PORTFOLIO INVESTMENTS IN EMERGING MARKETS

AN EMPIRICAL ANALYSIS OF DIVERSIFICATION BENEFITS

Thesis submitted for the Award of

DOCTOR OF PHILOSOPHY

(Ph. D.)

In

COMMERCE

by

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APRIL 1998

STATEMENT BY THE CANDIDATE

I, Uma Shashikant, hereby declare that this thesis for Ph.D. Degree in Commerce titled "Portfolio Investments In Emerging Markets : An Empirical Analysis of Diversification Benefits, " is a bonafide record of independent research work done by me under the guidance and supervision of Dr. B. Ramesh, Reader, Head and Chairman, Department of Commerce, Goa University. I also declare that this dissertation, or part thereof, has not previously formed the basis for award of any Degree, Diploma, Associateship, Fellowship or any other similar title.

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CERTIFICATE OF THE RESEARCH GUIDE

I hereby certify that this thesis for Ph.D. Degree in Commerce titled "Portfolio Investments In Emerging Markets : An Empirical Analysis of Diversification Benefits, " is a bonafide record of independent research work done by Uma Shashikant, Research Scholar, Department of Commerce, Goa University, under my guidance and supervision. I also certify that this dissertation, or part thereof, has not previously formed the basis for award of any Degree, Diploma, Associateship, Fellowship or any other similar title.

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Uma Shashikant
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STATEMENT ON CONTRIBUTION OF THE THESIS

The 1990s have seen a remarkable increase in international investments, as more and more institutional investors have increased their allocations to foreign assets. One of the important features of the globalisation of portfolios is the growing allocation to emerging markets. The present study seeks to examine the diversification benefits from international investing, with specific reference to emerging markets. Most research on international investments focusses on developed markets; there is limited work on emerging markets.

The following are the major research objectives:

a. To examine risk and return characteristics of emerging markets and compare and contrast them with empirical evidence in the context of developed markets;
b. To empirically verify the diversification benefits from investing in emerging markets;
c. To analyse the intertemporal stability and predictability of the correlation structure, with the view to understanding diversification benefits; and
d. To attempt an explanation of prevalence and persistence of diversification benefits.

The study is one of first that examines diversification benefits and the behaviour of emerging market correlations. It is an important contribution towards understanding emerging markets as an asset class in the international markets, and provides important evidences on the risk-return and diversification attributes of emerging markets in an international context.

In the context of liberalisation of the Indian markets, it is crucial to understand the relative attractiveness of Indian markets to global investors; the major motivations for international diversification; and the issues in international diversification. The recent concerns about increase in market volatility after liberalisation, the exposure of Indian markets to developments in other markets, and the reduction in diversification benefits in the context of growing integration have all been addressed in this study, and empirical evidence on each of these issues is presented.

The findings are useful to international portfolio managers, local investors and policy makers who have to appreciate the implications of global investing. This study also initiates research in an area of growing concern and interest and has the potential to trigger more research into emerging markets and international diversification.

1. Emerging Markets and International Investment

1.1 Emerging Markets : Definition and Classification

The International Finance Corporation(IFC), a subsidiary of the World Bank, first coined the term emerging markets and defined them thus[1]: " The term 'emerging market' can imply that a process of change is underway, with stock markets growing in size and sophistication, in contrast to markets that are small and stagnant. The term can also refer to any market in a developing economy, with the implication that all have the potential for development."

The above definition was proposed in 1986, when promotion of capital markets was taken up by a team of IFC experts. IFC also floated the first emerging markets fund in 1986, with a corpus of $ 50 million, subscribed by institutional investors, for exclusively investing in emerging capital markets. The IFC's definition was originally aligned with the economic status of a country. All markets located in countries that were classified as low-income or middle-income economies, were classified as emerging markets. This classification was based on the GNP per capita of the country, the threshold for which was defined by the World Bank, every year. Thus any country whose per capita GNP did not exceed $9,386 in 1996 is eligible to be classified as having an emerging market, as per the most recently defined threshold.

