace their proportional covers by non-proportional covers force the reinsurer to study carefully the risks confronting him, not only to find the most suitable and optimal type of reinsurance (retrocession) protection, but also to select the other proper tools in order to reduce the chance of risk occurrence. These tools will be studied in the following sections.

4.2 Methods of Risk Protection and Prevention

It is clear from the analyses of the nature of reinsurance risks in the preceding chapter that many of their causative factors are related

to the technical rules used, contractual obligations and managerial aproaches.

4.2.1 The Technical Decision

These devices mainly involve the rules and procedures for preparing the technical and financial results of covers and business, the accounts of retrocession covers as well as the underwriting and retention policy.

4.2.1.1 Technical Result of Covers

Before the end of each calendar year (or cover period) the reinsurer has the possibility of revising his participation in the light of the result of each cover and to make a decision about renewal of his participation.

This decision is very important, not only for the reinsurer's business, but also for the result of his retrocession covers which are a part of inward business. The analysis of the questionnaire data (part F-1) using BMDP 1M 3M (summarized in Figures 4.1 and 4.2) indicate that :-

1- The reinsurer's renewal decision depends basically on the result of these covers. 78.5 % of reinsurers* consider it as a strong factor influencing their renewal decision, and the rest of them consider it as a medium factor.

2- The difference in assessment of these factor from one branch to another were tested and found non-significant. This means there is no difference in their effects on the renewal decision for all types of business.

3- The technical result factor, alone, explains 11.5 % of the variation of the renewal decision.

4- The factors influencing the reinsurer's renewal decision can be classified into six factors explaining 88 % of the variation leaving only 12 % to random fluctuation.

5- The main clusters are :-

i- The nature of the portfolio covered which include "OL" and "PI" and explain 18.7 % of variance.

ii- Changes in the main terms of the cover which involve "CC" and "CCS" and explain 18.0 % of variance. This refers to the expected effects of these amendments on the result of covers in future.

iii- Settlement of balances due, which explains 15.6 % and involves "SB" and "MR".

iV- "RR" which contains one cluster and explains 12.4 % of variance.

V- "RWC" is considered a separate cluster and explains 11.8 % of variance

STATISTICS FOR EACH VARIABLE

Table (4.1)

VARIABLE	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION	SMALLEST VALUE	SMALLEST STANDARD SCORE	FIRST CASE FOR SMALLEST	LARGEST VALUE	LARGEST STANDARD SCORE	FIRST CASE FOR LARGEST
2 TRC	3.76923	0.42314	0.112261	3.0000	-1.82	22	4.0000	0.55	1
3 PR	2.84615	0.82645	0.290375	1.0000	-2.23	22	4.0000	1.40	1
4 OL	3.35897	0.84549	0.251711	1.0000	-2.79	3	4.0000	0.76	9
5 PI	3.03419	0.81927	0.270019	1.0000	-2.48	3	4.0000	1.18	9
6 SS	3.41880	0.65967	0.192953	2.0000	-2.15	23	4.0000	0.85	1
7 MR	3.16239	0.81956	0.259158	1.0000	-2.64	40	4.0000	1.02	3
8 CC	2.52991	0.74943	0.296215	1.0000	-2.04	3	4.0000	1.96	1
9 CCS	2.47009	0.78315	0.317053	1.0000	-1.88	3	4.0000	1.95	1
10 RWC	3.16239	0.74229	0.234723	2.0000	-1.57	14	4.0000	1.13	1

CASE NUMBERS ABOVE REFER TO DATA MATRIX BEFORE ANY CASES
HAVE BEEN DELETED DUE TO MISSING DATA.
CASES WITH ZERO WEIGHTS ARE NOT INCLUDED.

FIGURE (4.1)

RENEWAL DECISION

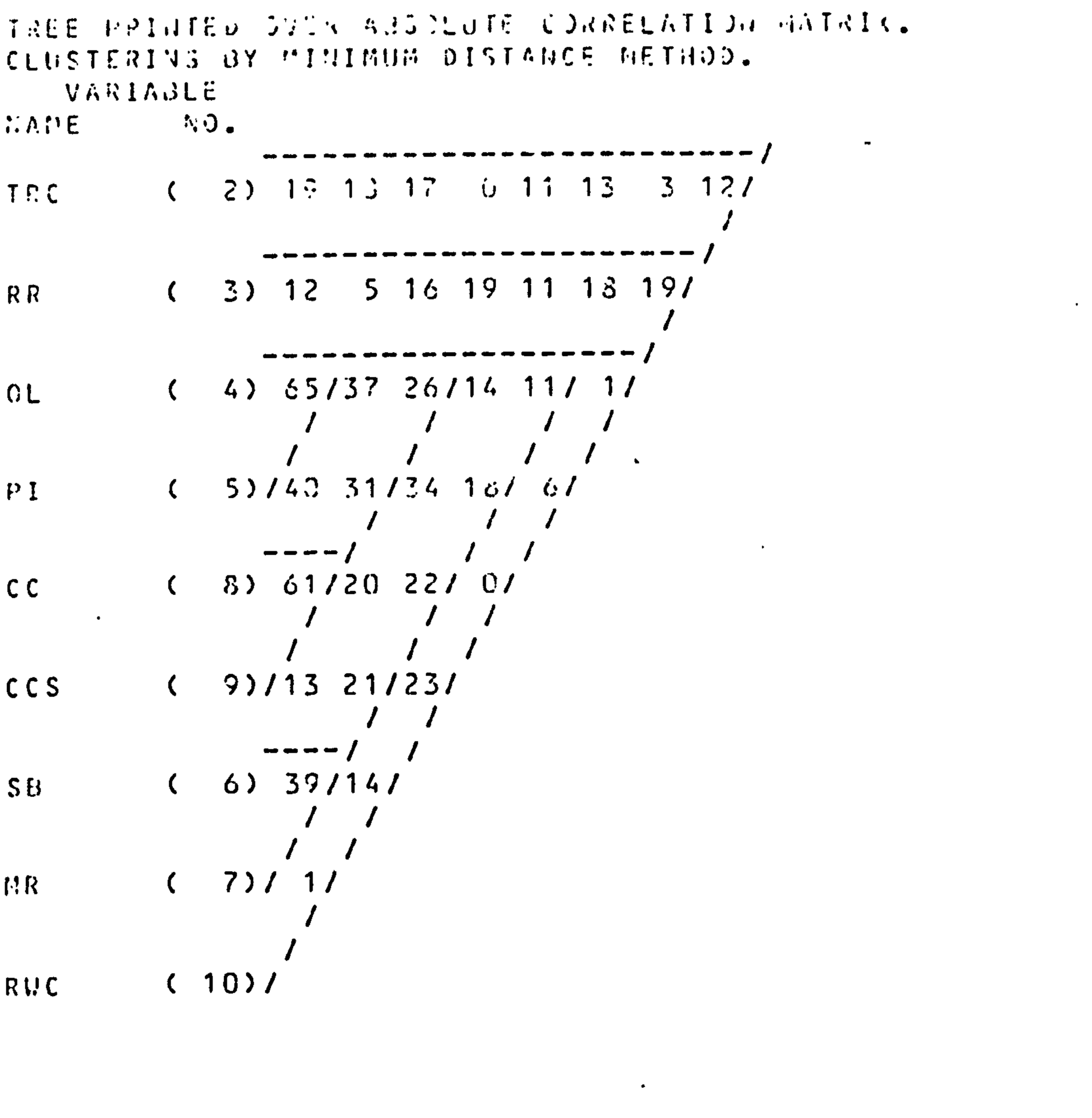


FIG. (4.2)

HISTOGRAM OF "RC" FOR

RENEWAL DECISION

	FIRE	ACCIDENT	MARINE	AVIATION	MOTOR	HULL	FACULT
VAR 3 EXCLUDED VALUES							

TABULATIONS AND COMPUTATIONS WHICH FOLLOW EXCLUDE VALUES LISTED ABOVE

```
MIDPOINTS
   4.600)
   4.400)
   4.200)
   4.000)*******      ****       *******      ****       ***        ****
   3.800)
   3.600)
   3.400)                                                           H
   3.200)
   3.000)************ ********** ************ *********  *****      ***
   2.800)H                                     N
   2.600)             H          H            H
   2.400)
   2.200)
   2.000)*********    *******    ***********  ****       ***        *
   1.800)
   1.600)
   1.400)
   1.200)
   1.000)**           ***        ****         **         **
   0.800)
   0.600)
```

GROUP MEANS ARE DENOTED BY H'S IF THEY COINCIDE WITH *'S, H'S OTHERWISE

	FIRE	ACCIDENT	MARINE	AVIATION	MOTOR	HULL	FACULT
MEAN	2.306	2.654	2.657	2.789	2.692	3.375	0.
STD.DEV.	0.373	0.692	0.938	0.918	1.032	0.744	0.
R.E.S.D.	0.894	0.938	1.007	0.913	1.096	0.837	0.
S. E. M.	0.157	0.175	0.158	0.211	0.286	0.263	0.
MAXIMUM	4.000	4.000	4.000	4.000	4.000	4.000	0.
MINIMUM	1.000	1.000	1.000	1.000	1.000	2.000	0.
SAMPLE SIZE	31	26	35	19	13	8	0

ALL GROUPS COMBINED (EXCEPT CASES WITH UNUSED VALUES FOR BRANCH)

MEAN	2.758
STD.DEV.	0.907
R.E.S.D.	0.941
S. E. M.	0.079
MAXIMUM	4.000
MINIMUM	1.000
SAMPLE SIZE	132

ANALYSIS OF VARIANCE TABLE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F VALUE	TAIL PROBABILITY
BETWEEN GROUPS	3.8313	5	0.7663	0.92	1.4674
WITHIN GROUPS	104.4112	126	0.8287		
TOTAL	108.2424	131			
LEVENE'S TEST FOR EQUAL VARIANCES		5, 126		0.32	0.9016
ONE-WAY ANALYSIS OF VARIANCE TEST STATISTICS FOR WITHIN-GROUP VARIANCES NOT ASSUMED TO BE EQUAL					
WELCH		5, 40		1.19	0.3301
BROWN-FORSYTHE		5, 90		0.94	0.4579

NOTE - ONLY THOSE GROUPS WITH NON-ZERO VARIANCE ARE USED IN THE COMPUTATIONS OF THE LEVENE, WELSH AND BROWN-FORSYTHE TESTS.

In the preceding chapter, the methods used in preparing these results were investigated and it was shown that their results varied with the fluctuation in exchange rate for each currency and with both the volume and the result of each currency. Thus, any renewal decision depending upon these results may not be the optimal decision and may expose the reinsurer to more risks i.e a significant deviation in actual results from those expected.

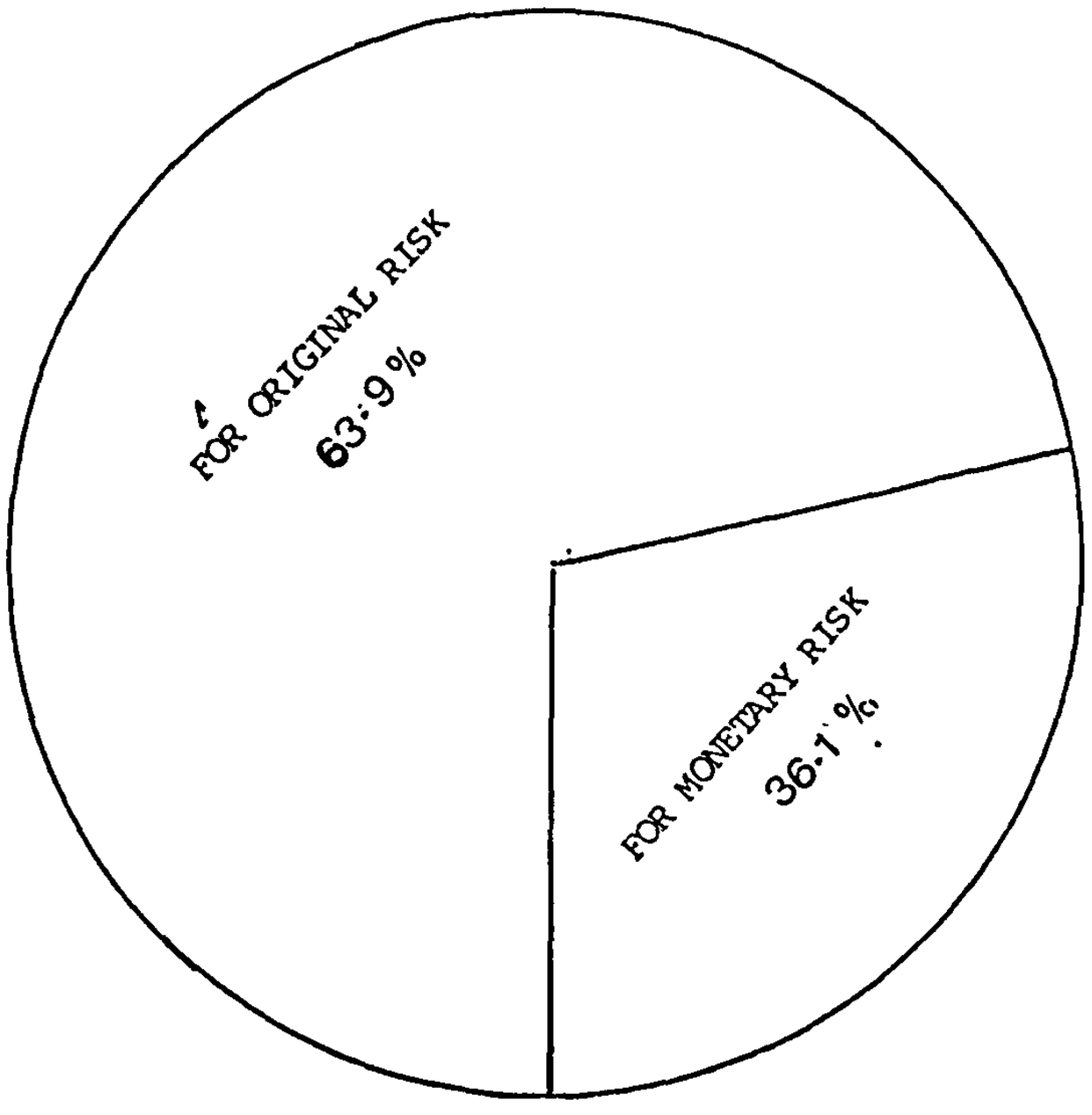
The results, in practice, of the method will be examined as well as the technique for determining the correction factors which may reflect benefits in the light of the actual results, from the reinsurer's point of view.

$$\text{Actual Result} = \frac{\text{Claims and Expenses Paid}}{\text{Net Premium and Interest Received}} \quad \%$$

This means that the exchange rate to be used is the rate used for payments and that which determines the financial and technical results are identical. In fact the reinsurers as commercial enterprises seeking for suitable return of capital are interested, mainly, in the net financial results of their business and consequently with the financial result of each cover.

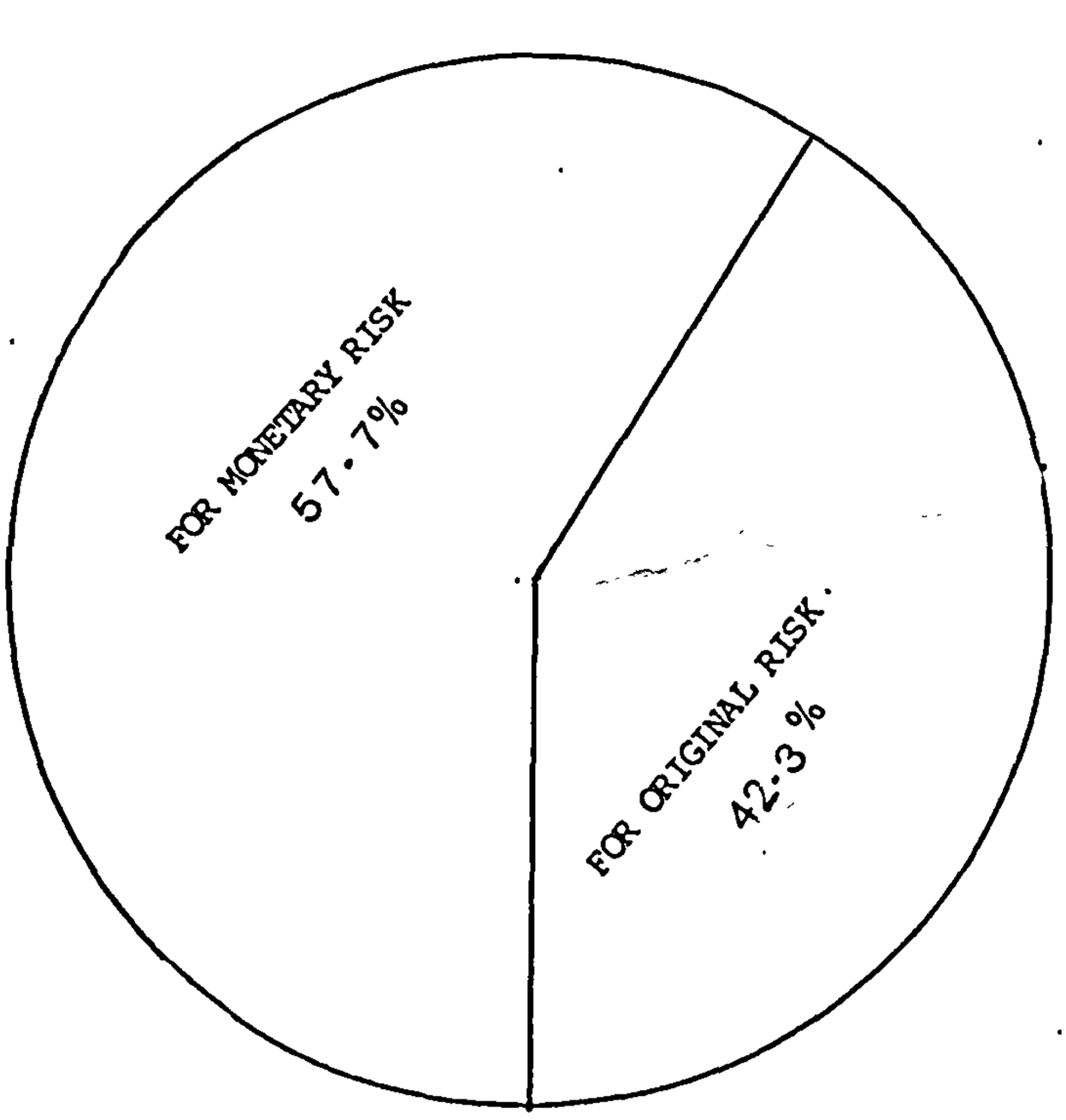
Table 4.2 shows the considerable differences between the balances due in one currency and the actual payments in any other currency which make the financial results very greatly different from the results calculated by any of the methods used.

FIGURE 4.3



BALANCE PAID IN SWF

(1969-1981)



BALANCE PAID IN L.

(1969-1981)

TABLE (4.2)

U\Y	BAIANCE DUE IN LE		EQUIVALENT DUE IN SG.L		EQUIVALENT DUE IN SW.F		RATIO OF MONETARY LOSS TO BAIANCE DUE IN TREATY 1		TREATY 2	
	TR1	TR2	TR1	TR2	TR1	TR2	%LE	%SW.F	%LE	%SW.F
1969	498	28	492	-20	4567	896	-3.1	8.4	-229.7	-69.4
1970	902	164	871	201	7587	753	-0.5			
1971	718	115	807	452	5484	446	-19.8	17.8	-77.1	132.5
1972	234	174	335	188	1216	1225	-31.5	67.2	-9.4	23.5
1973	500	-10	593	-83	2018	-4298	-7.3	105.3	-87.4	-84.1
1974	229	71	349	124	1302	593	-38.6	14.2	-37.8	-22.6
1975	109	-100	233	29	188	-610	-40.6	287.7	-540.1	10.4
1976	16	16	-69	-77	-605	-707	-134.1	-116.1	-131.3	-114.2
1977	21	-262	-17	-426	-468	-2188	-263.3	-132.0	-17.5	-38.8
1978	237	-600	191	-1060	1160	-2449	5.9	-15.9	-28.8	.88
1979	14	270	-18	357	737	1982	-191.6	-92.1	-12.4	44.5
1980	-2675	559	-2842	1255	-11671	3396	1.4	3.9	-52.0	-25.4
1981	33	-390	549	710	-2424	1047	108.0	-94.2	-26.0	72.2
TOTAL	857	-35	376	231	6091	1792	80.5	65.2	-272.3	27.0
BALANCE DUE			679	-294	10061	2276				
DIFFERENCE			303	-525	3970	484	44.6	39.5	178.7	21.3

* Under assumption that the balance due for any account paid by the end of next three monthes.

For example the balance due, under the first treaty, from the ceding company for U/Y 1969-1981 was LE 857,000 while reinsurers received L 376,000 as equivalent ie. a difference of the L 303,000 or 44.6 % of actual balance due. In the second treaty the situation was the opposite and the ceding company paid to reinsurers an amount of L 231,000 while the net balance in the original currency was LE 35,000 due to the ceding company. This means that the reinsurer may receive an inadequate premium or pay more claims resulting from the monetary risks. This type of situation affected the reinsurance business after 1973 as the results of the heavy depreciation in most currencies (see Fig. 3.4).

These effects became particularly clear to U.K. reinsurers in the mid to late 1970s when sterling was weakening against almost all other currencies. (C.I.I, 1982).

85.8 % of the reinsurers (Appendix no: one) feel that the change in the exchange rate must be taken into consideration in preparing the covers' results. It is still difficult for most of them, if not all, to determine the actual results of these covers. At the same time all methods used in the treatment of the difference in results of exchange for balances, reserves and remittances respectively are varied and aim only at achieving an artificial balance in their book accounts.

In practice the determination of the actual result may involve procedures too complicated for manual use. However, because of its

importance and the availability of electronic systems, it becomes more practical. Using a reliable program within a complete system provides the essential means of determining the actual result of the covers, or at least the correction factor for each category of covers, if not for each cover. For this technique formulae 3.4 and 3.7 can be improved for determining the actual result as follows :-

Let I_{it} = The net rate of interest in i^{th} year

$I_{it} = 0$ when $t = 0$

R_{ijt} = The rate of exchange for J^{th} currency and t^{th} month of i^{th} year.

L_{ijt} = The claims in j^{th} currency for i^{th} year which settled at t^{th} month where $t = 0$ when it still unsettled.

P_{ijt} = The premiums for i^{th} year in j^{th} currency which settled at t^{th} month or $t = 0$ when it still unsettled.

T_{ijt} = The net interest on reserves (which includes in a/c's.

Then :-

$$ART = \frac{\sum_{j=1}^{k} [R_{nj}\{L_{Rnj} + \sum_{j=1}^{k}\sum_{i=1}^{n}\sum_{t=0}^{12} (L_{ijt}(1+I_{it})^{n-i+1-t/12}R_{ijt})\}]}{\sum_{j=1}^{k} [R_{nj}\{P_{Rnj} + \sum_{j=1}^{k}\sum_{i=1}^{n}\sum_{t=0}^{12} (P_{ijt}+T_{ijt}-E_{ijt})(1+I_{it})^{n-i+1-t/12}R_{ijt}\}]} \quad \ldots(4.1)$$

Where $t = 1, 2, 3, 4, 5, ..., 12$

$t = 0$ when the account's item still due.

$T_{ij} = 0$ when $t = 0$ i.e $I_{i0} = 0$

$R_{ijt} = 1$ when $t = 0$ i.e $R_{ij0} = 1$

The suggested formula* for the result of reinsurance covers takes into consideration the effects of the following :-

1- The delay in settlement of balances due.

2- Change in exchange rates used in settlement of balances due under the cover.

3- Change in exchange rates used in preparing the result of reinsurance covers.

4- The retained reserves as well as the interest for the cover funds. When these reserves are included in the statement of the accounts, formula 4.1 can be improved to :-

$$ART = \frac{\sum_{j=1}^{k} [R_{nj} \{ \sum_{j=1}^{k} \sum_{i=1}^{n} \sum_{t=0}^{12} (\pm L_{Rijt} L_{ijt}) (1+I_{it})^{n-i+1-t/12} R_{ijt} \}]}{\sum_{j=1}^{k} [R_{nj} \{ \sum_{j=1}^{k} \sum_{i=1}^{n} \sum_{t=0}^{12} (\pm P_{Rijt} + P_{ijt} + T_{ijt} - E_{ijt}) (1+I_{it})^{n-i+1-t/12} R_{ijt} \}]} \quad \ldots (4.2)$$

---

* An alternative technique is suggested in 4.2.1.2 which depends upon isolating the technical result and balances due from all effects of the monetary risks.

In the covers based on a clear cut year system (such as in fire) the notations of the portfolios will be :-

$+ L_{Rijt}$ The "IN" loss portfolio in j^{th} currency.

$- L_{Rijt}$ The "OUT" loss portfolios.

$+ P_{Rijt}$ The "IN" premium portfolio in j^{th} currency.

$- P_{Rijt}$ The "OUT" premium portfolio.

Using this formula, the deviation in results will be examined to decide how long the reinsurer can rely upon the results from these methods in making his decisions and how much are the risks to which he is exposed to if he does so. The main property can be realized by using the ratio of deviation instead of the deviation of the result itself. Table 4.4 and figure 4.3 explain the percentage deviations for one currency and indicate that:*

---

* These deviations (errors) were calculated by using two of the reinsurance covers and eight currencies (Table 3.3), where each U/Y was considered a seperate cover.

TABLE (4.3)

RATIO OF ERRORS IN TECHNICAL RESULTS ACCORDING TO THE USED METHOD

		ORIGINAL CURRENCY S.Fr.										CONVERTED CURRENCY S.£.				
U/Y	C/Y	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	AVERAGE
1969	EQ. 3.4	0.	-7.45	-18.72	-29.07	-39.05	-42.55	-40.98	-39.07	-38.86	-33.27	-29.16	-28.06	-27.15	-26.44	-33.76
	EQ. 3.5	0.	-5.05	-12.17	-20.37	-26.50	-32.45	-29.03	-29.85	-28.75	-25.61	-22.05	-21.01	-20.15	-19.46	-22.50
	EQ. 3.6	0.	-4.79	-10.45	-14.63	-15.78	-15.61	-14.02	-11.19	-9.05	-6.91	-5.37	-4.48	-3.73	-3.16	-9.17
	EQ. 3.7	0.	-4.79	-10.45	-14.63	-15.78	-15.61	-14.02	-11.19	-9.05	-6.91	-5.37	-4.48	-3.73	-3.16	-9.17
1970	EQ. 3.4	0.	0.	-16.03	-33.04	-49.74	-59.76	-70.09	-72.90	-66.82	-51.58	-46.94	-45.69	-43.76	-42.57	-49.91
	EQ. 3.5	0.	0.	-8.33	-22.80	-33.37	-46.76	-51.75	-58.97	-51.77	-40.02	-36.25	-32.88	-32.05	-31.10	-37.17
	EQ. 3.6	0.	0.	-5.53	-14.04	-15.53	-19.39	-21.26	-20.15	-17.56	-13.02	-10.55	-8.75	-7.20	-6.12	-13.26
	EQ. 3.7	0.	0.	-5.53	-14.04	-15.53	-19.39	-21.26	-20.15	-17.56	-13.02	-10.55	-8.75	-7.20	-6.12	-13.26
1971	EQ. 3.4	0.	0.	0.	-21.83	-41.22	-50.78	-61.69	-59.41	-53.89	-44.98	-37.15	-36.94	-35.12	-33.73	-43.34
	EQ. 3.5	0.	0.	0.	-18.17	-33.34	-47.80	-53.34	-57.02	-49.56	-46.02	-39.68	-31.91	-33.08	-32.02	-40.18
	EQ. 3.6	0.	0.	0.	-8.33	-15.96	-19.78	-21.72	-20.77	-16.75	-12.52	-9.70	-7.39	-5.65	-4.41	-13.30
	EQ. 3.7	0.	0.	0.	-8.33	-15.96	-19.78	-21.72	-20.77	-16.75	-12.52	-9.70	-7.39	-5.65	-4.41	-13.30
1972	EQ. 3.4	0.	0.	0.	0.	-28.73	-40.18	-53.42	-55.71	-55.79	-45.31	-38.50	-37.19	-35.22	-33.36	-42.34
	EQ. 3.5	0.	0.	0.	0.	-22.97	-40.21	-48.83	-56.15	-54.64	-47.46	-41.01	-35.33	-35.34	-33.58	-41.55
	EQ. 3.6	0.	0.	0.	0.	-11.35	-17.61	-22.43	-22.76	-20.40	-16.70	-13.25	-10.66	-8.64	-7.08	-15.09
	EQ. 3.7	0.	0.	0.	0.	-11.35	-17.61	-22.43	-22.76	-20.40	-16.70	-13.25	-10.66	-8.64	-7.08	-15.09
1973	EQ. 3.4	0.	0.	0.	0.	0.	-20.52	-37.33	-46.96	-55.56	-50.60	-44.97	-47.22	-36.82	-34.39	-41.60
	EQ. 3.5	0.	0.	0.	0.	0.	-30.69	-40.22	-58.16	-64.69	-66.61	-63.80	-56.27	-47.79	-45.63	-52.65
	EQ. 3.6	0.	0.	0.	0.	0.	-11.18	-14.75	-18.65	-22.35	-20.96	-19.35	-17.51	-11.76	-9.39	-16.21
	EQ. 3.7	0.	0.	0.	0.	0.	-11.18	-14.75	-18.65	-22.35	-20.96	-19.35	-17.51	-11.76	-9.39	-16.21
1974	EQ. 3.4	0.	0.	0.	0.	0.	0.	-29.34	-41.14	-54.68	-55.59	-51.16	-55.32	-51.57	-49.48	-48.54
	EQ. 3.5	0.	0.	0.	0.	0.	0.	-17.68	-39.10	-49.68	-58.16	-56.36	-50.26	-48.88	-47.19	-45.91
	EQ. 3.6	0.	0.	0.	0.	0.	0.	-7.51	-13.83	-19.25	-22.02	-22.41	-21.69	-18.93	-16.98	-17.83
	EQ. 3.7	0.	0.	0.	0.	0.	0.	-7.51	-13.83	-19.25	-22.02	-22.41	-21.69	-18.93	-16.98	-17.33
1975	EQ. 3.4	0.	0.	0.	0.	0.	0.	0.	-14.83	-29.24	-32.04	-29.56	-34.64	-34.75	-33.43	-29.78
	EQ. 3.5	0.	0.	0.	0.	0.	0.	0.	-28.80	-39.11	-52.04	-52.39	-48.36	-50.88	-49.40	-45.86
	EQ. 3.6	0.	0.	0.	0.	0.	0.	0.	-7.00	-13.02	-18.11	-20.08	-20.68	-20.20	-19.03	-16.87
	EQ. 3.7	0.	0.	0.	0.	0.	0.	0.	-7.00	-13.02	-18.11	-20.08	-20.68	-20.20	-19.03	-16.87
1976	EQ. 3.4	0.	0.	0.	0.	0.	0.	0.	0.	-19.58	-19.92	-17.55	-25.35	-26.82	-26.20	-22.57
	EQ. 3.5	0.	0.	0.	0.	0.	0.	0.	0.	-14.86	-27.63	-29.20	-26.65	-32.15	-31.50	-27.00
	EQ. 3.6	0.	0.	0.	0.	0.	0.	0.	0.	-7.44	-11.97	-15.81	-18.21	-18.67	-18.09	-15.03
	EQ. 3.7	0.	0.	0.	0.	0.	0.	0.	0.	-7.44	-11.97	-15.81	-18.21	-18.67	-18.09	-15.03
1977	EQ. 3.4	0.	0.	0.	0.	0.	0.	0.	0.	0.	-0.64	1.78	-6.50	-9.63	-11.13	-5.22
	EQ. 3.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	-15.93	-16.06	-15.36	-22.09	-24.03	-18.71
	EQ. 3.6	0.	0.	0.	0.	0.	0.	0.	0.	0.	-5.04	-6.85	-12.69	-15.12	-16.23	-11.58
	EQ. 3.7	0.	0.	0.	0.	0.	0.	0.	0.	0.	-5.04	-8.85	-12.69	-15.12	-16.23	-11.58
1978	EQ. 3.4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	10.03	-2.12	-6.62	-9.14	-1.96
	EQ. 3.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	3.11	4.82	-3.34	-6.10	-0.37
	EQ. 3.6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-0.98	-4.73	-8.44	-10.57	-6.18
	EQ. 3.7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-0.98	-4.73	-8.44	-10.57	-6.18

FIG. (4.4)

HISTOGRAM OF ERROR IN RESULTS

IN ONE CURRENCY

```
          METHOD1                    METHOOD2                   METHOD3
          ...........................+...........................+...........................+
MIDPOINTS
 240.000)
 230.000)
 220.000)
 210.000)                            *
 200.000)
 190.000)
 180.000)
 170.000)                            *                          *
 160.000)*                                                      *
 150.000)                                                       *
 140.000)*
 130.000)**                          *                          *
 120.000)*                           *****
 110.000)**********                  **************
 100.000)M************************   M************************  ****************
  90.000)***************             **********                 M******************
  80.000)******                      ***                        *************
  70.000)******                      ********                   ******
  60.000)                                                       *******
  50.000)
  40.000)
  30.000)
GROUP MEANS ARE DENOTED BY M'S IF THEY COINCIDE WITH *'S, M'S OTHERWISE

MEAN          97.595                    100.706                    88.992
STD.DEV.      16.299                     21.715                    20.800
R.E.S.D.      14.444                     17.061                    16.697
S. E. M.       2.006                      2.673                     2.560
MAXIMUM      155.340                    206.989                   173.434
MINIMUM       69.201                     66.985                    59.223
SAMPLE SIZE       66                         66                        66

      ALL GROUPS COMBINED          ********************************* ANALYSIS OF VARIANCE TABLE *********************************
(EXCEPT CASES WITH UNUSED VALUES   *
  FOR METHOD  )                    *   SOURCE                SUM OF SQUARES      DF      MEAN SQUARE    F VALUE    TAIL PROBABILITY
                                   *
MEAN              95.764           *   BETWEEN GROUPS          4860.0740          2       2430.0370       6.23          0.0024
STD.DEV.          20.265           *   WITHIN  GROUPS         76038.8381        195        389.9428
R.E.S.D.          16.969           *
S. E. M.           1.440           *   TOTAL                  80898.9121        197
MAXIMUM          206.989           ********************************************************************************************
MINIMUM           59.223           *   LEVENE'S TEST FOR EQUAL VARIANCES      2, 195                        0.37          0.6913
SAMPLE SIZE          198           ********************************************************************************************
                                   *   ONE-WAY ANALYSIS OF VARIANCE
                                   *   TEST STATISTICS FOR WITHIN-GROUP
                                   *   VARIANCES NOT ASSUMED TO BE EQUAL
                                   *      WELCH                   2, 128                        5.58          0.0047
                                   *      BROWN-FORSYTHE          2, 195                        6.23          0.0024

NUMBER OF INTEGER WORDS OF STORAGE USED IN PRECEDING    PROBLEM    1432
CPU TIME USED      3.100 SECONDS
```

1- The errors varied from method to method according to the nature of the accounts and the fluctuation in exchange rate.

2- These errors are affected by the reserves and rate of loading premiums in the first years of each U/Y.

3- The ratio of these errors to actual results were tested and found to vary significantly with the methods used, which mean that the deviation of statistical anticipation and actual result may not be regarded as entirely random.

4- The difference between the result of method four and the actual result can be considered the financial effects of the interest rate.

In reinsurance covers based on more than one original currency, the errors in results will be affected by the fluctuation of each currency as well as the volume of business included in the cover in each case. Table 4.4 and Fig. 4.5 express the errors using SWF and DM as the original currency and L as the converted currency indicating that :-

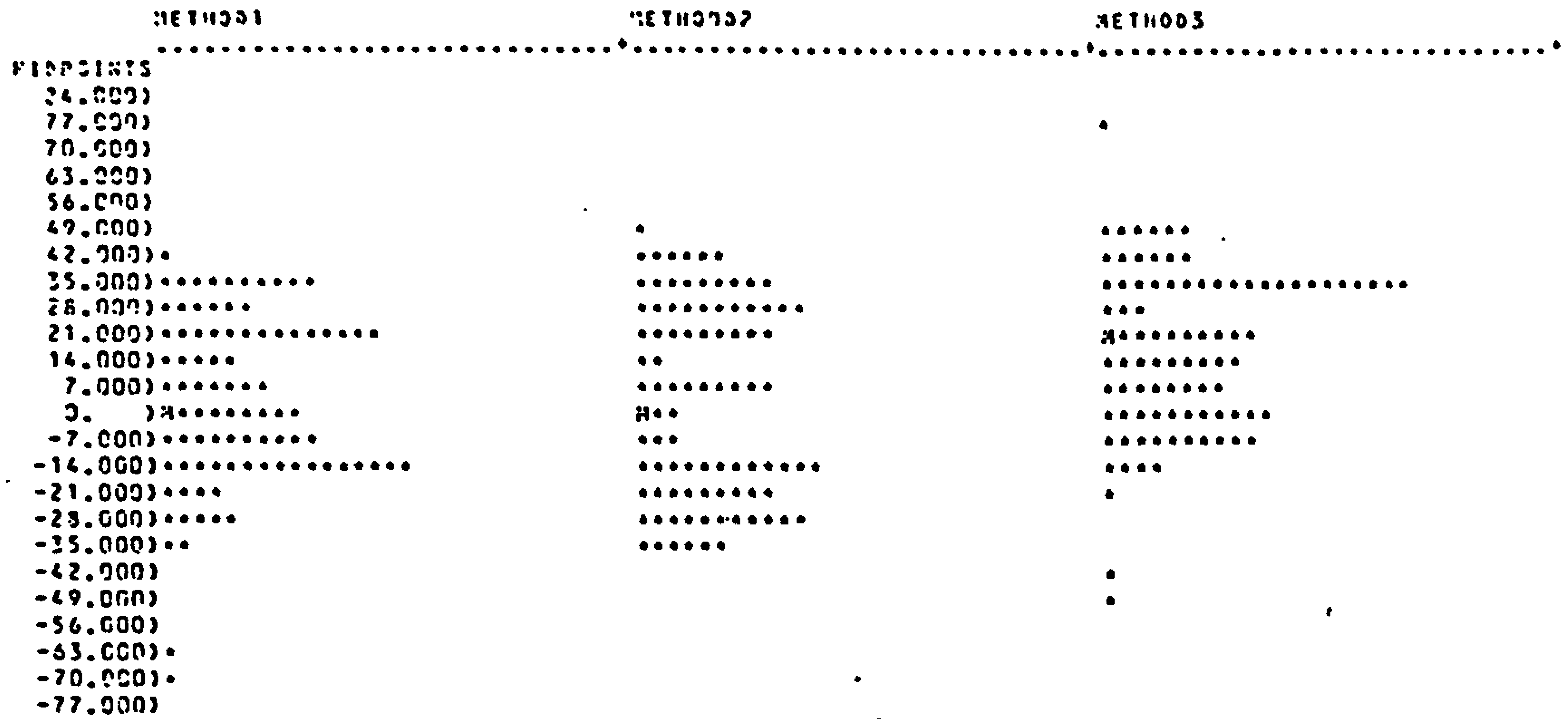
TABLE (4.4)

RATIOS OF ERRORS 'THE TECHNICAL RESULTS ACCORDING TO THE USED METHOD

		ORIGINAL CURRENCY S.Fr.									CONVERTED CURRENCY £.				
U/Y	C/Y	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	AVERAGE
1969	EQ. 3.4	0.	0.40	-7.96	-14.28	-16.31	-19.57	-18.18	-15.28	-13.81	-10.27	-8.76	-8.10	-7.46	-6.89	-11.27
	EQ. 3.5	0.	-3.94	-6.31	-12.34	-16.27	-17.04	-15.76	-16.04	-14.05	-11.60	-9.18	-8.52	-7.88	-7.30	-11.25
	EQ. 3.6	0.	-3.63	-8.20	-11.53	-12.96	-13.34	-11.44	-9.74	-8.48	-6.75	-5.55	-4.91	-4.29	-3.73	-8.04
	EQ. 3.7	0.	-3.63	-8.20	-11.53	-12.96	-13.34	-11.44	-9.74	-8.48	-6.75	-5.55	-4.91	-4.29	-3.73	-8.04
1970	EQ. 3.4	0.	0.	-11.97	-23.34	-28.11	-36.09	-42.04	-40.26	-34.60	-26.24	-24.37	-23.49	-22.43	-21.63	-27.88
	EQ. 3.5	0.	0.	-C.18	-11.15	-16.89	-22.73	-26.90	-30.93	-23.99	-17.00	-14.48	-12.99	-12.16	-11.44	-16.90
	EQ. 3.6	0.	0.	-4.45	-11.24	-14.24	-17.43	-18.84	-18.60	-15.72	-11.30	-9.91	-8.73	-7.53	-6.58	-12.05
	EQ. 3.7	0.	0.	-4.45	-11.24	-14.24	-17.43	-18.84	-18.60	-15.72	-11.30	-9.91	-8.73	-7.53	-6.58	-12.05
1971	EQ. 3.4	0.	0.	0.	-14.75	-20.31	-28.50	-35.41	-30.42	-25.20	-18.44	-15.70	-15.40	-14.88	-14.32	-21.21
	EQ. 3.5	0.	0.	C.	-13.91	-23.15	-27.16	-32.60	-34.54	-27.06	-23.31	-17.59	-14.79	-14.80	-14.39	-22.12
	EQ. 3.6	0.	0.	C.	-6.88	-12.15	-15.38	-17.14	-16.18	-12.99	-10.42	-8.73	-7.05	-5.72	-4.64	-10.66
	EQ. 3.7	0.	0.	0.	-6.88	-12.15	-15.38	-17.14	-16.18	-12.99	-10.42	-8.73	-7.05	-5.72	-4.64	-10.66
1972	EQ. 3.4	0.	0.	0.	0.	-7.35	-17.42	-26.12	-24.79	-23.20	-16.40	-14.11	-13.51	-12.85	-11.87	-16.76
	EQ. 3.5	0.	0.	0.	0.	-12.66	-18.02	-25.55	-30.50	-27.47	-22.26	-18.09	-16.01	-15.66	-14.70	-20.39
	EQ. 3.6	0.	0.	C.	0.	-6.13	-10.98	-15.00	-15.99	-15.11	-11.93	-10.08	-8.64	-7.42	-6.30	-10.76
	EQ. 3.7	0.	0.	0.	0.	-6.13	-10.98	-15.00	-15.99	-15.11	-11.93	-10.08	-8.64	-7.42	-6.30	-10.76
1973	EQ. 3.4	0.	0.	0.	0.	0.	-18.16	-31.57	-32.88	-33.83	-26.84	-25.20	-26.50	-21.98	-21.16	-26.46
	EQ. 3.5	0.	0.	C.	0.	0.	-8.89	-19.40	-31.59	-29.74	-27.78	-22.83	-20.47	-17.20	-16.61	-21.61
	EQ. 3.6	0.	0.	0.	0.	0.	-7.49	-11.38	-15.26	-17.05	-16.08	-16.37	-15.46	-9.62	-7.97	-12.96
	EQ. 3.7	0.	0.	C.	0.	0.	-7.49	-11.38	-15.26	-17.05	-16.08	-16.37	-15.46	-9.62	-7.97	-12.96
1974	EQ. 3.4	0.	0.	0.	0.	0.	0.	-23.22	-23.90	-27.38	-22.70	-21.64	-24.09	-23.05	-22.60	-23.57
	EQ. 3.5	0.	0.	C.	0.	0.	0.	-19.08	-35.78	-36.35	-37.70	-31.57	-29.69	-29.33	-29.04	-31.37
	EQ. 3.6	0.	0.	0.	0.	0.	0.	-7.10	-12.70	-16.79	-18.57	-19.15	-19.03	-16.53	-15.27	-15.64
	EQ. 3.7	0.	0.	0.	0.	0.	0.	-7.10	-12.70	-16.79	-18.57	-19.15	-19.03	-16.53	-15.27	-15.64
1975	EQ. 3.4	0.	0.	0.	0.	0.	0.	0.	1.24	-2.61	3.00	3.10	-0.11	-1.38	-1.16	0.30
	EQ. 3.5	0.	0.	C.	0.	0.	0.	0.	-20.84	-19.34	-21.75	-17.08	-16.53	-18.44	-18.17	-18.88
	EQ. 3.6	0.	0.	0.	0.	0.	0.	0.	-4.94	-9.36	-12.21	-14.25	-15.29	-15.67	-15.41	-12.45
	EQ. 3.7	0.	0.	C.	0.	0.	0.	0.	-4.94	-9.36	-12.21	-14.25	-15.29	-15.67	-15.41	-12.45
1976	EQ. 3.4	0.	0.	0.	0.	0.	0.	0.	0.	-1.28	8.07	7.97	2.74	0.19	-0.15	2.92
	EQ. 3.5	0.	0.	0.	0.	0.	0.	0.	0.	2.86	-0.35	5.29	5.17	1.57	1.24	2.63
	EQ. 3.6	0.	0.	C.	0.	0.	0.	0.	0.	-2.83	-6.76	-10.23	-12.47	-12.90	-13.28	-9.74
	EQ. 3.7	0.	0.	0.	0.	0.	0.	0.	0.	-2.83	-6.76	-10.23	-12.47	-12.90	-13.28	-9.74
1977	EQ. 3.4	0.	0.	0.	0.	0.	0.	0.	0.	0.	19.34	18.35	11.98	8.09	5.17	12.59
	EQ. 3.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.52	8.72	7.65	2.61	-0.46	4.01
	EQ. 3.6	0.	0.	C.	0.	0.	0.	0.	0.	0.	0.14	-3.41	-7.05	-8.51	-11.36	-6.24
	EQ. 3.7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.14	-3.41	-7.05	-8.51	-11.36	-6.24
1978	EQ. 3.4	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	8.92	-2.24	-8.81	-13.23	-3.85
	EQ. 3.5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	20.19	18.07	11.13	7.32	14.18
	EQ. 3.6	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.78	-1.82	-5.66	-8.29	-3.50
	EQ. 3.7	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.78	-1.82	-5.66	-8.29	-3.50

FIG. (4.5)

HISTOGRAM OF ERROR IN RESULTS



GROUP MEANS ARE DENOTED BY M'S IF THEY COINCIDE WITH *'S, N'S OTHERWISE

	METHOD1	METHOD2	METHOD3
MEAN	2.757	3.123	17.606
STD.DEV.	22.335	25.202	22.142
R.E.S.D.	24.044	28.599	23.453
S. E. M.	2.391	2.642	2.321
MAXIMUM	42.503	45.727	76.234
MINIMUM	-70.325	-34.130	-50.464
SAMPLE SIZE	91	91	91

ALL GROUPS COMBINED (EXCEPT CASES WITH UNUSED VALUES FOR METHOD)

MEAN	7.896
STD.DEV.	24.327
R.E.S.D.	26.028
S. E. M.	1.472
MAXIMUM	76.234
MINIMUM	-70.325
SAMPLE SIZE	273

ANALYSIS OF VARIANCE TABLE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F VALUE	TAIL PROBABILITY
BETWEEN GROUPS	12871.2524	2	6435.6262	11.73	0.0000
WITHIN GROUPS	148094.7025	270	548.4989		
TOTAL	160965.9551	272			
LEVENE'S TEST FOR EQUAL VARIANCES		2, 270		3.35	0.0365
ONE-WAY ANALYSIS OF VARIANCE TEST STATISTICS FOR WITHIN-GROUP VARIANCES NOT ASSUMED TO BE EQUAL:					
WELCH		2, 179		12.40	0.0000
BROWN-FORSYTHE		2, 267		11.73	0.0000

NUMBER OF INTEGER WORDS OF STORAGE USED IN PRECEDING PROBLEM 1782
CPU TIME USED 9.311 SECONDS

1- The errors still vary from method to method with maximum deviation in the result of method four and the minimum error for method one*.