Recently, IFC has recognised the economic criteria as inadequate in defining emerging markets, and has suggested another criterion which is more broadly

defined, called the " Developing stock market criterion". This criterion will consist of pre-determined quantitative measures applied to the stock markets, irrespective of the economic classification of the country. IFC has not yet finalised the criterion. The objective is to be able to include markets in high-income countries, which continue to have lesser developed capital markets, and be able to track emerging markets whose GNP has crossed the World Bank threshold, but whose capital markets are still emerging. An emerging market would then be one that satisfies one of the above criteria. Since the IFC has the most extensive and long term data base on emerging markets, most research on emerging markets uses the IFC definition and the IFC's Emerging Markets Data Base (EMDB).

According to the IFC's classification, there are 158 emerging markets and 51 developed markets as at the end of 1996. With GNP of $ 5179 billion, emerging markets command a mere 19% share of the World GNP; but with a population of 4772 millions, they command a 84%` share of the world population. The average GNP per capita of emerging markets is $1085 compared to $24, 926 for developed markets, and the World average of $4880.

IFC began to track the performance of emerging markets in 1981, when it began to compile emerging stock market indices for 10 markets. The database has grown by December 1996, to cover 70 markets, of which 44 markets are included in the IFC indices. The emerging markets tracked by the EMDB as at the end of December 1996 are listed in Table 1.1.

Table 1.1

Emerging Markets tracked by the IFC

Market	Date of Inclusion in the IFC EMDB	Market	Date of Inclusion in the IFC EMDB
Latin America		Sri Lanka	Dec. 1992
Argentina	Dec. 1975	Thailand	Dec. 1975
Brazil	Dec. 1975	**Europe/Mid East/Africa**	
Chile	Dec. 1975	Czech Republic	Dec. 1993
Columbia	Dec. 1984	Egypt	Dec. 1995
Mexico	Dec. 1975	Greece	Dec. 1975
Peru	Dec. 1992	Hungary	Dec. 1992
Venezuela	Dec. 1984	Jordan	Dec. 1978
East Asia		Morocco	Dec. 1995
China	Dec. 1992	Nigeria	Dec. 1984
Korea	Dec. 1975	Poland	Dec. 1992
Philippines	Dec. 1984	Portugal	Jan 1986
Taiwan, China	Dec. 1984	Russia	Dec. 1995
South Asia		Slovakia	Dec. 1995
India	Dec. 1975	South Africa	Dec. 1992
Indonesia	Dec. 1989	Turkey	Dec. 1986
Malaysia	Dec. 1984	Zimbabwe	Dec. 1975
Pakistan	Dec. 1984	Frontier Markets	Dec. 1995

IFC Frontier markets include Bangladesh, Botswana, Bulgaria, Cote d'Ivoire, Ecuador, Ghana, Jamaica, Kenya, Lithuania, Mauritius, Slovakia, Slovenia, Trinidad & Tobago and Tunisia.

1.2 Growing Importance of Emerging Markets

International investor interest in emerging markets has grown very significantly in the 1990s. The following are important trends in the flow of long term funds into emerging markets, that underline the growing importance of private investments in emerging markets[2] :

a) Aggregate resource flows into emerging markets has gone up from US $69 billion in 1984 to $100.3 bn in 1990, and rising to $284.6 bn in 1996, a more than four-fold increase in 12 years.

b) There is a marked shift away from official development finance to private flows. Private flows in the form of private equity, debt and foreign direct investments now dominate the long term flows into emerging markets. In 1984, 48.5% of resource flows were official and 51.5% were private flows. The percentage share of private flows has since risen to 63% in 1992 and to 85.66% in 1996.

c) Private equity investment in emerging markets was merely $0.2 billion in 1984. This figure has steadily moved up to $3.2 billion in 1990, touching a record high of $45.7 bn in 1996.

d) Foreign direct investment is the dominant form of private flows to emerging markets until the 1990s. Since 1992, portfolio flows have gained in importance, and registered the highest growth for all types of flows, from $3.2 billion in 1990 to over $ 45 billion in 1996.

e) Portfolio flows to emerging markets is largely concentrated, with nearly three-quarters of the flows going to the top 10 countries.