2- The change in the result of method three may be due to the change in the exchange rate only when all items are the same in original currency.

3- The errors in net results of each method depend on the fluctuation in the exchange rate of each currency, ie. they are due to the method used.

4- When the result in each currency and its relative items in the accounts differ from the result in other currencies, the errors resulting from the third and fourth methods will be considerably greater.

The relation between these errors and the changes in the exchange rate is affected by many factors such as premiums, claims, charges and reserves in each account as well as the period of account and currencies used. Due to the difficulties in arriving at the actual result, the determination of the fraction for correcting the results from the methods already used is important.

---

* This is when the converted currency is weakening against the original currency.

It is possible to develop a regression equation that takes into account the influence of the rate of interest, fluctuation in the exchange rate, premiums and claim reserves retained, average of period of settlement and a dummy variable for the years (in U/Y covers), by making certain assumptions about the distributions of these variables and the nature of their relationship.

4.2.1.2 Retrocession Covers

Little attention has been paid by the insurance and reinsurance companies as well as theoretically and by researchers to the relationship between premiums and claims in reinsurance and in retrocession accounts and their actual value in the original currency.*

When the currency or currencies of protection covers are different from the original currency, the reinsured applies the rate at transaction date or his own system. The reinsurance accounts take place after a period depending on the period of (reinsurance and retrocession) accounts. In practice the reinsurance contracts, especially for non-proportional covers give attention only to the changes of exchange rate and its effects on the liability limits and other reinsurance contracts leaving the rate applied for accounts and settlement to the

---

* Neave (1973) described the situation when retrocession is not effected in the same currency as one where the reinsurer incurs an exchange risk. This could distort completely the technical result and make a mockery of the reinsurance principle of following the fortune of the original company.

reinsured system. To examine these effects on the result of retrocession covers,

Let T_{Ri} = The technical result in original currency for inward business.

r_i = The rate of exchange in the year.

L_i = Losses and other charges.

P_i = Net premiums and other items

Then

$$TR = \frac{L_1R_1 + L_2R_2 + L_3R_3 + . \ . \ .}{P_1R_1 + P_2R_2 + P_3R_3 + . \ . \ . \ .}$$

Due to the long period between preparing direct insurance accounts and reinsurance or retrocession accounts, the technical result for the reinsurer will be :-

$$TR_R = \frac{L_1R_{12} + L_2R_{22} + L_3R_{33} + . \ . \ . \ .}{P_1R_{12} + P_2R_{22} + P_3R_{33} + . \ . \ . \ .}$$

When $R_{12} = R_1 + C_1$ and $R_{22} = R_2 + C_2$

The difference between the reinsured's and reinsurer's results will be as follows :-

$$TR_R - TR_i = \frac{\sum_{i=1}^{n} L_i R_i}{\sum_{i=1}^{n} P_i R_i} - \frac{\sum_{i=1}^{n} L_i (R_i + C_i)}{\sum_{I=1}^{n} P_i (R_i + C_i)}$$

$$= \frac{\sum_{n=1}^{n} L_i \overset{*}{R_i} \sum_{i=1}^{n} P_i \cdot C_i \cdot - \sum_{i=1}^{n} P_i \cdot R_i \cdot \sum L_i \cdot C_i \cdot}{\sum_{i=1}^{n} P_i \overset{*}{R_i} \left(\sum_{i=1}^{n} P_i \cdot R_i \cdot + \sum_{i=1}^{n} P_i \cdot C_i \cdot \right)}$$

Then the technical result of retrocession covers equals the original result of risk retroceded only when $R_i - C_i = R_i$

ie. when $C_i = 0$

To investigate the effects of these procedures, we examine here, for instance, the result of a retrocession cover arising from inward covers in different currencies to the London market and the balance due in L against the result of the same business after retrocession. Table (4.5) shows that* :-

1- The result in original currencies differs considerably from the result in L (for inward business) as well as from the result in L for the protection cover in the same original currency or after conversion to LE.

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* For simplicity and to have a more accurate result we assume the result for all original currencies are the same. This avoids the deviation in result due to the weights of the results of the actual business in each currency.

TABLE (4.5)

MONETARY RISK AND RETROCESSION COVERS

U/Y	BALANCE DUE								ERRORS IN THE RESULTS	
	A-THE REINSURED				B-THE REINSURER					
	RECEIVED	PAID	DIFFERENCE		ACTUAL	RECEIVED	DIFFERENCE	ACTUAL	A	B
1969	882	883	1	0.2	855	883	-26	3.2	-11.2	-11.3
1970	1633	1689	56	3.4	1553	1689	136	8.7	-16.9	27.9
1971	1494	1538	44	2.5	1170	1537	367	2.9	-22.1	-21.2
1972	567	544	-23	-3.9	417	544	127	30.6	-20.1	-16.8
1973	1161	1277	116	10.0	980	1277	297	30.4	-21.6	-26.5
1974	622	662	39	6.3	457	662	204	44.7	-31.1	-23.6
1975	287	119	-168	-58.4	250	119	-13.1	-52.3	-18.9	0.3
1976	-61	-4	-57	-93.6	43	-4	-47	-109.2	2.6	2.9
1977	-235	-350	-115	49.2	53	-350	-403	-756.1	4.	12.6
1978	159	390	231	145.1	588	391	-198	-33.6	14.2	3.9
1979	213	517	303	142.3	26	517	491	1915.4		
1980	-4309	-4230	-521	12.1	-4244	-4230	-585	12.1		
1981	1096	1036	-60	-5.5	62	1036	974	-5.5		
TOTAL	3509	4071	-40	-1.1	2220	4071	1206	54.3		

* Using the first method.
* Under assumption that blalances due are paid by the end of next three months

_he difference was on average 9.7 % for inward business and 11.9 % for retrocession covers in the original currencies when the retocession covers were in EL.

2- Although the results in original currencies are the same for all currencies, the difference in results in converted currencies were tested and found highly significant which means that they are due to the fluctuation in exchange rate.

3- The balances received by the reinsurer for this business* differed from those paid to the reinsurers for the same business. These differences reached LE 40 000 or 1.1 % of the balance received in L for these years. The total loss due to the monetary risks was L 1206 000 or 54.3 % of the retrocession transaction (net balance).

4- The difference in balances due for inward business from those due for retrocession cover in original currencies or L were found considerably differed. This means there is a strong correlation between the differences in balances, results and the fluctuation in exchange rate. These differences may vary according to :-

---

* We assume here that there is no difference in clauses of inward business and protection (retrocession) covers.

i- The result of business in each currency.

ii- The bulk of business in each currency.

iii- The period of accounts for the inward covers and retrocession cover.

iv- The fluctuation in the rate of exchange in both original currency(s) and currency of retrocession cover.

Therefore, the more interference (overlapping) in the covers and the more retroceded is the reinsurance the more deviation there is in their results from the results of risks covered and the more the deviation of the reinsurer's decision from the optimum decision. Also any attempt to get over this problem and to eliminate the monetary risk has to depend upon the rate of exchange. That may be through giving more attention to these risks which are created by the insurance and reinsurance technique or operation and avoiding, or at least minimizing, their effects whether in fluctuation in losses or through making a wrong decision. This can be achieved through international co-operation in applying a new technique for insurance and reinsurance covers as follows :-

1- Using a fixed exchange rate for each U/Y and for all currencies at the same date.

2- These fixed rates should be used for :-

i- Settlement of all balances due under all business for this U/Y.

ii- Determining the limits of liabilities.

iii- Converting the original currencies in any inward business for the retrocession covers.

3- Isolating and identfying the monetary losses by the reinsured and using the pools or any other form of reinsurance to protect his account against the monetary risks as a separate risk.

This procedure or system may provide the stability required in insurance and reinsurance business as well as in the international markets. It means that the reinsurer will receive the premiums and pay the claims for any risk with the same exchange rate, consequently his business result will not be affected by the monetary risk. Instead the reinsured will bear all the financial consequences of these risks,* but with a capability to determine the actual losses and prepare suitable reinsurance coverage to protect himself and his reinsurers from its severity.

The actual monetary losses can be determined, by the following :-

Define :

ML = The monetary loss

B_{tjy} = The balance due for U/Y y in j^{th} currency for t^{th} account.

---

* Especially when he is asked to convert all balances to his national currency.

F_{Rjy} = The fixed rate of exchange for j^{th} currency and y^{th} U/Y.

$R_{j,dt+1}$ = The exchange rate for j^{th} currency at (dt+1) month from the anticipated date where "d" is the period of account in months.

Then ML can be expressed as:

$$ML_y = \sum_{t=0}^{nt} \sum_{j=1}^{k} B_{tj} \left(F_{Rj} - R_{j,dt+1} \right) \quad \ldots(4.3)$$

Where ML_y for U/Y "y" may be extended for all underwriting years for one cover or for more than one treaty.

Tables 4.5 and 4.6 show the values of ML for two reinsurance covers over the period 1969-1981 according to this method, and indicate that :-

1- The reinsurer will bear only the burden of the original risks whatever the fluctuation in exchange rate. This should provide more reliability in his statistical inference, and technical and financial results of his business.

TABLE NO: (4.6)
DETERMINATION OF THE ACTUAL
LOSS IN RESULTING OF CHANGE IN EXCHANGE RATE

YEAR		t=1	t=2	t=3	t=4	t=5	t=6	t=7	t=8	t=9	t=10	t=11	T=12	T=13	U/Y TOTAL
1969	BL(t) EG.L.	-103300	405334	94766	39552	-593	1578	43024	2753	324	9553	5374	0	0	498365
	BL(t) SG.L.	-98974	389482	85397	38742	-652	1717	54336	4129	434	12011	6218	0	0	492840
	M.L.	0	-1119	5401	-846	83	-205	-13113	-1491	-123	-2857	-1069	0	0	-15339
	M.L./SG.%	0.	-0.287	6.325	-2.184	-12.730	-11.939	-24.133	-36.110	-26.341	-23.787	-17.192	0.	0.	-3.112
1970	BL(t) EG.L.	46400	552697	235250	-72315	7634	27492	-5972	55045	53110	1764	817	1410	0	901922
	BL(t) SG.L.	44585	498059	230433	-79536	8306	34720	-8958	73856	66779	2041	880	1899	0	871165
	M.L.	0	33022	-4383	10049	-970	-8303	3219	-20963	-15746	-345	-94	-544	0	-4514
	M.L./SG.%	0.	6.630	-1.902	-12.635	-11.678	-23.914	-35.934	-28.384	-23.579	-16.903	-10.682	-28.647	0.	-0.518
1971	BL(t) EG.L.	-191600	547447	151586	21970	38416	60063	50831	16981	9313	12574	5478	2636	0	717581
	BL(t) SG.L.	-172659	536239	166724	23906	48517	90103	68202	21351	10776	13548	7380	3216	0	905707
	M.L.	0	-42910	-30123	-4107	-13898	-35977	-22395	-6048	-2383	-2217	-2443	-640	0	-160058
	M.L./SG.%	0.	-8.002	-18.068	-17.180	-23.646	-39.929	-32.836	-28.327	-22.114	-16.364	-33.103	-26.119	0.	-19.841
1972	BL(t) EG.L.	-393600	405584	65783	48334	25749	17049	49681	10035	3964	964	671	0	0	234214
	BL(t) SG.L.	-385542	446088	71581	61043	38627	22875	62468	11611	4271	1298	818	0	0	335138
	M.L.	0	-48807	-7144	-13698	-13405	-6175	-13804	-1781	-388	-353	-160	0	0	-105715
	M.L./SG.%	0.	-10.941	-9.930	-22.440	-34.704	-26.995	-22.098	-15.339	-9.085	-27.196	-19.560	0.	0.	-31.544
1973	BL(t) EG.L.	-466700	740756	7689	-12412	91101	39652	-24547	4881	116570	2935	0	0	0	499925
	BL(t) SG.L.	-513308	806045	9710	-18619	122233	49857	-28404	5259	157060	3581	0	0	0	593414
	M.L.	0	8688	-1253	4967	-22033	-6245	1405	109	-28848	-352	0	0	0	-43562
	M.L./SG.%	0.	1.078	-12.904	-26.677	-13.025	-12.526	-4.946	2.073	-18.368	-9.830	0.	0.	0.	-7.341
1974	BL(t) EG.L.	-269200	333810	33721	29297	24405	7727	7041	58895	3470	0	0	0	0	229166
	BL(t) SG.L.	-292927	421583	50586	39309	30686	8941	7586	79351	4234	0	0	0	0	349349
	M.L.	0	-58351	-13392	-7429	-4129	-532	75	-15265	-458	0	0	0	0	-99981
	M.L./SG.%	0.	-13.841	-27.462	-18.899	-13.456	-5.950	0.989	-19.237	-10.817	0.	0.	0.	0.	-28.619
1975	BL(t) EG.L.	-450300	365412	111215	80146	-9612	7212	4231	806	0	0	0	0	0	109110
	BL(t) SG.L.	-568704	548172	149221	100774	-11122	7770	5700	983	0	0	0	0	0	232794
	M.L.	0	-86676	-3762	446	-1017	1338	-356	34	0	0	0	0	0	-94993
	M.L./SG.%	0.	-15.812	-5.372	0.443	9.144	17.220	-6.246	3.459	0.	0.	0.	0.	0.	-40.806
1976	BL(t) EG.L.	-577800	527751	3077	-26092	11054	77626	-40	0	0	0	0	0	0	15576
	BL(t) SG.L.	-866786	708105	3368	-30192	11910	104589	-48	0	0	0	0	0	0	-55554
	M.L.	0	83600	747	-8949	4672	11861	-12	0	0	0	0	0	0	91919
	M.L./SG.%	0.	11.806	19.312	29.640	39.228	11.341	25.000	0.	0.	0.	0.	0.	0.	-134.083
1977	BL(t) EG.L.	-591500	549216	3228	-7174	60137	7147	0	0	0	0	0	0	0	21054
	BL(t) SG.L.	-793640	690577	3735	-7729	81025	8721	0	0	0	0	0	0	0	-17311
	M.L.	0	46328	596	-1896	-336	868	0	0	0	0	0	0	0	45560
	M.L./SG.%	0.	6.709	15.957	24.531	-0.415	9.953	0.	0.	0.	0.	0.	0.	0.	-263.185
1978	BL(t) EG.L.	-895000	676605	236029	145946	23722	0	0	0	0	0	0	0	0	237302
	BL(t) SG.L.	-1125361	782926	308187	196639	28946	0	0	0	0	0	0	0	0	191337
	M.L.	0	67328	51462	-13128	881	0	0	0	0	0	0	0	0	107043
	M.L./SG.%	0.	8.663	16.698	-6.676	3.044	0.	0.	0.	0.	0.	0.	0.	0.	55.945
1979	BL(t) EG.L.	-1130100	889538	132632	172292	0	0	0	0	0	0	0	0	0	14362
	BL(t) SG.L.	-1365540	958450	178701	210240	0	0	0	0	0	0	0	0	0	-19149
	M.L.	0	70869	-25227	-10374	0	0	0	0	0	0	0	0	0	34768
	M.L./SG.%	0.	7.394	-14.117	-5.172	0.	0.	0.	0.	0.	0.	0.	0.	0.	-191.570
1980	BL(t) EG.L.	-3197300	-267387	789438	0	0	0	0	0	0	0	0	0	0	-2675249
	BL(t) SG.L.	-3444995	-360262	963316	0	0	0	0	0	0	0	0	0	0	-2841941
	M.L.	0	72160	-112720	0	0	0	0	0	0	0	0	0	0	-40560
	M.L./SG.%	0.	-20.030	-11.701	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	1.427
1981	BL(t) EG.L.	-4629100	4661665	0	0	0	0	0	0	0	0	0	0	0	32565
	BL(t) SG.L.	-6236998	5688425	0	0	0	0	0	0	0	0	0	0	0	-548573
	M.L.	0	592449	0	0	0	0	0	0	0	0	0	0	0	592449
	M.L./SG.%	0.	10.415	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-107.998

TABLE NO: (4.7)
DETERMINATION OF THE ACTUAL
LOSS IN RESULTING OF CHANGE IN EXCHANGE RATE

YEAR		t=1	t=2	t=3	t=4	t=5	t=6	t=7	t=8	t=9	t=10	t=11	T=12	T=13	U/Y TOTAL
1969	BL(t) EG.L.	-103300	405334	94766	39557	-593	1573	43024	2753	324	9553	5374	0	0	498365
	BL(t) SW.F.	-1025319	4023166	853286	343303	-4915	10242	288074	17237	1656	39303	21834	0	0	4567367
	M.L.	0	1997	87786	49467	-973	5428	139175	10101	1561	55562	31532	0	0	381636
	M.L./SF.%	0.	0.050	10.288	14.409	19.797	52.997	48.312	58.601	94.263	141.368	144.417	0.	0.	8.356
1970	BL(t) EG.L.	46400	552697	235250	-72315	7634	27492	-5972	55045	53110	1764	817	1410	0	901922
	BL(t) SW.F.	460545	4976562	2041923	-599477	49552	184077	-37392	281358	218505	7167	3703	6518	0	7536523
	M.L.	0	509264	293064	-118289	26219	88796	-21883	264994	308641	10341	4406	7477	0	1355553
	M.L./SF.%	0.	10.233	14.352	19.732	52.912	48.239	58.523	94.184	141.251	144.286	118.985	114.713	0.	15.000
1971	BL(t) EG.L.	-191600	547447	151586	21970	38416	60063	50831	16981	9313	12574	5478	2636	0	717581
	BL(t) SW.F.	-1725193	4751731	1256619	142606	257221	376075	259819	69863	37839	57004	25324	13556	0	5433584
	M.L.	0	177559	108282	55214	88682	164740	197870	83036	46016	56214	24000	10176	0	977613
	M.L./SF.%	0.	3.737	8.617	38.718	34.477	43.805	76.157	118.855	121.610	98.614	94.772	75.081	0.	17.828
1972	BL(t) EG.L.	-393600	405584	65783	48334	25749	17049	49681	10035	3964	964	671	0	0	234214
	BL(t) SW.F.	-3416370	3362215	426995	323629	161223	87144	204398	40772	17970	4456	3450	0	0	1215882
	M.L.	0	158173	143988	95900	62273	60837	226823	46329	16436	3911	2374	0	0	817044
	M.L./SF.%	0.	4.704	33.721	29.633	38.625	69.812	110.971	113.629	91.464	87.769	68.812	0.	0.	67.198
1973	BL(t) EG.L.	-466700	740756	7689	-12412	91101	39652	-24547	4881	116570	2935	0	0	0	499925
	BL(t) SW.F.	-3868855	4808230	51483	-77715	465656	163136	-99735	22128	538902	15094	0	0	0	2018324
	M.L.	0	1332497	12257	-25178	239554	165571	-103755	18334	427441	9236	0	0	0	2125957
	M.L./SF.%	0.	27.713	23.808	32.393	62.182	101.493	104.031	82.854	79.317	61.190	0.	0.	0.	105.333
1974	BL(t) EG.L.	-269200	333810	33721	29297	24405	7727	7041	58895	3470	0	0	0	0	229166
	BL(t) SW.F.	-1747371	2235085	211138	149749	100407	31395	31920	272271	17846	0	0	0	0	1302440
	M.L.	0	-68331	7744	40417	58005	18760	13782	110015	4677	0	0	0	0	185069
	M.L./SF.%	0.	-3.057	3.663	26.990	57.770	59.755	43.177	40.406	26.208	0.	0.	0.	0.	14.209
1975	BL(t) EG.L.	-450300	365412	111215	30146	-9612	7212	4231	806	0	0	0	0	0	109110
	BL(t) SW.F.	-3015065	2287971	568467	329737	-39054	32695	19559	4145	0	0	0	0	0	188455
	M.L.	0	158711	176193	206395	-25304	15594	8770	1251	0	0	0	0	0	542110
	M.L./SF.%	0.	6.937	30.994	62.745	64.792	47.695	44.839	30.181	0.	0.	0.	0.	0.	287.660
1976	BL(t) EG.L.	-577800	527751	3077	-26092	11054	77626	-40	0	0	0	0	0	0	15576
	BL(t) SW.F.	-3617807	2697561	12659	-106013	50113	358864	-205	0	0	0	0	0	0	-604828
	M.L.	0	606872	6607	-57358	19099	127179	-45	0	0	0	0	0	0	702354
	M.L./SF.%	0.	22.497	52.192	54.105	38.112	35.439	21.951	0.	0.	0.	0.	0.	0.	-116.125
1977	BL(t) EG.L.	-591500	549216	3228	-7174	60137	7147	0	0	0	0	0	0	0	21054
	BL(t) SW.F.	-3023410	2259590	13115	-32523	278013	36756	0	0	0	0	0	0	0	-468459
	M.L.	0	547688	3384	-4146	29373	-224	0	0	0	0	0	0	0	576075
	M.L./SF.%	0.	24.238	25.303	12.748	10.565	-0.609	0.	0.	0.	0.	0.	0.	0.	-122.972
1978	BL(t) EG.L.	-895000	676605	236029	145946	23722	0	0	0	0	0	0	0	0	237302
	BL(t) SW.F.	-3682218	2749085	1296713	674707	122001	0	0	0	0	0	0	0	0	1160288
	M.L.	0	34610	-119929	-74254	-24403	0	0	0	0	0	0	0	0	-133976
	M.L./SF.%	0.	1.259	-9.249	-11.005	-20.002	0.	0.	0.	0.	0.	0.	0.	0.	-15.856
1979	BL(t) EG.L.	-1180100	889533	132632	172292	0	0	0	0	0	0	0	0	0	14362
	BL(t) SW.F.	-4794815	4032722	613157	886093	0	0	0	0	0	0	0	0	0	737157
	M.L.	0	-418476	-74265	-186060	0	0	0	0	0	0	0	0	0	-678801
	M.L./SF.%	0.	-10.377	-12.112	-20.998	0.	0.	0.	0.	0.	0.	0.	0.	0.	-92.084
1980	BL(t) EG.L.	-3197300	-267387	789438	0	0	0	0	0	0	0	0	0	0	-2675249
	BL(t) SW.F.	-14494967	-1236123	4060059	0	0	0	0	0	0	0	0	0	0	-11671036
	M.L.	0	23928	-481139	0	0	0	0	0	0	0	0	0	0	-457211
	M.L./SF.%	0.	-1.936	-11.851	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	5.917
1981	BL(t) EG.L.	-4629100	4661665	0	0	0	0	0	0	0	0	0	0	0	32565
	BL(t) SW.F.	-21400	30523974825	0	0	0	0	0	0	0	0	0	0	0	2574520
	M.L.	0	-2423972	0	0	0	0	0	0	0	0	0	0	0	-2423972
	M.L./SF.%	0.	-10.110	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	-94.152

2- The losses of monetary risks are affected by the changes in exchange rate and the net balance due. These losses were 42.0 % of balances due in converted currency for first treaty and 78.7 % for the second treaty in the same period (1969-1981).

3- The monetary loss for one part of the reinsurance contract does not imply a profit of the same value to the other party and vice versa.

4- The value of ML is affected by the balance due for each account and the deductible items (commission and reserves etc.) in these accounts.

5- In a clean cut year system, "ML" equals the difference in result caused by using a rate of exchange for the withdrawal portfolio at the end of any year and the fixed rate for next year in the entry portfolio.

6- The actual amount of "ML" may be reduced when more than one currency is used in settlement of balances due. This may be due to the difference in exchange rate fluctuation from one currency to another (Table 3.6).

7- This will help the insurers and reinsurers to avoid using any artificial item for exchange rate differences in their books, they can achieve an actual balance using the value of ML or the cost of the protection cover.

8- When R_{ij} is constant for each U/Y the result of all methods (formulea 3.4 - 3.6) will be identical. This means the reinsurer's decisions become more rational.

9- The limits of the liability under the cover will not deviate from those accepted by the reinsurer and which he has arranged to bear.

10- The balances received from inward business will be in equilibrium with their relative balances paid to the reinsurer under retrocession covers whatever the overlapping in the business covered.

11- The rate of insurance premium, in the long term, will be amended to cover the monetary risks of the national currency (or the original currencies).

12- The more currencies that are used in the covers or in settlement balances the less the severity of monetary risks.

4.2.1.3 Underwriting Policy

Underwriting is a systematic technique of evaluating the risks which are offered, selected, classified and rated. Underwriting policy refers to the regulations, rules and instructions which provid the framework within which the underwriter makes decisions, such as risks to be accepted, limits of underwriting for retention and for retrocession covers, and the technique to be used in evaluating risk. The optimal underwriting policy is absolutely essential for making rational decisions and selecting profitable operations through eliminating the risks which are related to :-

1- The ceding company's underwriting policy.

2- The fluctuation in the result of the original risks covered.

3- Economic, social and political environment.

4- Accumulation of liabilities.

The accuracy both of analyzing the factors affecting the results and the process of accepting or rejecting any reinsurance cover and consequently the underwriting decision, mainly, depends upon:-

1- The volume and precision of the data and information available.

2- The technical ability and the personal characteristics of the underwriters. All underwriters consider this the basis of the underwriting decision.

3- The facilities available and the technique used in this analysis.

The reinsurer may face difficulties in reaching the optimal underwritng policy as a result of the limited data which may be introduced to him about the individual risk* in any particular reinsurance cover, especially for the medium and small sum insured. The information within any reinsurance offer may be insufficient on its own to make a rational decision, and then the reinsured has to rely in his analyses on other sources of information. The main sources according to the response to the qestionnaire are as follows :-

i-	The underwriter's own experience	94.9 %
ii-	Data and information in the offers	89.5 %
iii-	The company's file data	83.7 %
iv-	The company's reports and researches	74.0 %
v-	Other companies' reports	52.8 %
vi-	Conferences and discussions	70.9 %

The data and information within the reinsurance offer can be classified into :-

1- Information about risks covered which involve the original risks covered, nature of business covered, territorial scope, limits of liabilities and the ceding company's retention or priority.

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* The data available to the underwriter in direct insurance involve data and information introduced by the insured or reports and inspections, past experience of the risk, the policy and the business covered.

2- Information about the financial terms of the cover which includes the premium rate (for surplus and non-proportional covers), rate of commission, profit commission and other charges, reserves and portfolio system, period of accounts, and settlement of balances and currency or currencies for accounts and payments.

3- The past experience of the cover in detail over the last few years.

4- General information, such as, the ceding if the offer is through a broker, the period of cover and the commencement date, the share offered and any special clauses or changes in portfolio.

In facultative covers the offer or slip always gives more information about the individual risk covered with regard to the insured, the sum of insured , "MPL", original company, rate of premium . . . etc.*

In the case of a reinsurance treaty of any kind, the picture is far more complicated, as the underwriter has only an estimate of what he may have accepted, it depends on what the reinsured will write within the period considered (Craighead, 1979). 73.6 % of the underwriters consider the result of cover under investigation not enough for making the underwriting decision. At the same time the appropriation of this information for making a rational decision depends on the nature of the factors influencing the underwriting decision.

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* The reinsurer becomes in the same position as the insurer in direct insurance.

4.2.1.4 Underwriting factors

Carter (1979), Gerathewohl (1980), Holton (1973) have discussed the essential information and the factors affecting the reinsurance underwriting decision. Owing to the variability of these factors and their effects in assessing the risks, they will be evaluated here using the survey data which reflect the underwriters' opinions.

The use of factor analysis and the clustering technique and one way analysis of variance for the first and second part of the questionnaire data gives the results* which are summarized in table (4.11) and figures (4.6, 4.7). These results are very important for detecting, evaluating the main factors and determining their effects for planning the underwriting policy and for making a successful underwriting decision. They indicate that there are thirteen main factors which are discussed in detail in the following :-

1- The relationship with the ceding company.

This factor involves "RWC" and "PRS" and explain 9.2 % of the variation of the reinsurer's underwriting decision. This reflects the delegation of the technical aspects to the middle level of management of these companies. This may be due to the strong competition in the international market and the limited covers offered.

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* Using BMDP 1M, 3M and 7D.

This relation can be quantified by taking into account :-

i- The period of the relationship.

ii- The number of covers ceded and participated.

iii- Net profit for the last five years.

iv- The future of this relationship ie. number of covers in force and the bulk of business included.

2- Political and economic situation

This is a difficult factor to assess because it is subject to rapid changes and sometimes its severity is unpredictable. Some recent studies have reached the conclusion that there is a strong relationship between the underwriting result and the economic cycle.

In the opinion of the underwriters this factor explains 8.3 % of the variation of their underwriting decision. The underwriter needs an evaluation of many economic sectors and of their effects on insurance and reinsurance business as well as on the risks covered. These involve study of the following :-

i- The inflation rate.

ii- Investment and interest rate.

iii- The balance of payments of the country and the monetary restrictions.

iv- The stability of economic and political systems.

3- Past experience

Past experience, in the absence of any disturbing influence (which is rarely likely) will reflect the actual experience of the following

i- Risks covered.

ii- Territory scope.

iii- The ceding company's underwriting policy.

Unfortunately, many other factors influence past experience and make it unreliable for statistical inference. Schwartz (1983) explains that the loss ratio will considerably differ according to the principles used.*

and $\text{Var } C_p > \text{Var } C_n > \text{Var } C_s$

Where C_p = The standard calendar year loss ratio by policy year.

C_s = The standard calendar year loss ratio.

C_n = The calendar year loss ratio by policy year.

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* $$C_s = \sum_{i=j}^{-\infty} A_s \left(L_{i,1-i} - L_{i,-i} \right) / P_s$$

$$C_p = \sum_{i=0}^{-\infty} A_i \left(L_{i,1-i} - L_{i,-i} \right) / P_i$$

$$C_n = \sum_{-8}^{-7} A_i \left(L_{i,1-i} - L_{i,-i} \right) / P_i + \sum_{i=-8}^{-\infty} A_{-8} / P_{-8} \left(L_{i,1-i} - L_{i,-1} \right)$$

where A_s, A_i are correction factors, and P, L the premiums and claims respectively.

Although, this factor accounts for 7.9 % of the underwriting decision variation, 84.1 % of the underwriters give more attention to the trend of the data introduced from past experience. There was no significant difference between all types of the reinsurance business. This means that the average loss ratio used by the reinsurers is a biased estimation of the trend of the results.

$$ALR = \frac{\sum_{j=1}^{k} \sum_{y=1}^{Y} C_{njy}}{\sum_{j=1}^{k} \sum_{y=1}^{Y} P_{njy}} \qquad (4.4)$$

For currency j, and underwriting year y. Where C_{njy} and P_{njy} are the claims and premiums for U/Y y and the development year n for currency j.

It is obvious that for the U/Y covers the final result at the end of any of the following few years will differ from the results at the offered date. This is mainly due to the errors in estimating the outstanding losses, I.B.N.R and the inflation rate. Thus the estimation of loss ratio should take into account all the elements of the run-off triangle of the net loss ratio and not rely only on the diagonal elements (4.4). The technique of the chain ladder method explained by Beard (1975), Clark (1974), Taylor (1975) and Benjamin (1977) can be used to estimate the loss ratio for the development years.

Table (4.8)

U/Y	At end of the development year					
	1	2	3	4	5	J
1	R_{11}	R_{12}	R_{13}	R_{14}	R_{15}	$R_{1,J}$
2	R_{21}	R_{22}	R_{23}	R_{24}	R_{25}	$R_{2,J}$
3	R_{31}	R_{32}	R_{33}	R_{34}	R_{35}	$R_{3,J}$
4	R_{41}	R_{42}	R_{43}	R_{44}	R_{45}	$R_{4,J}$
5	R_{51}	R_{52}	R_{53}	R_{54}	R_{55}	$R_{5,J}$

This means that the changes in the average loss ratio from one year to the next year is the basis of filling the empty cells of the lower triangle of table (4.8). Then:

$$R_{I-j+1,j+1} = \frac{\prod_{j=1}^{k-1} R_{j,j+1}}{\prod_{j=1}^{k-1} R_{i,j}} \cdot R_{I-j+1,j}^{I-j} \qquad \text{(E4.5)}$$

$R_{I-j+1,j}$ = The diagonal elements.

$R_{I-j+1,J+1}$ = The empty cells.

Starting with the diagonal next to the run-off triangle, its value is used in estimating the next diagonal cells . . .etc. As an example numerical figures are quoted from Benjamin (1977) with an assumption that the payments were equal to the claims and the outstanding losses. Using formula (4.5), we obtain results in table (4.9).

TABLE (4.9)

U/Y	Ratio of losses to develpment years				
	1	2	3	4	5
70	32.71	60.87	74.40	81.93	94.55
71	28.24	56.76	67.74	76.82	88.65
72	26.17	50.34	61.66	68.91	79.52
73	31.85	64.50	78.27	87.47	100.94
74	23.46	45.83	55.6	62.15	71.72

The average ratio at the end of 1974 from formula (4.4) is 58.82 % while the estimation loss ratio from table (4.9) will be :-

$$\sqrt[k]{\prod_{i=1}^{k} R_{ik}} = 86.44\ \%$$

Where k=4 at the end of fourth development year.

The expected loss ratio for the risks which have a long tail liability at the development year "J" may depend upon the past experience of the same category of risks covered for a longer period of years. Then:

$$RG_{i,J} = \left(\prod_{h=1}^{j-1} M_h \right) R_{J-i+1,J}$$

$$M_h = \sum_{i=1}^{J-j} R_{i,h+1} \Big/ \sum_{i=1}^{j-1} R_{i,h}$$

where and $RG_{i,J}$ is the loss ratio of the category of risks at the end of development year J. and

$$R_{i,J} = \frac{R_{i,k}}{RG_{i,k}} \cdot RG_{i,J}$$

as $R_{i,k}$ for the cover under investigation and $RG_{i,k}$ for the general experience of category calculated from formula (4.5) for the U/Y considered, Table (4.10).

TABLE (4.5)

PASTE EXPERIENCE FOR A CATEGORY X OF RISKS

U/Y	DELOPMENT YEAR 1	2	3	4	5	6	7	8	9	J
i-5	$RG_{i-5,1}$	$RG_{i-5,2}$	$RG_{i-5,3}$	$RG_{i-5,4}$	$RG_{i-5,5}$	$RG_{i-5,6}$	$RG_{i-5,7}$	$RG_{i-5,8}$	RG_{i-9}	$RG_{i-5,J}$
i-4	$RG_{i-4,1}$	$RG_{i-4,2}$	$RG_{i-4,3}$	$RG_{i-4,4}$	$RG_{i-4,5}$	$RG_{i-4,6}$	$RG_{i-4,7}$	$RG_{i-4,8}$	$RG_{i-4,9}$	$RG_{i-4,J}$
i-3	$RG_{i-3,1}$	$RG_{i-3,2}$	$RG_{i-3,3}$	$RG_{i-3,4}$	$RG_{i-3,5}$	$RG_{i-3,6}$	$RG_{i-3,7}$	$RG_{i-3,8}$		$RG_{i-3,J}$
i-2	$RG_{i-2,1}$	$RG_{i-2,2}$	$RG_{i-2,3}$	$RG_{i-2,4}$	$RG_{i-2,5}$	$RG_{i-2,6}$	$RG_{i-2,7}$			$RG_{i-2,J}$
i-1	$RG_{i-1,1}$	$RG_{i-1,2}$	$RG_{i-1,3}$	$RG_{i-1,4}$	$RG_{i-1,5}$	$RRG_{i-1,6}$				$RG_{i-1,J}$
i	$RG_{i,1}$	$RG_{i,2}$	$RG_{i,3}$	$RG_{i,4}$	$RG_{i,5}$					$RG_{i,J}$
i+1	$RG_{i+1,1}$	$RG_{i+1,2}$	$RG_{i+1,3}$	$RG_{i+1,4}$						$RG_{i+1,J}$
i+2	$RG_{i+2,1}$	$RG_{i+2,2}$	$RG_{i+2,3}$							$RG_{i+2,J}$
i+3	$RG_{i+3,1}$	$RG_{i+2,2}$								$RG_{i+2,J}$
i+4	$RG_{i+4,1}$									$RG_{i+4,J}$

THE RESULTS OF THE OFFERED COVER

i+1	$R_{+1,1}$	$R_{i+1,2}$	$R_{i+1,3}$	$R_{i+1,4}$
i+2	$R_{i+2,1}$	$R_{i+2,2}$	$R_{i+2,3}$	
i+3	$R_{i+3,1}$	$R_{i+3,2}$		
i+4	$R_{i+4,1}$			

4- Risk premium.

The bargains for establishing the premium rate and other reinsurance conditions are limited by the leader on the cover and other reinsurers follow him in regard to the main clauses at least. A number of quantitative tools or techniques, for fixing the premium rate, have been developed especially for non-proportional covers. This factor involves "PR" and "COC" and explains 7.2 % of decision variation, where commission and other charges should be related to the type of cover, type of risk and the profitability of cover.

5- Limits of liabilities and retrocession covers.

The underwriting decission is limited by the capacity of the company ie. its retention and retrocession cover limits. Then "LLC" and "LRC" join in one cluster and explain together 7.6 % of the variation of underwriting decision. This means that the market conditions, reinsurance facilities, underwriting capacity and retention are closely linked and they all have to be investigated before an underwriting policy can be developed.

6- The ceding company's underwriting policy.

As mentioned in 3.4 the underwriting result (for original risk) depends on the ceding company's underwriting policy which affects the reinsurer's underwriting decision and explains 6.7 % of its variation.

7- Territory of the cover.

This factor explains 6.6 % and reflects the importance of the nature of the reinsurance business, accumulation, the variation in policies and their conditions as well as the natural catastrophe. These should be considered by the reinsurer when making his underwriting decision in order to reduce the fluctuation in his portfolio.

8- Type of reinsurance cover.

The type of the cover determines, usually, the relationship between the result of the cover and the result of the ceding company's account and his interest or retention from the same business. Therefore it affects the rating and the charges of the cover. This factor explains 6.6 % of the variation of underwriting decision.

9- The competition in reinsurance market.

Competition as a factor imposes a constraint on the underwriting decision and explains 6.4 % of its variation.

10- The ceding company's retention.

The absolute net retention of the original insurer should be clear to the underwriter and should be taken into account in determining the decision and the other conditions of the cover especially the premium rate. This factor explains about 6.3 % of the decisions variation.

11- Financial position of the ceding company.

This factor involves "R" and "FPC" and explains 6.3 % of the variation. This means that there exists reciprocity with any company and may protect the reinsurer and provide confidence in this relationship and operation. The financial strength can be quantitative through evaluating the balance sheets, profit and loss accounts, assets, liabilities, reserevs, investments, the bulk of business in each class and its results.

12- Type of risk covered.

In practice the portfolio includes various type of risks, but these are linked in one way or another. The nature of risks and the factors which influence their occurrence and their movement will affect the future result, especially if they are subject to rapid change. Therefore the past may not provide a sure basis for prediction to the future. This difficulty explains 6.1 % of the variation of the reinsurer's underwriting decision.

13- Risks included in the cover.

This factor explains 5.6 % of the underwriting decision variation (for its effects on underwring results see 3.4/).

All factors affecting underwriting decision taken together explain 90 % of the decision variation which means that 10 % are due to random

elements of variance. One can hardly find a single factor that can be expected to remain unchanged throughout a period of about five years (Gerathewohl, 1980). But the fact is that these factors will still influence the reinsurance underwriting decision even if with different weight.

4.2.1.5 Mathematical models

As the result of the introduction of computerbased information systems, many researchers have turned to the study of the mathematical tools which might significantly help the reinsurer in his attempt to approach optimization in his underwriting decision. Craighead (1979) explained the nature of this decision as the underwriter is dealing with an amalgam of "soft data", the measure of the moral risk involved (in its widest sense) and "hard data", that is statistical data almost always incomplete and almost never completely applicable to the risk involved (although it may purport to do so). For these, the contribution of the factors we have been studying ealier may be used. 52.5 % of underwtiters* consider their decision-making to be too complicated to be parallelled by computer modelling. They argue that there is no substitute for intelligence and common sense. Some 47.5 % of reinsurers partly (but not fully) computerize their underwriting decision while at least 32.6 % are using some mathematical models to assist them.

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* Or at least 51.1 % with 95 % confidence.

4.2.2 Contractual devices

4.2.2.1 - The nature of reinsurance contracts

The reinsurance contract rests on mutual confidence between two parties. Each should consider the other's financial strength, capacity and willingness to deal openly, fairly and promptly (Advanced Group, No:148, 1975). Also in addition to these legal principles, which are applicable to all reinsurance contracts as a contract uber-rima fides, there are many special clauses* which aim directly to protect the reinsurer from the risks which are related to the ceding company's underwriting policy, errors in operating the covers, changes in the nature of the risks covered and the increase of liabilities by authorities. The most important of these clauses will be studied here as tools for preventing some of the risks faced by the reinsurer and in order to assess their effects.

4.2.2.2 Special clauses

1- Right of inspection clause

This clause gives the reinsurer rights to inspect the reinsured's records, books, accounts, and any document relating to the business covered under the reinsurance protection. (Appendix no: 2). However this clause is rarely used in practice mainly because :-

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* Whatever the different of basic wording in use.

i- It implies doubt as to the ceding company's business operation and consequently could affect the reinsurer's relationship with the ceding company, a very important factor in reinsurance business. Then it will be valuable for all reinsurers if the leader on the cover becomes obliged to provide the other reinsurers with a technical report about his regular revision to the reinsured documents and policy.

ii- The ceding company may not have enough detail about the individual risks included in the retrocession covers.

iii- The nature of some covers such as "TONNERS"* where claims due to the ceding company have no apparent relation to its share of the original claims.

2- Underwriting policy clause

Under this clause (Appendix no: 2), the reinsured shall inform his reinsurers of any significant changes in the nature of the risks covered, the level of rate or in his reinsurance programme. In non-proportional covers the reinsured has to have prior approval from his reinsurers for any changes in his underwriting policy or liability.

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* This cover depends upon the possibility that the ceding company will be involved under many treaties for the same part of almost every major disaster in the world (see C.I.I, 1983).

This clause is very important for protecting the reinsurer from the effects of changes in the factors which influence the result of covers.

3- Other clauses

In order to help the reinsurer in his assessment of the risks in his portfolio some clauses determine the minimum data and information that the ceding company is obliged to send to the reinsurer, such as claims advices, loss bordreaux, main risks under the cover . . etc. Other clauses determine the limits and definitions of the main terms (Appendix no: 2).

4.3 Managerial devices

Insurance and reinsurance company management is significantly different from the management tasks of the other industries. Reinsurance business is more complex and subject to many variations as a result of the complexity of modern life. Then the success of the reinsurer in achieving stability in his business results depends, to a large degree, on the efficiency of the management which in turn depends on technical ability and training facilities, the precision of and the quality of data and information available, the soundness of judgement of the underwriters and staff and the facilities and techniques used in planning underwriting, retention, investment, and marketing policies.

4.4 Methods of risk avoidance

All reinsurers and insurers must retain at least a part of each individual risk in their portfolio. As the reinsurance and retrocession covers do not protect them from all the financial consequences of risk, they should avoid being involved in heavy risks or in a huge liability for any one risk or event, by limiting their underwriting and using.

4.4.1 Exclusion clause

This helps the direct insurer to eliminate or at least minimize the effects of moral hazards, uninsurable risks, catastrophic risks, and this extends to reinsurance business. It enables the reinsurer to avoid being involved in risks with heavy losses, national disaster, accumulation .....etc.

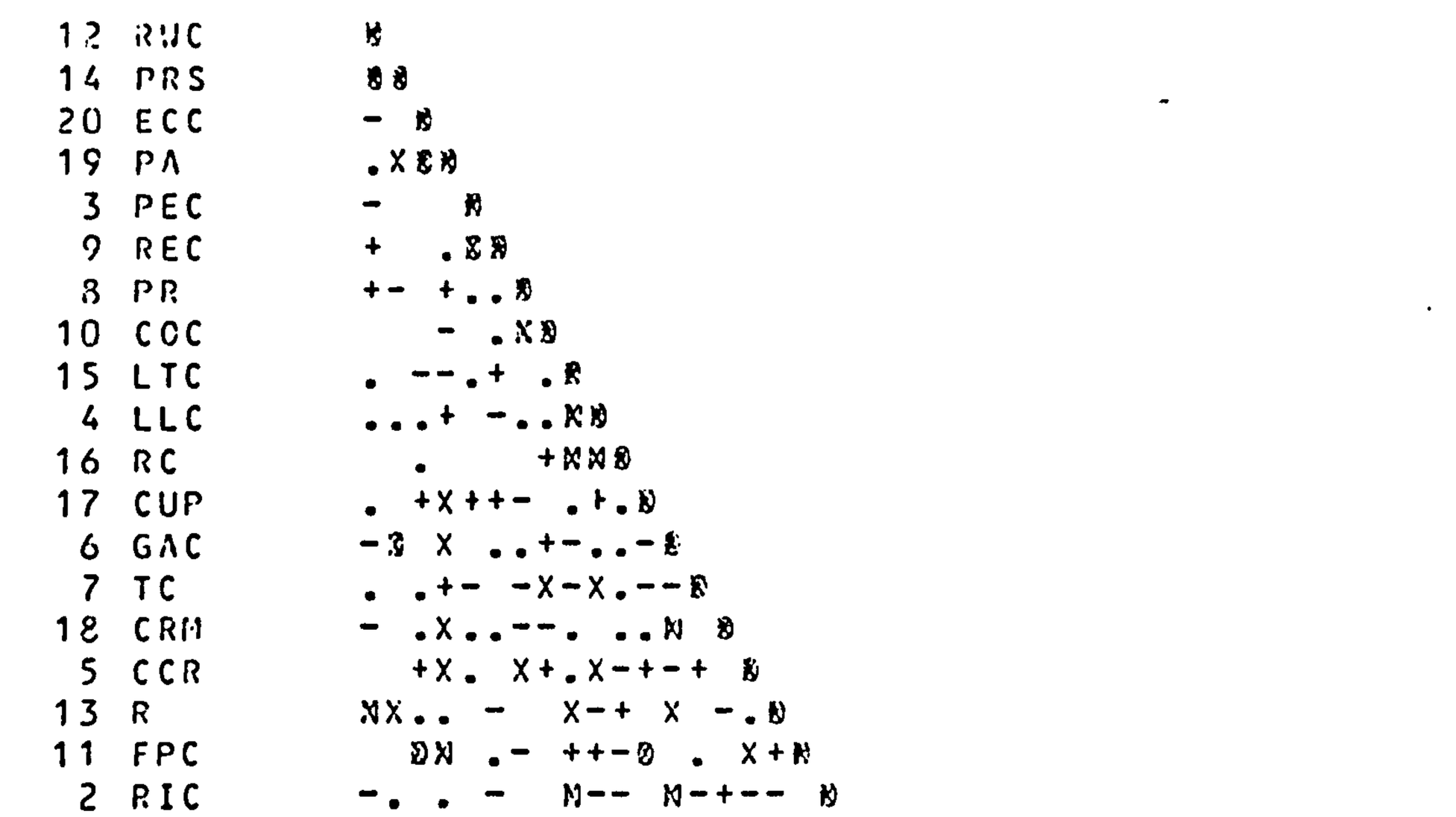
4.4.2 Underwriting limits

To reduce some risks the reinsurer may limit his underwriting from risks or from some countries in the light of their past results or owing to the expectation of economic and political factors which may influence these results in the future.

FIGURE (4.6)

UNDERWRITING DECISION

ABSOLUTE VALUES OF CORRELATIONS IN SORTED AND SHADED FORM



THE ABSOLUTE VALUES OF
THE MATRIX ENTRIES HAVE BEEN PRINTED ABOVE IN SHADED FORM
ACCORDING TO THE FOLLOWING SCHEME

	LESS THAN OR EQUAL TO		0.069
.	0.069	TO AND INCLUDING	0.138
-	0.138	TO AND INCLUDING	0.206
+	0.206	TO AND INCLUDING	0.275
X	0.275	TO AND INCLUDING	0.344
M	0.344	TO AND INCLUDING	0.413
@	0.413	TO AND INCLUDING	0.481
@		GREATER THAN	0.481

TEXT BOUND INTO

THE SPINE

SORTED ROTATED FACTOR LOADINGS (PATTERN)

TABLE (4.11)

		FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
RWC	12	0.858	0.	0.	0.	0.	0.	0.	0.	0.	0.
PRS	14	0.781	0.	0.	0.	0.	0.	0.	0.484	0.	0.
ECC	20	0.	0.933	0.	0.	0.	0.	0.	0.	0.	0.
PA	19	0.	0.667	0.	0.	0.	0.	0.	0.	0.	0.427
PEC	3	0.	0.	0.892	0.	0.	0.	0.	0.	0.	0.
REC	9	0.	0.	0.773	0.	0.413	0.	0.	0.	0.	0.
PR	8	0.262	0.	0.	0.825	0.	0.	0.	0.	0.	0.
COC	10	0.	0.	0.	0.711	0.	0.338	0.	0.306	0.282	0.
LTC	15	0.	0.	0.	0.	0.763	0.	0.	0.	0.	0.
LLC	4	0.255	0.	0.	0.	0.561	0.438	0.	0.	0.388	0.
RC	16	0.	0.	0.	0.	0.	0.920	0.	0.	0.	0.
CUP	17	0.	0.	0.	0.	0.	0.	0.923	0.	0.	0.
GAC	6	0.	0.	0.	0.	0.	0.	0.	0.864	0.	0.
TC	7	0.	0.	0.	0.	0.	0.	0.	0.	0.924	0.
CRM	18	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.929
CCR	5	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
R	13	0.347	0.	0.	0.	0.	0.	0.	0.	0.	0.
FPC	11	0.	0.381	0.	0.	0.	0.	0.510	0.	0.	0.
RIC	2	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.

		FACTOR 11	FACTOR 12	FACTOR 13
RWC	12	0.	0.	0.
PRS	14	0.	0.	0.
ECC	20	0.	0.	0.
PA	19	0.272	0.	0.
PEC	3	0.	0.	0.
REC	9	0.	0.	0.
PR	8	0.	0.	0.
COC	10	0.	0.	0.
LTC	15	0.	0.291	0.284
LLC	4	0.327	0.	0.
RC	16	0.	0.	0.
CUP	17	0.	0.	0.
GAC	6	0.	0.	0.
TC	7	0.	0.	0.
CRM	18	0.	0.	0.
CCR	5	0.907	0.	0.
R	13	0.	0.311	0.
FPC	11	0.280	0.571	0.
RIC	2	0.	0.	0.912

	VP	1.751	1.584	1.502	1.362	1.295	1.272	1.269	1.262	1.219	1.203
		1.195	1.157	1.063							

THE ABOVE FACTOR LOADING MATRIX HAS BEEN REARRANGED SO THAT THE COLUMNS APPEAR IN DECREASING ORDER OF VARIANCE EXPLAINED BY FACTORS. THE ROWS HAVE BEEN REARRANGED SO THAT FOR EACH SUCCESSIVE FACTOR, LOADINGS GREATER THAN 0.5000 APPEAR FIRST. LOADINGS LESS THAN 0.2500 HAVE BEEN REPLACED BY ZERO.

STATISTICS FOR EACH VARIABLE

VARIABLE	MEAN	STANDARD DEVIATION	COEFFICIENT OF VARIATION	SMALLEST VALUE	SMALLEST STANDARD SCORE	FIRST CASE FOR SMALLEST	LARGEST VALUE	LARGEST STANDARD SCORE	FIRST CASE FOR LARGEST
2 RIC	3.67769	0.66100	0.179731	1.0000	-4.05	23	4.0000	0.49	1
3 PEC	3.19835	0.72595	0.226975	1.0000	-3.03	42	4.0000	1.10	1
4 LLC	3.20661	0.69423	0.216500	1.0000	-3.18	41	4.0000	1.14	1
5 CCR	3.19008	0.78861	0.247206	1.0000	-2.78	63	4.0000	1.03	1
6 GAC	3.09091	0.89443	0.289374	1.0000	-2.34	22	4.0000	1.02	9
7 TC	3.32231	0.84367	0.255447	1.0000	-2.74	24	4.0000	0.80	1
8 PR	3.75207	0.48737	0.130027	2.0000	-3.59	26	4.0000	0.51	1
9 REC	3.43802	0.65692	0.191075	2.0000	-2.19	26	4.0000	0.86	1
10 COC	3.47107	0.56333	0.162437	2.0000	-2.61	29	4.0000	0.94	1
11 FPC	3.13223	0.78467	0.250514	2.0000	-1.44	3	4.0000	1.11	1
12 RMC	2.99174	0.73595	0.245989	2.0000	-1.35	3	4.0000	1.37	1
13 R	2.28099	0.91491	0.401100	1.0000	-1.40	3	4.0000	1.88	36
14 PRS	2.51240	0.89550	0.356434	1.0000	-1.69	3	4.0000	1.66	22
15 LTC	3.16529	0.73425	0.231968	2.0000	-1.59	8	4.0000	1.14	1
16 RC	2.72727	1.01553	0.372728	1.0000	-1.70	13	4.0000	1.25	1
17 CUP	3.76660	0.42343	0.112372	3.0000	-1.81	8	4.0000	0.55	1
18 CRM	2.71901	0.91491	0.336485	1.0000	-1.88	22	4.0000	1.40	9
19 PA	2.52066	0.93184	0.369679	1.0000	-1.63	3	4.0000	1.59	17
20 ECC	2.38430	0.73730	0.272959	1.0000	-2.39	18	4.0000	1.42	24

CASE NUMBERS ABOVE REFER TO DATA MATRIX BEFORE ANY CASES
HAVE BEEN DELETED DUE TO MISSING DATA.
CASES WITH ZERO WEIGHTS ARE NOT INCLUDED.

4.5 Summary

The main function of risk management is to control the risk factors. The means used for this objective are varied according to the nature of the risks and factors influencing them. In reinsurance the main risk management tools is divided into two main groups. The first is related to the technical approach and the second is related to contractual obligations. In this chapter each of the technical results, the factors influencing the renewal decision, the actual result and the deviation or error in the result introduced in practice, were discussed. The retrocession cover and the severity of the monetary losses were investigated, also the methods of determination and handling of monetary risks were explained.

In studying the underwriting policy, the factors influencing the underwriting decision were analysed according to the questionnaire data, covering the main factors which must be taken into account. In regard to the contractual devices, the main clauses affecting directly the risk factors were also studied.

CHAPTER FIVE

RISK MANAGEMENT

MEANS TO REDUCE THE SEVERITY OF LOSSES

5.1 Introductiion

As mentioned earlier, complete prevention of all risks or their effects is impossible. Therefore available risk management tools should be used to eliminate or at least to reduce the severity of their financial effects. The main tools which are used by the reinsurer as well as those which could be used will be discussed in this chapter.

5.2 The Technical Means

The main technical means, which may used to reduce the severity of financial loss involve in the risks confronting the reinsurer are concerned with the measurement of fluctuation in the portfolio, the determination of retention limits, selecting the proper retrocession covers, operating pools and establishing the technical reserves.

5.2.1 Evaluation of Risk in Reinsurance Portfolio

In any portfolio actual loss experience during any one underwriting year may fluctuate considerably from its expected experience averaged over a longer period (Carter, 1979). At the same time the actual

premium charged will deviate from calculated risk premium (based on anticipated experience) as a result of underwriting decision in the conditions of the market (Benjamin, 1977).

The reinsurance portfolios are significantly differed from the direct insurance portfolios in respect of the nature of the risks covered, the number of policies and limits of liabilities as well as the details about the individual risk covered and the distribution of claims experience. Only details of large losses may be available for the reinsurer which makes any evaluation of the risks influencing their portfolio more difficult and consequently also, the selection and application of the appropriate devices for reducing the financial consequences of these risks.

The variance as a measure of the dispersion of the results in the reinsurer's portfolio may depend on the following assumptions:

1- A limited number of reinsurance covers are included in the portfolio and each can be treated as one policy whatever the number of its original policies (which is always unknown).

2- The results are balanced over a long period (many years) and there is no autocorrelation between the results for the individual underwriting years.

3- The more homogenienty in the portfolio, the less the variation in the results and the more capability of establishing an adequate premium rate.

4- The loss ratio instead of the claims experience is used, as the existence of correlation between claims and premiums means that the ratio estimate may be a better measure of claims than the claims mean (Yamane, 1967).

5- The distributions of claims and premiums (for non-proportional cover) are normal and the errors associated with any pair of observation are assumed to be independent.*

$E(e_{ij}\ e_{nj}) = 0$ where n, j stands for any pair of years

$E(e_{ij}\ e_{nk}) = 0$ where n, k stand for any pair of years

Defined: r = pure ratio of claims to premiums in the portfolio for i^{th} year.

C = claims and claims expenses for reinsurance cover j

P = net premiums for reinsurance cover j.* Then:

$$r = \frac{\sum_{j=1}^{k} c_j}{\sum_{j=1}^{k} p_j} = \frac{\bar{c}}{\bar{p}}$$

C = claims in portfolio for n years

P = premiums in portfolio for n years.

---

* See Hays and Winkler, 1970.

* Net premium = written premium - commission and other charges

$$\text{Then} \quad R = \frac{\sum_{i=1}^{n} c_i}{\sum_{i=1}^{n} p_i} = \frac{\bar{c}}{\bar{p}} \qquad (5.1)$$

$$\text{Subsitute} \quad \bar{c} = \bar{C} + (\bar{c} - \bar{C}) = \bar{C}\left(1 + \frac{\bar{c} - \bar{C}}{\bar{C}}\right)$$

$$\text{And} \quad \bar{p} = \bar{P} + (\bar{p} - \bar{P}) = \bar{P}\left(1 + \frac{\bar{P} - \bar{p}}{\bar{P}}\right)$$

$$\text{Use Taylor's formula to expand } \left[1 + \frac{\bar{c} - \bar{C}}{\bar{C}}\right]^{-1} \text{ (Yamane, 1967)}$$

$$r = R\left(1 + \frac{\bar{c} - \bar{C}}{\bar{C}} - \frac{\bar{p} - \bar{P}}{\bar{P}} + \frac{(\bar{p} - \bar{P})}{\bar{P}^2} - \frac{(\bar{c} - \bar{C})(\bar{p} - \bar{P})}{\bar{C}\,\bar{P}} + \ldots\right.$$

In reinsurance business, we assume that over a long time the premiums should equal claims, which means that $R \longrightarrow 1$. Also we assume that in any reinsurance portfolio (except for non-proportional covers in the short-run) there is no claim when there is no premium and vice versa. Therefore the regression line of claims on premiums is a straight line which goes through the origin and the value of R_i will be scattered around this line at a 45 degree angle; then the bias will be zero and r is an unbiased estimation of R (Yamane, 1967). And

$$V(r)^2 = E(R-R)^2 = \frac{N-K}{n} \cdot \frac{1}{K} \cdot \frac{1}{P^2} \left[\frac{\sum_{i=1}^{n} \sum_{j=1}^{k} (C_{ij} - RP_{ij})^2}{N-1} \right] \quad \ldots \quad (5.2)$$

Where $N = n \cdot K$

$$V(r) = \frac{n-1}{\bar{P}^2 \cdot N(N-1)} \left[\sum_{i=1}^{n} \sum_{j=1}^{k} \{(C_{ij} - \bar{C}) - R(P_{ij} - \bar{P})\}^2 \right]$$

$$= \frac{n-1}{\bar{P}^2 \cdot N(N-1)} \left[\sum_{i=1}^{n} \sum_{j=1}^{k} (C_{ij} - \bar{C}_j) + R^2 \sum_{i=1}^{n} \sum_{j=1}^{k} (P_{ij} - \bar{P}_j) \right.$$

$$+ \sum_{j=1}^{k} n_j (\bar{C}_j - \bar{C})^2 + R^2 \sum_{j=1}^{k} n_j (\bar{P}_j - \bar{P})^2$$

$$\left. - 2R \sum_{i=1}^{n} \sum_{k=1}^{k} (P_{ij} - \bar{P}_j)(C_{ij} - \bar{C}_j) \right]$$

Where $2R^2 \sum_{i=1}^{n} \sum_{j=1}^{k} [(p_{ij} - \bar{p}_j)(\bar{p}_j - \bar{p})] = 2R^2 \sum_{i=1}^{n} \sum_{j=1}^{k} [(c_{ij} - \bar{c}_j)(\bar{c}_j - \bar{c})] = 0$

and $2R \sum_{i=1}^{n} \sum_{j=1}^{k} [(\bar{c}_j - \bar{c})(p_{ji} - \bar{p}_j)] = 2R \sum_{i=1}^{n} \sum_{j=1}^{k} [(c_{ij} - \bar{c}_j)(\bar{p}_j - \bar{p})] = 0$

Since the value represented by the terms $(p_{ij} - \bar{p}_j)$ and $(c_{ij} - \bar{c}_j)$ are the same $(\bar{p}_j - \bar{p})$ and $(\bar{c}_j - \bar{c})$ must be zero when taken over all i^{th} in any group. Then:

$$V(r) = \frac{N\,(N-1)}{\left(\sum_{i=1}^{n}\sum_{j=1}^{k} P_{ij}\right)(N-1)} \left(\sum_{i=1}^{n}\sum_{j=1}^{k} C_{ij}^{2} + R^{2} \sum_{i=1}^{n}\sum_{j=1}^{k} P_{ij}^{2} - R^{2}\frac{\left(\sum_{i=1}^{n}\sum_{j=1}^{k} P_{ij}^{2}\right)}{N} - \frac{\left(\sum_{i=1}^{n}\sum_{j=1}^{k} C_{ij}^{2}\right)}{N} - 2R \sum_{i=1}^{n}\sum_{j=1}^{k} (P_{ij} - \bar{P}_{j})(C_{ij} - \bar{C}_{j})\right]$$

... (5.3)

The equilibrium in the reinsurance portfolio will not be achieved until after many years, during which the conditions and the nature of risks covered may be changed. It will be necessary to estimate the risk on data for only a short time ie a few years. When N is very large in relation to K, K/N may be ignored and the fraction of sampling in formula 5.3 will then be equal to one as

$$1 - K/N = 1 - 0 = 1$$

And formula 5.3 can be developed to:

$$V(r) = \frac{N^{2}}{\left(\sum_{i=1}^{n}\sum_{j=1}^{k} P_{ij}^{2}\right) K(N-1)} \left[\sum_{i=1}^{n}\sum_{j=1}^{k} C_{ij}^{2} + R \sum_{i=1}^{n}\sum_{j=1}^{k} P_{ij}^{2} - R^{2}\frac{\left(\sum_{i=1}^{n}\sum_{j=1}^{k} P_{ij}\right)}{N} - \frac{\left(\sum_{i=1}^{n}\sum_{j=1}^{k} C_{ij}\right)}{N} - 2R \sum_{i=1}^{n}\sum_{j=1}^{k} (P_{ij} - \bar{P}_{j})(C_{ij} - \bar{C}_{j})\right]$$

... (5.4)

This formula explains that the increase of reinsurance covers "k" in portfolio reduces the fluctuation in result.

Also the longer period of years "n" the less the "error" in the estimated ratio.* Deviation in the result of the risks may occur:

1- At random in any given year

2- From errors in the risk premium or in the original risk fluctuation data.

Thus the variance in the result may be the result of risks covered ie. the reinsurance covered in the portfolio and $V(r_c)$ which may be determined as:

$$V(r) = \frac{N^2}{\left(\sum_{i=1}^{n}\sum_{j=1}^{k} P_{ij}^{\,2}\right) K(N-1)} \left[\sum_{j=1}^{k} \frac{\left(\sum_{i=1}^{n} C_{ij}\right)^2}{N_j} + R^2 \sum_{j=1}^{k} \frac{\left(\sum_{i=1}^{n} P_{ij}\right)^2}{N_j} - \frac{\sum_{i=1}^{n}\sum_{j=1}^{k} C_{ij}^{\,2}}{N} - R^2 \frac{\sum_{i=1}^{n}\sum_{j=1}^{k} P_{ij}^{\,2}}{N} - 2R \sum_{i=1}^{n}\sum_{j=1}^{k} (P_{ij} - \bar{P}_j)(C_{ij} - \bar{C}_j) \right] \quad \ldots \quad (5.5)$$

with $df^* = k - 1$

Where the variance due to random fluctuation, (the annual fluctuation $V(r_y)$ can be expressed as:

---

* Under assumption that the other values are the same.

$$V(r) = \frac{N}{\left(\sum_{i=1}^{n}\sum_{j=1}^{k} P_{ij}^{2}\right) K\,(N-1)} \left[\sum_{i=1}^{n}\sum_{j=1}^{k} C_{ij}^{2} + R^{2}\sum_{i=1}^{n}\sum_{j=1}^{k} P_{ij}^{2} - \sum_{j=1}^{k}\frac{\left(\sum_{i=1}^{n} C_{ij}\right)^{2}}{N_i} - R^{2}\sum_{j=1}^{k}\frac{\left(\sum_{i=1}^{n} P_{ij}\right)^{2}}{N_i}\right] \quad \ldots \quad (5.6)$$

with $df = N_j - 1$

It would have been desirable to compute an annual measure of maximum deviation of the total claims in the portfolio. According to the defintion of risk in the first chapter, the reinsurance is concerned only with the negative deviation as a severity of risk measure or what is called "The semivariance"* where

$$V(r_{+}) = \int_{R}^{\infty} (r - R)^{2}\, df(r)$$

$$V(r_{-}) = \int_{-\infty}^{R} (r - R)^{2}\, df(r)$$

Berliner (1980) has reached the conclusion that the semivariance V_{+} is a better risk measure with respect to the content of the word "dangerousness" than the variance; the third central moment and the linear combin:ation $c(V) + d(\mu_3)$.* For normal distribution

---

* Markowitz, H. (1938) referred to the semivariance as a measure of variability in a portfolio analysis.

$$V = V_+ + V_- \qquad \text{and} \qquad V_+ = V_-$$

Then $V_+ = 1/2\ (V)$

For single truncated normal distribution the skewness is to wright, so that V_+ is always greater than V_-.

Then the severity of risk in any portfolio can be measured as follows:

$$\sum_{j=1}^{k} c_j = \sum_{j=1}^{k} P_j \cdot R$$

as r is an unbiased estimator of R (See p.169). Then:

$$Tc = Tp \cdot R \qquad \text{and}$$

$$V(TC) = TP^2 \cdot V(r) \qquad \text{given TP}$$

$$V(Tc) = \frac{N^2}{K(N-1)} \left[\sum_{i=1}^{n} \sum_{j=1}^{k} C_{ij}^2 + R^2 P_{ij}^2 - \frac{\left(\sum_{i=1}^{n} \sum_{j=1}^{k} C_{ij} \right)^2}{N} \right.$$

$$\left. - R^2 \frac{\left(\sum_{i=1}^{n} \sum_{j=1}^{k} P_{ij} \right)^2}{N} - 2R \sum_{i=1}^{n} \sum_{j=1}^{k} (P_{ij} - \bar{P}_j)(C_{ij} - \bar{C}_j) \right]$$

... (5.7)

---

* There are many arguments about the credibility of using variance or the skewness as a measure of risks' degree, consequently about the pure risk loading.

The risk's severity = 1/2 . V(Tc) when the normality of distribution is assumed or when $\lambda \longrightarrow \infty$ (see table 5.3). In general

$$\text{Severity of risk} = V(Tc)_{\lim c > \bar{c} \,,\, p > \bar{p}}$$

Then the severity of risk in the portfolio is influenced by the following:

1- Number of covers in portfolio k

2- Total of premiums Tp, and total of claims Tc.

3- The difference between premiums and claims for each cover and for all covers or the ratio R.

4- The distributions of both claims and premiums.

5- The period of investigation n

That means there is no contradiction between the result of recent studies, which have emphasized that the increase in the number of policies in a portfolio will result in a decrease in the risk, and the Bernouilli theory regarding the effects of higher risks in the portfolio on the fluctuation in results, as the some writers may have thought .*

Taking into consideration the size of portfolio and the strength of the reinsurer, the degree of risk and its severity will depends on the relative risk to total claims, premiums, liabilities or capital and reserves.

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* See Carter (1979); Gherathewohle (1980).

5.2.2 Retention Policy

Retention may be defined as the maximum amount that the company is prepared to pay on any loss affecting a policy, risk or group of risks (C.I.I., 1982). Retention policy is discussed here as a risk management tool by which the reinsurer can reduce the severity of the financial result of risks facing him. Then retention policy is very important for insurance and reinsurance companies and they should take into account its effects on:

1- Their underwriting policy, the national and international market capacity and consequently the maximum amount of protection that can be provided for any one risk or policy and amount of insurance required in the national market.

2- Their investment planning, loss ratio and cash flow of the company.

3- The balance of payments of the country especially in reduction to the cost of reinsurance protection required from the international market.

4- The management expenses and reinsurance methods and costs.

5- The actual profit which is achieved by the level and form of the retention, because the potential probability of a portfolio depends upon underwriting policy (C.I.I., 1982).

ROTATED FACTOR LOADINGS (PATTERN)

Table (5.1)

		FACTOR 1	FACTOR 2	FACTOR 3	FACTOR 4	FACTOR 5	FACTOR 6	FACTOR 7	FACTOR 8	FACTOR 9	FACTOR 10
PAC	2	-0.010	0.097	0.141	0.060	0.029	0.929	0.017	0.191	0.118	0.059
LLR	3	-0.037	-0.049	0.032	-0.001	0.951	0.031	0.056	-0.012	-0.043	0.009
FR	4	-0.015	0.094	0.093	0.037	-0.015	0.184	0.062	0.945	0.017	-0.011
NRC	5	0.125	0.064	0.014	-0.070	0.009	0.053	0.115	-0.010	-0.008	0.951
FL	6	0.049	0.039	0.162	0.007	-0.042	0.112	0.174	0.018	0.956	-0.007
BEP	7	0.117	0.091	0.115	0.947	-0.007	0.061	0.081	0.037	0.003	-0.073
AR	8	0.029	0.011	0.074	0.033	0.198	-0.010	0.099	0.139	-0.020	0.139
CRC	9	0.923	0.172	0.023	-0.031	-0.172	0.037	0.109	-0.010	-0.022	0.022
MCT	10	0.090	0.137	0.232	0.183	0.200	0.254	0.006	-0.010	0.100	-0.080
UP	11	0.016	0.089	-0.050	0.079	0.057	0.017	0.946	0.063	0.175	0.116
CR	12	0.050	0.035	0.119	0.129	0.080	-0.022	0.112	0.186	0.025	0.164
PI	13	0.180	0.056	0.874	0.113	0.014	0.136	-0.091	0.082	0.189	0.023
CARM	14	0.773	0.056	0.214	0.293	0.223	-0.087	-0.149	-0.010	0.128	0.196
GP	15	-0.042	0.569	0.488	0.285	0.185	0.254	0.202	0.247	0.102	-0.016
ME	16	0.216	0.934	0.021	0.043	-0.092	0.051	0.052	0.050	0.021	0.074

		FACTOR 11	FACTOR 12	FACTOR 13
PAC	2	-0.009	-0.021	0.184
LLR	3	0.176	0.070	0.129
FR	4	0.131	0.175	-0.006
NRC	5	0.127	0.148	-0.055
FL	6	-0.020	0.022	0.070
BEP	7	0.037	0.116	0.123
AR	8	0.918	0.149	-0.142
CRC	9	0.116	0.011	0.000
MCT	10	-0.191	-0.044	0.819
UP	11	0.092	0.104	0.001
CR	12	0.148	0.927	-0.034
PI	13	0.082	0.123	0.245
CARM	14	-0.143	0.066	0.125
GR	15	0.032	0.099	-0.256
ME	16	0.003	0.014	0.154

	VP	1.575	1.294	1.194	1.147	1.118	1.078	1.061	1.059	1.035	1.026
		1.017	0.996	0.932							

THE VP FOR EACH FACTOR IS THE SUM OF THE SQUARES OF THE ELEMENTS OF THE COLUMN OF THE FACTOR PATTERN MATRIX CORRESPONDING TO THAT FACTOR. WHEN THE ROTATION IS ORTHOGONAL, THE VP IS THE VARIANCE EXPLAINED BY THE FACTOR.

Fig (5.1)

PAGE 15 RETENTION DECISION

ABSOLUTE VALUES OF CORRELATIONS IN SORTED AND SHADED FORM

```
 9 CRC          B
14 CARM         BB
16 ME           M+B
15 GR           .-BB
13 PI           -M-BB
 7 DBP          .X-MXB
 3 LLR          -.... B
 2 PAC            -MX- B
11 UP           . -+ -..B
 4 FR             -M+. M-B
 6 FL           .-.+X. +X.B
 5 NRC          ---. . .+  B
 8 AR           .  +. X ++ +B
12 CR           .-.X++- +M.XMB
10 MCT          .X+-BX+B  +.+ B
```

THE ABSOLUTE VALUES OF
THE MATRIX ENTRIES HAVE BEEN PRINTED ABOVE IN SHADED FORM
ACCORDING TO THE FOLLOWING SCHEME

	LESS THAN OR EQUAL TO		0.072
.	0.072	TO AND INCLUDING	0.143
-	0.143	TO AND INCLUDING	0.215
+	0.215	TO AND INCLUDING	0.287
X	0.287	TO AND INCLUDING	0.359
M	0.359	TO AND INCLUDING	0.430
B	0.430	TO AND INCLUDING	0.502
B		GREATER THAN	0.502

HISTOGRAM OF "GR" FOR
RETENTION DECISION

	FIRE	ACCIDENT	MARINE	AVIATION	MOTOR	HULL	FACULT
VAR IS EXCLUDED VALUES	..	..	.				

TABULATIONS AND COMPUTATIONS WHICH FOLLOW EXCLUDE VALUES LISTED ABOVE

```
MIDPOINTS
   4.600)
   4.400)
   4.200)
   4.000)*********      ****          ********       **            *****          **
   3.800)
   3.600)
   3.400)
   3.200)
   3.000)***            *******       *******        *****                        ***
   2.800)
   2.600)                                                          N
   2.400)N              N             H                                           H
   2.200)                                              H
   2.000)************   ********      *************  ******        ******
   1.800)
   1.600)
   1.400)
   1.200)
   1.000)*****          ******        ******         *****         **            ***
   0.800)
   0.600)
GROUP MEANS ARE DENOTED BY N'S IF THEY COINCIDE WITH *'S, H'S OTHERWISE
```

MEAN	2.433	2.360	2.436	2.222	2.615	2.500	0.
STD.DEV.	1.090	1.036	1.040	1.003	1.193	1.309	0.
R.E.S.D.	1.204	1.130	1.142	1.067	1.389	1.507	0.
S. E. M.	0.202	0.207	0.176	0.236	0.331	0.463	0.
MAXIMUM	4.000	4.000	4.000	4.000	4.000	4.000	0.
MINIMUM	1.000	1.000	1.000	1.000	1.000	1.000	0.
SAMPLE SIZE	29	25	35	18	13	8	0

ALL GROUPS COMBINED
(EXCEPT CASES WITH UNUSED VALUES FOR BRANCH)

MEAN	2.433
STD.DEV.	1.063
R.E.S.D.	1.167
S. E. M.	0.094
MAXIMUM	4.000
MINIMUM	1.000
SAMPLE SIZE	123

ANALYSIS OF VARIANCE TABLE

SOURCE	SUM OF SQUARES	DF	MEAN SQUARE	F VALUE	TAIL PROBABILITY
BETWEEN GROUPS	1.5677	5	0.3135	0.27	0.9290
WITHIN GROUPS	141.9323	122	1.1634		
TOTAL	143.5000	127			
LEVENE'S TEST FOR EQUAL VARIANCES		5, 122		0.65	0.6641
ONE-WAY ANALYSIS OF VARIANCE TEST STATISTICS FOR WITHIN-GROUP VARIANCES NOT ASSUMED TO BE EQUAL					
WELCH		5, 38		0.26	0.9320
BROWN-FORSYTHE		5, 64		0.25	0.9393

NOTE - ONLY THOSE GROUPS WITH NON-ZERO VARIANCE ARE USED IN THE COMPUTATIONS OF THE LEVENE, WELSH AND BROWN-FORSYTHE TESTS.

5.2.2.1 Factors influencing retention

Retention policy varies from company to company not only according to the main factors influencing their business but also according to their assessment of the weight attached to each factor. The analyses of the questionnaire data using BMDP 1M and 7D for factor analysis and analysis of variance and clustering, give results which are summarised in Table (5.1) and Figures (5.1, 5.2) which indicate that:

1- Most of the variables may be regarded as separate factors influencing the retention except "CRC" and "CARM" which are contained in one cluster for the cost of retrocession covers available. Also "GR" and "ME" are joined in one cluster for the factor of government restrictions related to retention and transfer of balances due to the reinsurers. They explain 12.3 % and 15.7 % respectively.

2- These factors explain 96.9 % of the variance of reinsurer retention policy. This leaves only 3.1 % to random fluctuation.

3- These factors have the same effects in fixing the retention limits in all reinsurance portfolios, as there is no significant difference in assessment of these factors for the different types of portfolio.

4- Capital and reserves are considered an important factor. This explains alone 6.6 % of the variation in retention decision. When the number of clusters are reduced, the "FR" and "AR" join

"CR" in the same cluster. The relation between them has already been explained by Beard (1969), Benjamin (1977) as follows*:

$$U_t = U_0 + P_t (1 + \lambda) - C_t$$

5- The "UP" explains alone, within a separate cluster, 6.6 % of the decision variation. This shows the existence of a strong relationship between "UP" and retention limits.

6- "PI" has a strong effect on the retention limits. It explains 6.4 % of their variation. Carter (1969) has shown (on fire surplus business) that retention is close to a regression line of:

$$\text{Log } Y = 1/2 \text{ Log } 1000 X$$

Where Y = the retention and X = the premium income.

5.2.2.2 Determination of Retention

The reinsured fix their retention on that limit which minimizes the severity of risk ie. the variance of the retained portfolio. In direct insurance there are many arguments about the credibility of using risks or rating** as the basis of fixing these limits.

---

* See 5.

** According to the theory of individual risk there should be low retention for high rated contracts, but recent studies have emphasized that high retention should be applied to highly rated contracts and vice versa (Gerathewhol, 1980).

In fact they depend on the assessment of factors which influence the result and involve original risk factors, technical factors and economic factors. Due to the variety of these factors and the difficulty of their evaluation, there is no general formula stating what level of a retention must apply in particular conditions. Carter (1979) emphasized that models are rarely used in practice because the statistical data are not yet available in many classes of business. But the analyses of the questionnaire data (Appendix no: 1) shows that about 13.9 % of the reinsurers use a comprehinsive mathematical in fixing their retention while 48.7 % use a simple formula in one or more stages of fixing the retention limits. Also Lampire and others (1980) have criticized classical retention models because only one of the two main purposes of reinsurance* is considered while the other is more or less overlooked.

Looking at studies in this field it is clear that they are limited in their determination of optimal retention for the direct insurance companies. Some of them look at the problem from the point of view of a company which acts as both insurer and reinsurer (Borch, 1961; Johe, 1980; Lemair, 1980; Balah,1981)

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* These main purposes are:

1- To protect the ceding company from ruin.
2- To level out the annual results of the cedant, in reducing the random fluctuation.

Therefore the models discussed depend upon the characterstics of the insurer's portfolio and mainly on the nature of the direct claim distribution (which is assumed to be poisson or exponential) or on the loss ratio distribution according to the size of claim (which is assumed to be Beta or weibull), and on focussing on the variance and skewness of the retained portfolio.

However the reinsurer's portfolio may differ considerably from the direct insurer's portfolio mainly in:

1- The nature of protection provided.

2- The number of covers or policies included.

3- The extra risks due to reinsurance business.

4- The princibles used in rating the risk covered.

5- The limits of liability.

An examination of the available data about loss ratios in different countries and for different classes of business Fig. 5.1 indicates that distribution is affected by the difference in the expenses rate. In order to avoid the effect of commissions and all other charges the data have been adjusted using the average loss ratio for each class of business in each country as a correction factor. Then if we assume that the reinsurer's portfolio contains the same size of premium from all classes and countries, the amended technical results can be used to fit the claims ratio distribution for the reinsurer's portfolio.

Figure 5.3 shows an approximately normal claims ratio distribution. But this is for the retained account which may differ from the original portfolio of one company or for a part of its business. Wit and Kastelijm (1980) have suggested applying a correction factor to the Beta distribution, dividing the claim ratio by the maximum claim ratio in practice, or using the Weibull distribution.

Furthermore, the reinsurer has an opportunity to select the covers and to participate in a share within fixed liability limits, according to his capacity, from a group of covers which may have a normal distribution of size. Then premiums, in the reinsurer's portfolio, may have approximately a normal distribution according to the size of premium as `"P" and the claims "c" will take the same distribution since

$$P = C + e$$

and both premium "P" and error "e" are normally distributed. This means that most of the models discussed do not take into account all features of the reinsurer's portfolio.* Furthermore the appropriate retention in retrocession should aim simultaneously to minimize the fluctuation in results V(r) and maximize the retained premium (P - P')

*

---

* Such as the techniques of rating which rely upon the law of large numbers in direct insurance and mainly upon the expected cost of each cover in reinsurance.

* P' is the retroced premiums.

Fig (5.3)

```
PAGE   2     LOSS RATIO DISTRIBUTION
HISTOGRAM OF VARIABLE    4 DATA3
                         SYMBOL   COUNT      MEAN       ST.DEV.
                           X       572      67.265      18.194
                 EACH SYMBOL REPRESENTS          1 OBSERVATIONS
INTERVAL                                                                             FREQUENCY  PERCENTAGE
NAME           5   10   15   20   25   30   35   40   45   50   55   60   65   70   75   80   INT.  CUM.  INT.   CUM.
             +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
*31.5000 +XXXXXXX                                                                            7     7    1.2    1.2
*35.0000 +XXXXXXX                                                                            7    14    1.2    2.4
*38.5000 +XXXXXXXXXXXXX                                                                     13    27    2.3    4.7
*42.0000 +XXXXXXXXXXX                                                                       11    38    1.9    6.6
*45.5000 +XXXXXXXXXXXXXXXXXX                                                                18    56    3.1    9.8
*49.0000 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX                                                  32    88    5.6   15.4
*52.5000 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX                                                34   122    5.9   21.3
*56.0000 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX                                             37   159    6.5   27.8
*59.5000 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX                                             37   196    6.5   34.3
*63.0000 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX                                            38   234    6.6   40.9
*66.5000 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX                                           39   273    6.8   47.7
*70.0000 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX                    62   335   10.8   58.6
*73.5000 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX                                    46   381    8.0   66.6
*77.0000 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX                                            38   419    6.6   73.3
*80.5000 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX                                          40   459    7.0   80.2
*84.0000 +XXXXXXXXXXXXXXXXXXXXXXXXX                                                         25   484    4.4   84.6
*87.5000 +XXXXXXXXXXXXXXXXXXXXXXXXXX                                                        26   510    4.5   89.2
*91.0000 +XXXXXXXXXXXXXXXX                                                                  16   526    2.8   92.0
*94.5000 +XXXXXXXXXXXX                                                                      12   538    2.1   94.1
*98.0000 +XXXXXXXXXXX                                                                       11   549    1.9   96.0
*101.500 +XXXXXXXX                                                                           8   557    1.4   97.4
*105.000 +XX                                                                                 2   559    0.3   97.7
*108.500 +X                                                                                  1   560    0.2   97.9
*112.000 +XX                                                                                 2   562    0.3   98.3
*115.500 +X                                                                                  1   563    0.2   98.4
*119.000 +                                                                                   0   563    0.     98.4
*122.500 +X                                                                                  1   564    0.2   98.6
*126.000 +X                                                                                  1   565    0.2   98.8
*129.500 +XX                                                                                 2   567    0.3   99.1
*133.000 +                                                                                   0   567    0.     99.1
*136.500 +X                                                                                  1   568    0.2   99.3
*140.000 +XXX                                                                                3   571    0.5   99.8
*143.500 +                                                                                   0   571    0.     99.8
*147.000 +                                                                                   0   571    0.     99.8
*150.500 +                                                                                   0   571    0.     99.8
*154.000 +X                                                                                  1   572    0.2  100.0
*157.500 +                                                                                   0   572    0.    100.0
*161.000 +                                                                                   0   572    0.    100.0
             +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
               5   10   15   20   25   30   35   40   45   50   55   60   65   70   75   80

NUMBER OF INTEGER WORDS OF STORAGE USED IN PRECEDING    PROBLEM     896
CPU TIME USED      26.622 SECONDS
```

Fig (5.4)

```
PAGE    5    LOSS RATIO DISTRIBUTION
HISTOGRAM OF VARIABLE    2 S??
                                       SYMBOL   COUNT      MEAN      ST.DEV.
                                         X       572       1.127      0.152
                              EACH SYMBOL REPRESENTS        1 OBSERVATIONS
INTERVAL                                                                                     FREQUENCY  PERCENTAGE
NAME          5    10   15   20   25   30   35   40   45   50   55   60   65   70   75   80  INT. CUM. INT.  CUM.
            +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
 .350000 +                                                                                     0    0   0.     0.
 .400000 +                                                                                     0    0   0.     0.
 .450000 +X                                                                                    1    1   0.2    0.2
 .500000 +                                                                                     0    1   0.     0.2
 .550000 +X                                                                                    1    2   0.2    0.3
 .600000 +X                                                                                    1    3   0.2    0.5
 .650000 +                                                                                     0    3   0.     0.5
 .700000 +                                                                                     0    3   0.     0.5
 .750000 +XXXXXXXX                                                                             8   11   1.4    1.9
 .800000 +XXXXXXXX                                                                             8   19   1.4    3.3
 .850000 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX                                                     31   50   5.4    8.7
 .900000 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX                                            40   90   7.0   15.7
 .950000 +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX                            56  146   9.8   25.5
1.00000  +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*  103  249  18.0   43.5
1.05000  +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX*  117  356  20.5   64.0
1.10000  +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX    79  445  13.8   77.8
1.15000  +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX                                       45  490   7.9   85.7
1.20000  +XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX                                                  34  524   5.9   91.6
1.25000  +XXXXXXXXXXXXXXXX                                                                    16  540   2.8   94.4
1.30000  +XXXXXXXXX                                                                            9  549   1.6   96.0
1.35000  +XXXX                                                                                 4  553   0.7   96.7
1.40000  +XXXXX                                                                                5  558   0.9   97.6
1.45000  +XX                                                                                   2  560   0.3   97.9
1.50000  +XXX                                                                                  3  563   0.5   98.4
1.55000  +XXX                                                                                  3  566   0.5   99.0
1.60000  +XX                                                                                   2  568   0.3   99.3
1.65000  +X                                                                                    1  569   0.2   99.5
1.70000  +                                                                                     0  569   0.    99.5
1.75000  +X                                                                                    1  570   0.2   99.7
1.80000  +                                                                                     0  570   0.    99.7
1.85000  +                                                                                     0  570   0.    99.7
1.90000  +X                                                                                    1  571   0.2   99.8
1.95000  +X                                                                                    1  572   0.2  100.0
2.00000  +                                                                                     0  572   0.   100.0
2.05000  +                                                                                     0  572   0.   100.0
2.10000  +                                                                                     0  572   0.   100.0
2.15000  +                                                                                     0  572   0.   100.0
2.20000  +                                                                                     0  572   0.   100.0
            +----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+----+
              5    10   15   20   25   30   35   40   45   50   55   60   65   70   75   80
```

When the data cover many years, formula (5.7) will be improved by taking into consideration the inflation rate "F" and the annual growth in the reinsured's portfolio or the changes in the ceded shares "G". Then:

$$V(r) = \frac{N^2}{K\ (N-1)} \left[V(C'') + V(P'') - 2R\ \mathrm{cov}(C, P) \right] \quad \ldots(5.8)$$

Where $P''_{ij} = (P_{ij} - P'_{ij}) (1 + F)^{n-i} (1 + G)^{n-i}$

the standardized net premium retained

And $C''_{ij} = (C_{ij}\ C'_{ij}) (1+ F)^{n-i} (1 + G)^{n-i}$

The standardized net claims for retained portfolio.

As the underwriting portfolio will include various types of risk which can be grouped into categories, the variance of each category can be determined using two or more way analyses*

Therefore any substantial deviation, in premiums or in liabilities of covers from their mean, in portfolio will affect homogeneity and increase the random fluctuation in results.

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* Assuming the normality of premiums and claims distributions.

The lower integral limit in the normal distribution refers to the negative losses the occurrence of which may be due to a judgment of a court of appeal requiring the insured to repay the insurer part of the payments that he received in previous years (Benktander, G. 1974). But losses, of this kind, may not be allowed for the reinsurer portfolio whatever in the underwriting year system or in the clean cut year system. Then the normal distribution as an approximation for the P, C, and R distributions is questionable because the range of each includes negative values and this does not seem to be reasonable for claims, premiums or loss ratio. It is for these reasons that truncated normal distribution is more appropriate.*

Actually the reinsurer can not limit his maximum liability under any particpated cover to twice the mean of claims. Therefore, the degree of skewness of the distribution to the right will depends upon:

1- The non-proportional covers in the portfolio.

2- The reinsurers underwriting policy.

3- The competition in the market.

4- The number of covers in the portfolio.

Wit and Kaslelijn (1980) have found that the maximum claim ratio according to the Weibull distribution is similar to the maximum claim

---

* A form of Weibull distribution with the shape of parameter = 3.25 is almost identical with the unit normal distribution (Mann, 1970).

ratio on the basis of a Beta distribution, when Beta is transformed using the maximum loss as a correction factor. Comparing their results with the results we get from the weibull and truncated normal, it found that when the probability of ruin decreased from 1 % to 0.03 %, the maximum loss ratio increased from 115 % to 130 % for Beta and from 115.4 % to 130.2 % for transformed Beta, and from 113.9 % to 136 % for the Weibull distribution, of the density function (Mann, 1970).

$$P(x) = ca^{-1} (x/a)^{c-1} \exp[-(x/a)^{c}] \quad x \geq 0$$

$$= 0 \qquad x < 0$$

The maximum likelihood estimators c , a the scale and shape parameters respectively, satisfy the equations:

$$a = [\, n^{-1} \sum_{i=1}^{n} x^{c}_{i} \,]^{1/2}$$

$$c = [(\sum_{i=1}^{n} X^{c}_{i} \log x_i)(\sum_{i=1}^{n} x_i{}^{c})^{-1} - n^{-1} \log x_i \,]^{-1}$$

In practice, when the portfolio contains a considerable number of non-proportional covers (which have tended to increase in recent years) the frequency of zero claims as the loss ratio may not itself be zero. Therefore the single truncated normal distribution seems to be more satisfactory and we can use "K" as the normalizing constant such that:

$$\int_0^{\infty} f(x)\, dx = 1.$$

Where

$$f(x) = \frac{1}{K\sqrt{2\pi}\,\sigma} \text{EXP}\left[- \frac{(X - \mu)^2}{\sigma} \right]$$

$$K = \frac{1}{\sqrt{2\pi}} \left[\int_{-\infty}^{\infty} e^{-1/2t^2}\, dt \right]$$

$$= \frac{1}{\sqrt{2\pi}} \left[\int_{-\infty}^{2} e^{-1/2t^2}\, dt \right]$$

$$= \Phi\,(2\mu) \qquad \ldots(5.9)$$

This can easily be obtained from the cumulative standard normal distribution table as:

$$\Phi\,(2E) = \Phi\left(\frac{E}{\sigma}\right) \qquad \ldots(5.10)$$

Applying this to the OECD data (Wit and Kastelijn, 1980) for the period 1976-1978, the solvency margins are considerably greater than those from the Beta and Weibull as follows:

	LOSS RATIO MARGINs		
Probability of ruin	1 %	0.1 %	0.03 %
Beta	45.0		60.0
Beta transformed	45.4	56.6	60.2
Weibull	43.9	55.6	60.6
Truncated normal	45.2	59.8	65.8

Whatever the distribution used to obtain the optimal retention to reduce the ruin probability, it is important to determine the maximum claims (for any group of covers) which the reinsurer is prepared to bear in any year. This is limited by the total net premium in the portfolio TP_j, and the free resources and fund U_j which are related to these covers. Then:

$$TP_j + U_j > \max TC_j$$

where the maximum severity of risk

$= 1/2\ a_j\ V(Tc)$ for the normal distribution.

$= a_j\ V(Tc)_{\lim p>\bar{p},c>\bar{c}}$ for single truncated normal and Weibull distributions. and a_j is a factor to keep $\max(Tc)_j$ of the equilibrium level*

$$TP_j + b_j\ U_j = TC_j + K_j\ a_j \sqrt{V(Tc)}_{\lim p>\bar{p},c>\bar{c}} \qquad \ldots(5.11)$$

---

* We assume here that TP_j, U_j and TC_j have been adjusted for investment return and for inflation rate.

Where K_j is the number of reinsurance covers in class j portfolio, and b_j is safety factor (as a percentage) of free reserves depending on the other classes free reserves and the degree of risk. When the values of a_i and $V(Tc)_{lim\ p>\bar{p},c>\bar{c}}$ are known with α degree of confidence then:

$$\text{Max } TC_j = TC_j + K_j\, a_j \cdot \sqrt{V(Tc)}_{lim\ p>\bar{p},c>\bar{c}}$$

And the probability of claims exceeding the maximum limit according to the weibull distribution will be :

$$P(TC > MAX\ TC) = 1 - \alpha = EXP\ [\ -\ (MAX\ TC/a)^{c}\ ] \qquad ...(5.12)$$

This can be compared with the probability obtained from the single truncated normal where

$$P(TC > MAX\ Tc) = 1 - [P(TC \leqslant MAX\ Tc)]\,[K]^{-1} \qquad ...(5.13)$$

The reinsurer could reduce this probability by increasing U_j or minimizing $V(Tc)_{lim}$ using any of the risk management tools discusse earlier as well as the retrocession policy which will aim to minimize $V(Tc)_{lim}$ for the reinsurer's portfolio, but in some cases it pays more attention to the loss ratio where the result should not exceed a limit of the m.ximum loss ratio MLR. Using the same notation:

$$(TP_j)^{-1} \cdot (U_j + TP_j) < MLR$$

$$\text{And } MLR = R_j + a_j \cdot \sqrt{V(r)}_{lim\ p>\bar{p},c>\bar{c}}$$

Then : $(TP_j)_{-1}\ (b_j\ U_j + TP_j) = R_j + a_j\sqrt{V(r)}_{\lim\ p>p,c>c}$

where $U_j\ /TP_j$ is the solvency ratio 'U_r'.

$$U_r = R_j - 1 + a_j\sqrt{V(r)}_{\lim p>p,c>c} \quad \text{when } b_j = 1. \qquad \ldots(5.14)$$

The probability of net loss ratio exceeding the maximum limit can be determined using the same equation (5.12, 5.13). This probability will be considered as the important factor not only in fixing the optimum retention limits but also in choosing the optimal retrocession covers.

5.2.3 Retrocession Covers

Retrocession is defined as the reinsurance taken out by the reinsurer in order to obtain relief from part of the risk he has assumed (Gerathewhol, 1980). Retrocession cover is considered the main device used by the reinsurer to gain the stability required in his underwriting result and to provide the necessary protection against insolvency and financial strains .*

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* Not only as a result of changes in the original risk factors, but also as a result jointly of the risk of incorrect figures being applied to calculate premiums and the risk of false estimates in assessing claims reserves. Bohlman and Jewell (1978), Borch (1961); Benjamin (1977) and others have given attention to the optimal risk changes with interest of the economic utility function to justify choosing pareto or the optimal form of reinsurance covers.

Then the reinsurer's decision for selecting the proper type of retention retrocession cover will depend upon:

1- The variance of each category of risks.

2- The ruin probability margin.

3- The data and information available for the individual risks.

4- The cost of each cover and its relation to the reduction in the variance.

5- The maximum probable loss and its relation to the capital and free reserves.

6- The class of business.

7- The retention limits assumed.

8- The flexibility of the underwriting policy.

9- The type of reinsurance covers included in the portfolio.

10- The competition in national and international markets.

11- The economic factors affecting insurance and reinsurance business.

Retrocession covers, as for reinsurance covers, are classified into:

A- proportional covers

B- non-proportional covers

5.2.3.1 The Proportional covers

Under these covers the reinsured and reinsurer share premiums and claims according to a predetermined percentage. The arrangement may take one of the following forms:

(1)- The quota share covers

In this form the reinsurer accepts a fixed proportion on each risk accepted by the reinsured and included in the cover. It is used in all classes of insurance but is almost essential in proportional retrocession covers because it is not based so much on individual risks or losses, but rather on the overall risk portfolio.*

Therefore the technical result for business retained will be identical to that of the business reinsured. The insurer and reinsurer are interested to find out what exactly the effect the quota share covers have on the variance of results. This can be studied according to formula 3.5 as follows:

---

* Where the premiums and claims bordereaux for the reinsurance are replaced by quarterly summary accounts.

a = 1 - b is the ceded share. Then:

$$\sigma(C)_c = \frac{\sum [(c - ac) - (\bar{c} - \bar{ac})]^2}{N} = (1 - a)^2 V(C)$$

where σ^2 = The variance of retained portfolio and

$$\sigma^2(C)_R = (1 - b)^2 . V(C)$$

where $\sigma^2(C)_R$ = The variance of retrocession cover then:

$$\sigma^2(C)_c + \sigma^2(C)_R = (1 - a)^2 . V(C) + (1 - b)^2 . V(C)$$

$$= V(C) - B$$

where $B = (2a - 2a^2)$ and

$B > 0$ as $2a > 2a^2$ and $0 < a > 1$.

Then $V(C) - V(C)_c - V(C)_R > 0$

and $V(P) - V(P)_c - V(P)_R > 0$ and

Term of $2R > (p - p) (c - c) = 2R \, cov(p,c) / V(C) \, V(P) \, (1-a)$

So that:

$$V(r) - V(r)_c - V(r)_R > 0$$

$$V(r) > V(r)_c + V(r)_R$$

This means that using quota share covers will reduce the variance in retained portfolio by an amount exceeding the variance in the retrocession quota. This reduction becomes a maximum when a(1 - a) is a maximum ie. when the quota share is 50 %. In cases where the retention share is some other percentage such as K % Benktander (1980)

has explained that the remaining variance will be apportioned between the ceding company and reinsurer in inverse proportion to their respective risks (ac and ar respectively) where:

$$D.max = \frac{1}{2} \cdot V\left[\frac{ac^2}{ac + ar}\right]$$

and

$$\frac{K}{1 - K} = \frac{ar}{ac} \quad , \quad K = \frac{ar}{ac + ar}$$

(2)- Surplus covers

In surplus covers the reinsured and the reinsurer share a fixed percentage for each risk according to a schedule of retention limits. This method is used by the reinsurer only in limited cases and where the full details about the individual risk covered under the reinsurance are available ie. in the case of:

1- The compulsory cessions

2- Facultative covers

It appears that the analysis of the quota share covers may extend to apply to the surplus cover only for policies within the liability limits of surplus covers. But for all the portfolios the result of retained business will differ considerably from the result of the retrocession cover. Also the variance of the retrocession business will exceed the variance of the retained account because the number of

policies included in retrocession cover is less while the dispersion of premiums and claims is wider. Then both parties will not carry equal shares in all risks and:

$$V(r)_C < V(r) < V(r)_R$$

(3)- Compulsory cession

In some countries the national reinsurance company is obliged to accept a fixed percentage from all business written in the domestic market by the insurance companies which are equally obliged to cede these percentages with all bordereaux of premiums and claims required. Then the reinsurer portfolio from these cession can be treated by the same methods and techniques used by direct insurer.

(4)- Facultative covers

In facultative covers each risk accepted is an individual reinsurance contract and valid for the duration of original policy, normally for one year, and subject to all conditions of the original contract. It is mainly used to protect against the insufficiency of the predetermined capacity (the retention plus treaty covers) or because the automatic covers have been used up or the risk is excluded from these covers. The same analyses of surplus covers are applicable for facultative covers.

(5)- Pools arrangement

Pools are established for underwriting very special risks on behalf of the members or as a method of reinsurance or retrocession to protect their portfolio against large losses. It is considered as a kind of direct co-operation between the members in facing risks and reducing the management costs. It operates with varying methods and conditions but always on a quota share basis.

Bohman and Grenader (1980) have suggested a mutual reinsurance scheme depending on the participating companies committing themselves to dividing the claims exceeding a certain amount between them.

5.2.3.2 Non- Proportinal Covers

This system is concerned with the size of the loss or liability which is distributed between parties according to fixed amounts rather than to fixed proportions. Then there is no direct relationship between the technical result of cover and the result of the original portfolio. Consequently the follow of fortune of the reinsured is applied in a very limited sense (Group 201, 1980). The method is used to protect the reinsured's portfolio against the fluctuation of the experience from year to year (which is due to the random fluctuation covered in formula (3.7).

(1)- Excess of Loss Covers

This cover protects the reinsured from the large losses resulting from one risk (working excess of loss) or from one event (catastrophic excess of loss) which exceeds his priority*.

Although some writers have thought that this cover does not reduce the risk (Toma, 1938), Benkander (1980) has explained that the total variance reduction due to this cover when the claim size distribution is pareto with $a > z$ is:

$$V - V_1 - V_2 = \frac{2n}{\alpha - 1} (M - 1) \left[\frac{1}{M^{\alpha-1}} - \frac{1}{M_1^{\alpha-1}} \right]$$

Where V = The total variance in excess of M_0

V_1 = The variance $M_0 - M$

V_2 = The variance $M - M_1$

and he found $(V_C + V_R)$ has a maximum when

$$M < \frac{\alpha - 1}{\alpha - 2}$$

which is written in practice as

$$M = \frac{\alpha - 1}{\alpha - 2}$$

---

* The priority is defined as the amount which can be retained for own account on any one loss or event. Unfortunately the reinsurer is not in a position to use this method for all of his portfolio owing to the lack of information provided to him about the reinsurance cover.

where all losses up to the lower limit M_0 and all losses above the upper limit M_1 are born by the ceding company.

In fact it is impossible to protect the main reinsurer portfolio (from obligatory covers) using this form of covers. But if each cover is considered as a separate policy, then the reinsurer could protect his portfolio against losses which exceed a predetermined amount from any reinsurance cover instead of the amount of loss resulting from any one risk or event (see 5.5). This will protect the reinsurer against the increase in losses due under any single cover beyond those expected. These are mainly due to:

1- The random changes in the original risk factors.

2- The catastrophic losses which may affect any individual reinsurance cover.

3- Errors in fixing the premium rate for the original policy or the reinsurance cover.

4- The effects of changes in the political and economic climate.

5- The "target risks" and accumulation which arise from inward treaty acceptance.

(2)- Stop Loss Covers

Stop loss covers protect the reinsured portfolio from the heavy effects of losses in one branch or more. It is considered to be the main method of non-proportional covers which can be used by the reinsurer as it depends on the whole portfolio. The most common use of this form is for the protection of department accounts which already have proportion or excess of loss protecton or both. These covers operate only if the reinsured's loss ratio or total claims exceed a predetermined figure C_1 up to a maximum of limit C_2. Then the claims C_R will be:

$$C_R = \begin{cases} 0 & C < C_1 \\ C - C_1 & C_1 < C < C_2 \\ C_2 - C_1 & C_2 < C \end{cases}$$

This means, the net premiums will depend on the claims or on the loss ratio distributions* and equal $E(C_R)$.

$$\text{where} \quad P_R = E(C_R) = \int_{C1}^{C2} (C - C_1) \, df(c)$$

$$+ (C_2 - C_1) \int_{C_2}^{\infty} df(c)$$

---

* For the reinsurer portfolio we have assumed to have a single truncated normal distribution.

when the upper limit $= \infty$ ie. $C_2 = \infty$ Then

$$E(C_R) = \int_{C_1}^{\infty} (C - C_1) \frac{1}{\sqrt{2\pi}} \exp (- 1/2\ C^2) dc$$

Benktander (1980) has studied a large group of distributions when $C_1 = E$ and found that the risk premium in this special case can be approximately calculated by the formula

$$e(E) = \lim_{\lambda \to \infty} P`(\lambda) = \frac{\sigma}{\sqrt{2\pi}}$$

where E = Expected value of the distribution

$$V = \sigma^2$$

$$\lambda = E^2 / V$$

For the single truncated normal where $0 \leqslant X < \infty$

We get:

$$E(C) = \frac{1}{K\ 2\pi} \int_{C_1}^{\infty} \frac{(C - C_1)}{\sigma} \exp[-(\frac{(C - C_1)^2}{2\sigma^2})] dc$$

Then $E(C) = \sigma / K\sqrt{2\pi}$

where "K" is constant which depends on "E" and "σ"

then we can compare $P(\lambda)$ and $\frac{1}{K\sqrt{2\pi}}$ using comulative probability of the standard normal distribution table.

where $P(\lambda) = \frac{e^{-\lambda} \cdot \lambda^{\lambda}}{K\,\Gamma(\lambda+1)}$

λ	K	$1 / K\sqrt{2\pi}$	$P(\lambda)$
1	0.8413	0.474	0.437
2	0.9213	0.306	0.322
3	0.9584	0.240	0.234
4	0.9773	0.203	0.200
5	0.9875	0.180	0.177
6	0.9919	0.164	0.162
7	0.9960	0.152	0.150
8	0.9977	0 .141	0.140
9	0.9987	0.133	0.132
10	0.9992	0.126	0.125
20	1.0000	0.089	0.089

This suggests that when $\lambda > 10$ the skewness in the distribution* tends to equal zero ie. approaching to the normal. Even when $\lambda < 10$ it is close to the normal and on the safe side. In general case the values of E(C) can be determined using the table of unit normal loss integral according to the mean and variance of claims (table 5.3), where λ_T was calculated from generated data which was trancated in different points.

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* Sundt (1982) studied the stop loss premium when the claim number distribution is negative and geometrical. Also Vylder, Paid and Gooverts (1983) have studied the upper and lower bounds of stop loss premium.

(C)- Alternative covers

The reinsurer is impolled by the nature of his portfolio to look for other types of retrocession covers to reduce the severity of various risks to which he is exposed. These new types should take into consideration:

1- The lack of data and information for any individual risk in the portfolio.
2- The possibility of adopting classical types of covers for applications to protect the reinsurer's portfolio.
3- The additional risks which are correlated to the reinsurance business.
4- The variance in portfolio for any group of covers.

The "TONNER" cover is an example of the reinsurers efforts to get over the accumulation risk in the absence of the necessary information about the risk.

(1)- Excess variance covers

The reinsurer is interested in reducing the variance in his portfolio's loss ratio as well as in claims and to keep them within appropriate limits. Thus the bounds of the protection cover (for all the portfolio) could be based directly on the variance of claims or loss ratio at the end of th calendar year and after affecting all other retrocession covers where:

The lower bound $L_c = C + S_1\sqrt{V(Tc)}$ for claims

$L_r = R + S_1\sqrt{V(r)}$ for loss ratio

and the upper bound $U_c = C + S_u\sqrt{V(Tc)}$ for claims

$U_r = R + S_u\sqrt{V(r)}$ for loss ratio

Where S_1 and S_u are constant multiples of standerd deviation. In this case the bounds will not be predetermined as they depend on the variation of result. The pure premium can easily be detemined according to the distribution of loss ratio for the retained account.

(1)- Excess of claims cover

This cover may be used to protect the reinsurer from the excess of claims, under any reinsurance cover in his portfolio , above a fixed amount such as 150 % of loss ratio. The technique of excess loss covers and order statistics can be used to determine the net premium and the limits of liabilities.

(3)- Currency cover

The monetary risks are caused by unpredictable economic factors. They affect not only the reinsurance business but extend to affect the stability of the international reinsurance business. Then when the severity of these risks are detemined (see 4.3), the reinsurance cover is the main protection available. This needs an extensive study of the many national and international economic factors in addition to the the use of insurance and reinsurance techniques.

5.2.4 Technical Reserves

Benjamin (1977) devided the technical reserves into six categories. They are: unexpired premium reserves, unexpired risk reserves, outstanding claims reserves, I.B.N.R. reserves, catastrophe reserve. The reinsurer follows the reinsured or the direct insurer in regards to his estimation of outstanding claims reserves and I.B.N.R. reserves for the business covered by the reinsurance and the retrocession covers. For the other kinds of reserves the reinsurer relies in his estimation mainly on:

1- His portfolio past experience.

2- The nature of risks covered.

3- The territory of risk covered.

4- The maximum liability.

5- The efficiency of his retrocession program.

6- Inflation rate and other economic factors.

The problem faced by the reinsurer is the delay in receiving the reinsured's estimation especially when his financial year is different or when the reserves are included in the accounts only by regulation rules or are based on a percentage depending on the system used. *

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* Premium reserve is always determined using a half, eighth or twenty-fourth system.

But generally these reserves are determined for each cover according to the nature of the risk covered and they should be sufficient for each cover; each department and for the whole portfolio, to protect the reinsurer against the variation in his results.

For any risk when the other methods of protection are not valid such as for monetary risks, until now, reserving is considered the main device for protecting the reinsurer from severity of risk in the long run.

5.3 Contractual Devices

Retrocession contract contains many conditions or clauses which achieve a balance required between the rights and liabilities of each part. Some of these clauses affect directly the severity of the additional risks caused by economic factors. The main clauses are:

5.3.1 The Index Clause

In non-proportional covers, where the claims are subject to changes as a result of inflation, the burden of inflation may not be distributed in the same proportion (see 3.5). The effects of the stability clause is to maintain the monetary relatively between cedant's and reinsurer's liability by increasing both by the rate of inflation (Benjamin, 1977). Then the index, for the interval between the occurrence date and settlement data of claims, is the basis of sharing the burden of inflation.

In practice, this interval may start on a fixed date whatever the year of the event's occurrence (some times many years before it). This exposes the reinsured to risk because it affects the limits of actual claims. For example, if the annual rate of inflation is 7.5 % and the inception date was 1981, then a claim (amount of L 12900) which sittled in 1984 will be shared as follows:

	before inflation	after inflation
amount of claim	12000	12900
Based on 1981 index		
- the reinsured's share	10000	12900
- the rinsurer's share	2000	0
Based on 1983 index		
- the reinsured's share	10000	10750
- the reinsurers share	2000	2150

Therefore the index interval should start with the occurrence date and not any other date.

5.3.2 Currency Fluctuation Clause

This clause gives attention only to the changes in non-proportion's limits as a result of the currency movement so is to make both parties share it in the same proportion as the claims would be apportioned if there had been no currency movement. This clause should extend to protect the reinsurer from other risks which have been explained ealier and are connected with the rate of exchange used for books, ac-

counts, retrocession covers, reserves and settlement of balances where several currencies are involved.

5.3.3 Other Clauses

The other clauses reducing the severity of the additional risks, faced by the reinsurer involve the profit commission, premium and loss reserve deposits, portfolio entry and withdrawal.

5.4 Summary

Reducing the severity of risk is the main function of risk management. The tools which are used will differ from industry to industry, but in general involve both technical and contractual devices.

For reinsurance, the technical devices studied involved the evaluation of risks and their severity using the semivariance of loss ratio. Also the retention policy and the main factors affecting the retention limits were analysed according the questionnaire data. The main retrocession covers and their effect on the severity of risks as well as the technical reserves were discussed. In regard to the contractual methods in reinsurance the main clauses affecting the severity of risk such as the stability clause and currency clause were verified.

$\lambda = \frac{\mu^2}{\sigma^2}$, $\mu = 100$, $E(C) = \frac{\sigma}{\sqrt{2\pi}} \int_D^\infty (C-D) \cdot e^{-1/2 C^2} dc$, $D = \frac{C - \bar{C}}{\sigma}$, T FOR TRUNCATED - N FOR NORMAL

λ_n	λ_t	K	N	T	N	T	N	T	N	T
c_i			0.		1.00		2.00		3.00	
0.01	1.7339	0.5398	0.3989E 01	0.7390E 01	0.3509E 01	0.6509E 01	0.3069E 01	0.5685E 01	0.2668E 01	0.4942E 01
0.02	1.7475	0.5562	0.2821E 01	0.5072E 01	0.2349E 01	0.4223E 01	0.1940E 01	0.3488E 01	0.1580E 01	0.2841E 01
0.03	1.7570	0.5687	0.2303E 01	0.4095E 01	0.1839E 01	0.3233E 01	0.1434E 01	0.2521E 01	0.1107E 01	0.1947E 01
0.04	1.7793	0.5793	0.1995E 01	0.3444E 01	0.1535E 01	0.2649E 01	0.1152E 01	0.1986E 01	0.8435E 00	0.1456E 01
0.05	1.8108	0.5885	0.1784E 01	0.3032E 01	0.1355E 01	0.2302E 01	0.9597E 00	0.1631E 01	0.6713E 00	0.1140E 01
c_i			0.		0.50		1.00		1.50	
0.10	1.8781	0.6241	0.1262E 01	0.2021E 01	0.1027E 01	0.1646E 01	0.8241E 00	0.1321E 01	0.6508E 00	0.1043E 01
0.20	1.2020	0.6726	0.8921E 00	0.1326E 01	0.6643E 00	0.9877E 00	0.4799E 00	0.7133E 00	0.3356E 00	0.4911E 00
0.30	2.0198	0.7081	0.7284E 00	0.1029E 01	0.5055E 00	0.7139E 00	0.3350E 00	0.4732E 00	0.2112E 00	0.2983E 00
0.40	2.1309	0.7365	0.6308E 00	0.8565E 00	0.4120E 00	0.5596E 00	0.2530E 00	0.3436E 00	0.1451E 00	0.1970E 00
0.50	2.2212	0.7603	0.5642E 00	0.7422E 00	0.3492E 00	0.4593E 00	0.2001E 00	0.1861E 00	0.1048E 00	0.1379E 00
c_i			0.		0.20		0.40		0.60	
1.00	2.2661	0.8413	0.3989E 00	0.4742E 00	0.3069E 00	0.3648E 00	0.2304E 00	0.2738E 00	0.1687E 00	0.2005E-01
2.00	3.3035	0.9213	0.2821E 00	0.3132E 00	0.1933E 00	0.2098E 00	0.1261E 00	0.1368E 00	0.7800E-01	0.8460E-01
3.00	3.9752	0.9584	0.2288E 00	0.2387E 00	0.1431E 00	0.1493E 00	0.8290E-01	0.8730E-01	0.4430E-01	0.8064E-01
4.00	4.6633	0.9778	0.1995E 00	0.2040E 00	0.1152E 00	0.1178E 00	0.6010E-01	0.6150E-01	0.2810E-01	0.2870E-01
5.00	5.4497	0.9873	0.1784E 00	0.1786E 00	0.1453E 00	0.1454E 00	0.1140E 00	0.1141E 00	0.6800E-01	0.6800E-01
c_i			0.		0.05		0.10		0.15	
10.00	10.0516	0.9992	0.1246E 00	0.1247E 00	0.1014E 00	0.1015E 00	0.7960E-01	0.7960E-01	0.4750E-01	0.4750E-01
20.00	20.0000	1.0000	0.8920E-01	0.8920E-01	0.6640E-01	0.6640E-01	0.4840E-01	0.4840E-01	0.2270E-01	0.2270E-01
50.00	50.0000	1.0000	0.5640E-01	0.5640E-01	0.3490E-01	0.3490E-01	0.1990E-01	0.1990E-01	0.5000E-02	0.5000E-02

TABLE (5.3)

λ_n	λ_t	K	N	T	N	K	N	K	N	K
c_i			4.00		5.00		6.00		7.00	
0.01	1.7339	0.5398	0.2304E 01	0.4268E 01	0.1978E 01	0.3664E 01	0.1687E 01	0.3125E 01	0.1429E 01	0.2647E 01
0.02	1.7475	0.5562	0.1378E 01	0.2471E 01	0.1088E 01	0.1955E 01	0.8501E 00	0.1528E 01	0.6544E 00	0.1177E 00
0.03	1.7570	0.5687	0.8372E 00	0.1466E 01	0.6172E 00	0.1085E 01	0.4404E 00	0.7742E 00	0.3158E 00	0.5552E 00
0.04	1.7793	0.5793	0.6010E 00	0.1037E 01	0.4166E 00	0.7190E 00	0.2805E 00	0.4840E 00	0.1833E 00	0.3165E 00
0.05	1.8108	0.5885	0.5010E 00	0.8510E 00	0.2948E 00	0.5008E 00	0.5210E-01	0.8850E-01	0.1128E 00	0.1917E 00
c_i			2.00		2.50		3.00		3.50	
0.10	1.8781	0.6241	0.5059E 00	0.8105E 00	0.3864E 00	0.6192E 00	0.2903E 00	0.4652E 00	0.2141E 00	0.3431E 00
0.20	1.2020	0.6726	0.2270E 00	0.3491E 00	0.1481E 00	0.2201E 00	0.9310E-01	0.1384E 00	0.5639E-01	0.8383E-01
0.30	2.0198	0.7081	0.1264E 00	0.1785E 00	0.7160E-01	0.1011E 00	0.3812E-01	0.5384E-01	0.1917E-01	0.2708E-01
0.40	2.1309	0.7365	0.3843E-01	0.5216E-01	0.1760E-01	0.2389E-01	0.7434E-02	0.1010E-01	0.2890E-02	0.3924E-02
0.50	2.2212	0.7603	0.5030E-01	0.6610E-01	0.2189E-01	0.2879E-01	0.3057E-02	0.4022E-02	0.9308E-03	0.1224E-02
c_i			0.80		1.00		1.20		1.40	
1.00	2.2661	0.8413	0.1202E 00	0.1429E-01	0.8332E-01	0.9903E-01	0.5610E-01	0.6668E-01	0.3667E-01	0.4358E-01
2.00	3.3035	0.9213	0.2513E-01	0.2727E-01	0.1339E-01	0.1414E-01	0.6335E-02	0.6874E-02	0.2886E-02	0.3132E-02
3.00	3.9752	0.9584	0.2180E-01	0.1275E 00	0.9763E-02	0.1018E-01	0.3963E-02	0.4135E-02	0.1459E-02	0.1522E-02
4.00	4.6633	0.9778	0.1162E-01	0.1189E-01	0.4245E-02	0.4342E-02	0.1360E-02	0.1391E-02	0.3606E-03	0.3892E-03
5.00	5.4497	0.9873	0.6570E-02	0.6654E-02	0.1972E-02	0.1968E-02	0.5009E-03	0.5993E-03	0.6234E-04	0.1084E-03
c_i			0.20		0.25		0.30		0.35	
10.00	10.0516	0.9992	0.4807E-01	0.4810E-01	0.3611E-01	0.3614E-01	0.2414E-01	0.2143E-01	0.1551E-01	0.1552E-01
20.00	20.0000	1.0000	0.2258E-01	0.2267E-01	0.1308E-01	0.1308E-01	0.9313E-02	0.9313E-02	0.5639E-02	0.5639E-02
50.00	50.0000	1.0000	0.5026E-02	0.5026E-02	0.2189E-02	0.2189E-02	0.8867E-03	0.8867E-03	0.3065E-03	0.3065E-03

TABLE (5.3)

λ_n	λ_t	K	N	T	N	K	N	T	N	T
c_i			8.00		9.00		10.00		11.00	
0.01	1.7339	0.5398	0.1202E 01	0.2227E 01	0.1004E 01	0.1860E 01	0.8322E 00	0.1543E 01	0.6862E 00	0.1271E 01
0.02	1.7475	0.5562	0.4969E 00	0.8933E 00	0.3717E 00	0.6683E 00	0.2513E 00	0.4518E 00	0.1820E 00	0.3272E 00
0.03	1.7570	0.5687	0.4503E 00	0.2822E 00	0.1477E 00	0.2597E 00	0.9757E-01	0.1604E 00	0.1091E 00	0.1106E 00
0.04	1.7793	0.5793	0.1162E 00	0.2006E 00	0.7140E-01	0.2326E 00	0.4245E-01	0.7330E-01	0.2433E-01	0.4219E-01
0.05	1.8108	0.5885	0.6570E-01	0.1160E 00	0.3673E-01	0.6240E-01	0.1972E-01	0.3351E-01	0.1023E-01	0.1738E-01
c_i			4.00		4.50		5.00		5.50	
0.10	1.8781	0.6241	0.1551E 00	0.2485E 00	0.1102E 00	0.1766E 00	0.1394E-01	0.2369E-01	0.5252E-01	0.8415E-01
0.20	1.2020	0.6726	0.3148E-01	0.4879E-01	0.1836E-01	0.2730E-01	0.9859E-02	0.1466E-01	0.4942E-02	0.7348E-02
0.30	2.0198	0.7081	0.9156E-02	0.1293E-01	0.4081E-02	0.570 E-02	0.1231E-03	0.1285E-03	0.2972E-04	0.5046E-04
0.40	2.1309	0.7365	0.1029E-02	0.1398E-02	0.3368E-03	0.4573E-03	0.1130E-04	0.1155E-04	0.1782E-05	0.1823E-05
0.50	2.2212	0.7603	0.2804E-03	0.3683E-03	0.7170E-04	0.3688E-03	0.1125E-04	0.8058E-05	0.1162E-05	0.8319E-05
c_i			1.60		1.80		2.00		2.20	
1.00	2.26.1	0.8413	0.2324E-01	0.2762E-01	0.1428E-01	0.1697E-01	0.2430E-02	0.2432E-01	0.4887E-02	0.5809E-02
2.00	3.3035	0.9213	0.1230E-02	0.1334E-02	0.4890E-03	0.5307E-03	0.4890E-03	0.5308E-03	0.1801E-03	0.1954E-03
3.00	3.9752	0.9584	0.4838E-03	0.5048E-03	0.1446E-03	0.1509E-03	0.3894E-04	0.4063E-04	0.9399E-04	0.9809E-05
4.00	4.6633	0.9778	0.9260E-04	0.9470E-04	0.1955E-05	0.2195E-05	0.3573E-05	0.3654E-05	0.5635E-06	0.5765E-06
5.00	5.4497	0.9873	0.2182E-04	0.2212E-04	0.2862E-05	0.2898E-05	0.3558E-06	0.3604E-06	0.3673E-06	0.3721E-05
c_i			0.40		0.45		0.50		0.55	
10.00	10.0516	0.9992	0.7684E-02	0.7691E-02	0.5256E-02	0.5259E-02	0.3520E-02	0.3523E-02	0.2337E-01	0.2313E-03
20.00	20.0000	1.0000	0.1015E-02	0.1015E-02	0.5096E-03	0.5096E-03	0.4723E-02	0.4723E-02	0.1183E-03	0.1183E-03
50.00	50.0000	1.0000	0.7177E-04	0.7177E-05	0.1643E-05	0.1643E-05	0.3356E-06	0.3356E-06	0.6081E-06	0.6081E-07

CHAPTER SIX

SUMMARY OF CONCLUSIONS

Risk definition should give more attention to causative factors which are the subject matter of interest of economic, industrial, political and social studies. The profitability of general insurance requires to be safeguarded by the application of rational procedures for the classification and assessment of risks (Benjamin, 1977). The risks faced by the reinsurer are varied and may be classified with distinction between the original risk covered and the additional risks which are related to the reinsurance business as a a commercial enterprise.

Changes in the exchange rate affect the reinsurance result and technique as well as the international reinsurance business and prevent the statistics from truly reflecting the risks run by the reinsurers. Thus, a fixed rate of exchange and a method of isolating the monetary losses is suggested.

The semivariance of total claims depending on the loss ratio is a better measure of the severity of risk in reinsurance portfolios as it takes into account the variation in premiums as well as in claims. Then it can be used in the determination of the optimal retention and retrocession covers.

The claim and loss ratio distribution for the reinsurer portfolio may differ from those for the direct insurer portfolios. The single

truncated normal and weibull may be the better approximation according to the nature of the portfolio. Thus many of the mathematical models for retention, underwriting, reserves, reinsurance covers are not valid for the reinsurer. Only a sample of risk premium for non-proportional covers with different point of lower boundary is tabulated as an example. Full tables may help the reinsurance greatly.

The main clauses in the retrocession contracts should be changed to provide for the actual protection required wether for reducing the severity of risks or the chance of their occurrence.

Some reinsurance covers may be applied to the retrocession covers such as excess of loss for quota share and surplus covers. Also a retrocession cover should be studied by the reinsured to protect his portfolio and his reinsurers against the monetary risks.

6.2 Suggestion for Further Research

The changes in exchange rates significantly affect the technical and financial results, which differ according to the method used. Estimation of these effects and fixing the regression relationship will help the reinsurer to correct his result. This depends on adequate observational data.

Computerizing the reinsurer's underwriting and retention decisions require quantitative data of all the factors discussed here which involve economic, financial, technical and political factors.

APPENDIX NO: ONE

THE QUESTIONNAIRE DATA

(A)- STUDING OF COVER'S RESULTS

Please find hereunder some factors which may affect the results of the reinsurance covers; there are four possibilties for the effect of each factor:

- Factor hasn't any effect
- Factor has weak effect
- Factor has medium effect
- Factor has strong effect

Would you please, from your experience as underwriter for (Branch) remark (tick) the box showing the best answer.

Factor	I think that factor has			
	NO EFFECT	WEAK EFFECT	MEDIUM EFFECT	STRONG EFFECT
1. The risks included in the cover	0.8	8.2	14.9	76.1
2. Past experience of cover	2.2	11.9	50.1	35.8
3. The limits of liability of cover	0.8	14.3	48.08	36.1
4. The ceding company retention	2.2	18.1	41.4	38.3
5. Geographic area of cover	6.0	15.7	40.3	38.0
6. Type of covers (Q/S, surplus, XL, stop loss)	6.8	7.6	36.7	48.9
7. Premium rate	0.0	2.3	23.5	74.2

8. Other factors added by the underwriters.

- Indexation (in XL)
- Lack of underwriting
- Claims handling
- Level of deductible
- Exchange rate of currency
- The ceding company moral attitude

(B)- UNDERWRTITING DECISION

Please find hereunder some factors which may have effect on your underwriting decision, also there are four possibilties for the the effect of each factor. Would you please mark (tick) the box showing the best answer:

Factor	I think that factor has			
	NO EFFECT	WEAK EFFECT	MEDIUM EFFECT	STRONG EFFECT
1. The past experience of cover	0.0	8.2	39.6	52.2
2. Commission and other charges	0.0	4.5	46.3	49.2
3. The financial position of ceding co.	0.0	25.6	37.6	36.8
4. The relationship with the ceding co.	0.0	25.8	47.7	26.5
5. The reciprocity	22.7	35.6	32.6	9.1
6. The personal relationship	16.2	26.9	46.9	10.0
7. Limits of retention (for your company)	0.1	18.8	44.4	36.1
8. Retrocession covers	15.2	25.8	33.3	25.7
9. The ceding company underwriting policy	0.0	0.0	25.4	75.4
10. The competition in reinsurance market	10.8	30.7	38.5	20.8
11. Political aspects	16.4	26.6	43.0	14.0
12. The economic position of ceding co.'s country	6.3	18.0	56.3	19.5
13. Other factors added by the underwriters				

- Ceding company management
- Habits of paying balance
- Prospective of profitability
- accounting system

(C)- UNDERWRITING IN GENERAL

To answer the following please mark YES or NO

(1)- Do you think that the underwriting:

	YES	NO
Is an art	32.3	67.7
Is acquired by experience	99.2	0.8
Needs personal characteristics and and pit background	79.3	20.7
Needs scientific Background and some experience	74.0	26.0

- Other variables added by the underwriters

- Needs inteligence and common sence.

(2)- The underwriter's decision depends upon:

	YES	NO
His experience and ability as an underwriter	97.7	2.3
The result of cover under investigation only	26.4	73.6
the data in the offer	84.1	15.9
The prediction of profititability by some formula	34.7	65.3

Other variables added by the underwriting

- Results of similar offers
- Accumulation
- Class experience

(3)- Do you agree with the idea that mathematical models:

	YES	NO
Are important for making underwriting decisions	30.4	69.4
May be helpful in making underwriting decisions	91.3	8.7
Will not play any important part in underwriting	29.1	70.9
Are already used	53.1	46.9

Other variables added by the underwriters

- Are used for very special cases (non-proportional)
- Are already used but not enough
- Are sensible and are used sensibly

(4)- What do you think about computerizing the underwriting decision ?

	YES	NO
Some factors' affect can not be qualitative	92.4	7.6
It is already fully computerised	2.5	97.5
It is already partly computerised	47.5	52.5
It is a personal decision	85.2	14.8
It is too complicated to be done by computer	52.5	47.5

Other variables added by the underwriters

- It is a mixture ie. is part art and part science
- Decision can not be computerized, but computer can ably assist underwriter in arriving at decision

(5)- The main source of underwriting information are:

	YES	NO
His own experience	94.0	6.00
Data mentioned in the offers	89.5	10.5
His company file data	83.7	16.3
His company reports	74.2	25.8
Other companies' reports	52.8	47.2
Conference and Discussion	70.9	29.1

Other sourcs added by the underwriters

- Publications
- Insurance magazine
- Other companies exoerience
- Information provided by Lloyds
- Courses, seminars, and review books

(D)- RETENTION

Please find hereunder factors which may be considered in determining the retention. Also there are four possibilities for the effect of each factor, please tick the box showing the best answer:

Factor	I think that factor has			
	NO EFFECT	WEAK EFFECT	MEDIUM EFFECT	STRONG EFFECT
1. PROFITABILITY OF COVERS ACCEPTED	7.6	13.7	41.2	37.4
2. liability limits of covers	2.3	6.9	24.4	66.4
3. The fluctuation in results	2.3	23.5	49.2	25.0
4. Nature risks covered	0.1	1.6	31.8	65.9
5. The frequency of losses	3.0	8.3	40.2	48.5
6. Bulk of business (portfolio size)	6.6	9.8	46.7	36.9
7. Accumulation	0.0	4.7	22.0	73.2
8. The cost of retrocession (reinsurance) cover	3.1	43.1	48.8	14.0
9. The main currencies of transaction	25.2	35.1	31.3	8.4
10. The underwriting policy	0.0	4.6	27.7	67.7
11. Capital and reserves	0.1	16.3	38.8	44.2
12. Premium income	3.8	24.6	37.7	33.8
13. Covers available in reinsurance market	6.9	35.4	44.6	13.1
14. The government retrictions	20.9	36.4	19.4	22.5
15. Management expenses	6.0	50.0	34.6	5.4
16. Other factors added by the underwriters				

- Alteration in clauses
- Current underwriting philosophy

To answer the following, please tick the box showing your openion:

Retention is determined with:

	YES	NO
Establishing the"probability maximum loss"	76.0	24.0
Analysing the factors affect the results	71.3	28.7
Using a simple formula	48.7	51.3
Using a complicated formula (computerized)	13.9	86.1
Studing main risks and catastrophies experience	88.3	11.7

Studing reinsurance market capacity	39.2	60.8
Analyse the fluctuation in technical result	68.3	31.7

(F)- RENEWAL DECISION

(1)- Please find hereunder some factors which may be considered in making decision on renewal the participation of the cover. Please tick the box showing the best answer.

Factor	I think that factor has			
	NO EFFECT	WEAK EFFECT	MEDIUM EFFECT	STRONG EFFECT
1. Technical result of cover (the profitability)	0.0	0.0	1.5	78.5
2. The result of reciprocity	9.8	25.6	41.4	23.3
3. Outstanding losses	6.1	4.5	33.3	56.1
4. Premium income	5.2	16.4	50.0	28.4
5. Settlement of balances	0.0	9.9	35.1	55.0
6. Monetary restrictions	0.1	22.1	32.5	44.3
7. Changes in clauses	9.1	33.9	51.2	5.8
8. The changes in the ceding share	7.4	48.4	32.8	11.5
9. The relationship with				
10. The ceding company	0.0	19.7	43.9	36.4
11. Other factors added by the underwriters				

- Changes in primary market pricing
- Changes in underwriting policy of the ceding company
- Class trends
- Probablity of the future profit

To answer the following, please tick the box showing your opinion.

(2)- Do you think the following factors are considered in preparing the technical result of the reinsurance covers ?

	YES	NO
Changes in rate of exchange for foreign currencies	85.8	14.2
The interest on premium	59.5	40.5
The interest on claims paid	49.6	50.4
Incurred but not report events	88.5	11.5
The outstanding losses	99.2	0.8
The management expenses	69.3	30.7

(3)- The results are prepared:

	YES	NO
Manually	55.8	44.2
With original currencies	77.9	22.1
After transfer items to the national currency	69.7	30.3
Partly computerized	55.9	44.1
Fully computerized	30.1	69.9

(4)- The renewal decision:

	YES	NO
Depends on the technical results	99.2	0.8
Is a personal decision	79.1	20.9
Is partly computerized	31.3	68.7
Fully computerized	0.0	100.0

APPENDIX NO: TWO

The text of the clauses is as follows:

A- UNDERWRITING POLICY CLAUSE

The tariffs and policies used in the classes of insurance falling within the scope of the treaty shall form an integral part of the treaty. The REINSURED shall inform the REINSURER of any significant changes which are effected in these documents.

The REINSURED undertakes not to introduce any change in its established acceptance and underwriting policy in respect of the classes of insurance covered under this treaty without prior approval by the REINSURER. Any proportional reinsurance arrangement relating thereto shall be maintained or deemed to be maintained unaltered.

B- FOLLOW THE FORTUNE CLAUSE

Subject to the stipulation and limitations of this treaty, the REINSURER assumes the risk that the REINSURED becomes liable to pay under his insurance contracts including cover notes, to this extent the REINSURER follows the fortunes of the REINSURED.

The REINSURED shall be free to conduct as he thinks fit all business falling under this treaty. The measures and decisions taken by a

responsible official, an employee or the outside services of the REINSURED as regards the risks falling under the insurance contracts and cover notes shall be binding on the REINSURER, unless such measure or decision is manifestly in breach of the interests of the REINSURER.

Failer to take a measure or decision shall be deemed a "measure" or "decision" within the meaning of this clause.

The REINSURED shall at their sole discretion make payments on account, grant interest-free loans, compromise, settle or pay ex-gratia any claim or investigate, resist, contest, defind or recover any claim by legal proceeding or otherwise, undertake salvage or other operations and generally take any steps or measure, legal or otherwise, which in their judgment steps or may be beneficial for the defence, safeguard and/or recovery of the interests insured and the REINSURER shall be bound by the REINSURED's decision in all such matters and shall contribute a poroportionate share of all payments, loans, charge costs and expenses (except salaries of the REINSURED's officials) legal or otherwise but shall be entitled to a proportinate share of any salvage or recoveries.

C- RIGHT OF INSPECTION CLAUSE

The REINSURER, at any time during normal office houres and at any place where they shall be kept, inspect the REINSURED's records, books, accounts, and any documents relating to business covered under

this treaty, but where arbitration or legal proceeding are pending between the parties hereto this right of inspection shall only be exercised through a representative who is not an employee of the REINSURER.

The REINSURER shall advice the REINSURED of his intention to exercise his right of inspection at least forty-eight hours in advance.

The REINSURER's right of inspection shall exist as long as one of the parties hereto has a claim against the other party originating from business arising under this treaty, even after its termination.

Upon request, the REINSURED shall supply the REINSURER, at the REINSURER expense, with copies of the whole or any part of the REINSURED's record, books, accounts and any documents relating to business ceded under this treaty.

D- EXCLUSIONS CLAUSE

It is agreed that, in addition to the exclusions specified in the SPECIAL CONDITIONS, this treaty shall not apply to:

I- Obligatory reinsurance or retrocession treaties

II- It is further agreed that from the scope of this treaty shall be excluded any loss directly or indirectly caused by:

(a)- War, invasion, act of foreign enemy, hositilities or war-like operations (whether war be decleared or not), civil war.

(b)- Mutiny, civil commotion assuming the proportions of or amounting to a popular rising, military rising, insurrection, rebellion revolution, military or usurped power, or any act of any person acting on behalf of or in connection with any organization with activity directed towards the overthrow by force of its government de jure or de facto or to the influencing of it by terrorism or violence.

E- CURRENCY CLAUSE

Cession shall be made in the original currencies but accounts shall be rendered and settled in . . . FOR this purpose other currencies shall be converted into .... at the rates at which the original payments to or by the REINSURED were taken into the REINSURED's books, or failing this at the rate of exchange ruling on the last day of the month in which the payments were taken in foreign currency in the company's branch or agency account. The REINSURED shall not be obliged to alter cession already made on policies in foreign currencies as a result of fluctuation in the rate of exchange, and the REINSURER shall be liable for their share of losses and expenses as converted into .... in the manner set above.

For calculation of gross retention in the case of currencies other than ..... the mean rate of exchange ruling on the last day of the month at which the policy is closed shall be used.

F- STABILITY CLAUSE

It is the intention of this treaty that the deductible of the REINSURED and the limit of the liability of the REINSURER as set out in the SPECIAL CONDITIONS shall retain their relative values which exist at .....

At the date of payment of any claim the change in relative monetary value shall be ascertained from the latest available index of....

If the index figure at the date of payment of a claim shows a variation of more than 10 % from ..... then the deductible of the REINSURED and the limit of the liability of the REINSURER shall be increased in the index from ..... to the date of payment of the claim.

The date of payment of any claim for the purpose of this treaty shall be deemed to be as follows:

(a)- If no award is made by the court, the actual date upon which payment is made by the REINSURED,

(b)- The date an award is made by a court (if no Apeal is made),

(c)- The date an award is made by the Apeal Court if the case goes to Apeal,

(d)- In the event of a loss being settled in more than one payment, not withstanding anything to the contrary contained in sub-paragraphs a), b), and c) above, any advance payment in respect

of any claimant and the index used at the time of the final payment shall be the one employed to ascertain the deductible of the REINSURED and the limit of the liability of the REINSURER in respect of all payments to the respective claimant.

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