Table 1.2

Aggregate Net Long Term Resource Flows to Emerging Markets (US $ Billion)

	1984	1990	1993	1994	1995	1996
Official Development Finance	33.4	56.3	55	45.7	53	40.8
Private Debt Flows	26	16.6	44.9	44.9	56.7	88.6
Portfolio Equity	0.2	3.2	45	32.7	32.1	45.7
Foreign Direct Investment	9.4	24.2	67.2	83.7	95.5	109.5
Total Private	35.6	44	157.1	161.3	184.2	243.8
Aggregate Net Resource Flows	69	100.3	212	207	237.2	284.6

Source : World Debt Tables, World Bank, 1997

The important factors that have contributed to the growing international interest in emerging markets are as follows:

1.2.1 Differential economic growth rates and cycles

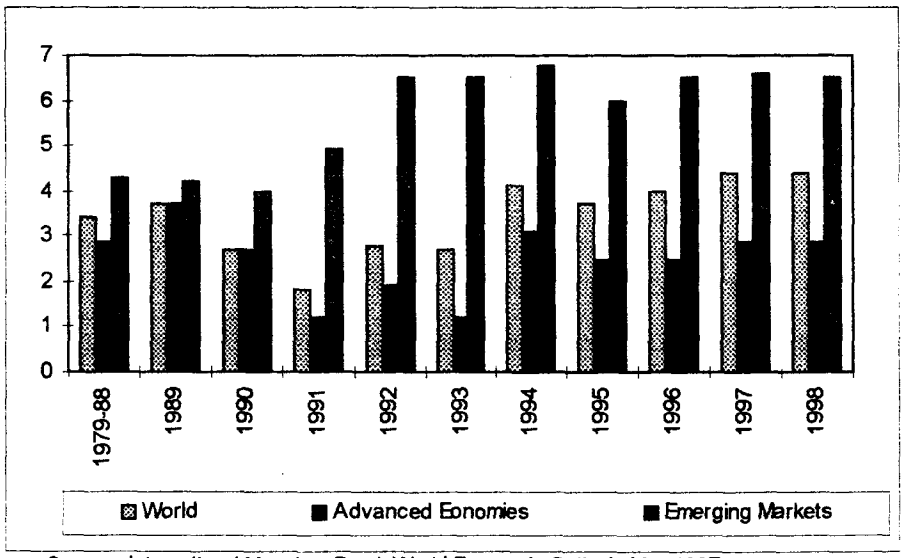
Developing economies have consistently recorded higher growth in economic activity, as compared to their developed counterparts. It is now widely acknowledged that while developed economies have reached a stage of saturated growth, opportunities for growth prevail and expand in the emerging market economies. The chief causes that are ascribed to the superior performance of emerging market economies are : Structural reforms that have enhanced the role of market forces, and strengthened the basis for sustained growth; trade integration and liberalisation of external payments leading to higher earnings from export orientation; and changes in the role of the state through privatisation and

deregulation. Developing economies have therefore become increasingly attractive destinations for international investors, seeking higher return than what is available in the developed economies. Figure 1.1 depicts the growth rates for the world, developed economies and emerging market economies.

It can also be seen that economic cycles have been different for developed and emerging economies. During the period 1989 to 1993 when both world output and the GDPs of developed economies shrank due to depressed economic conditions, many developing economies expanded and continued to grow. Developing economies therefore not only represent higher growth rates, but also low level of integration with the developed economies.

Figure 1.1

Growth in Real GDP : World, Developed and Emerging Market Economies



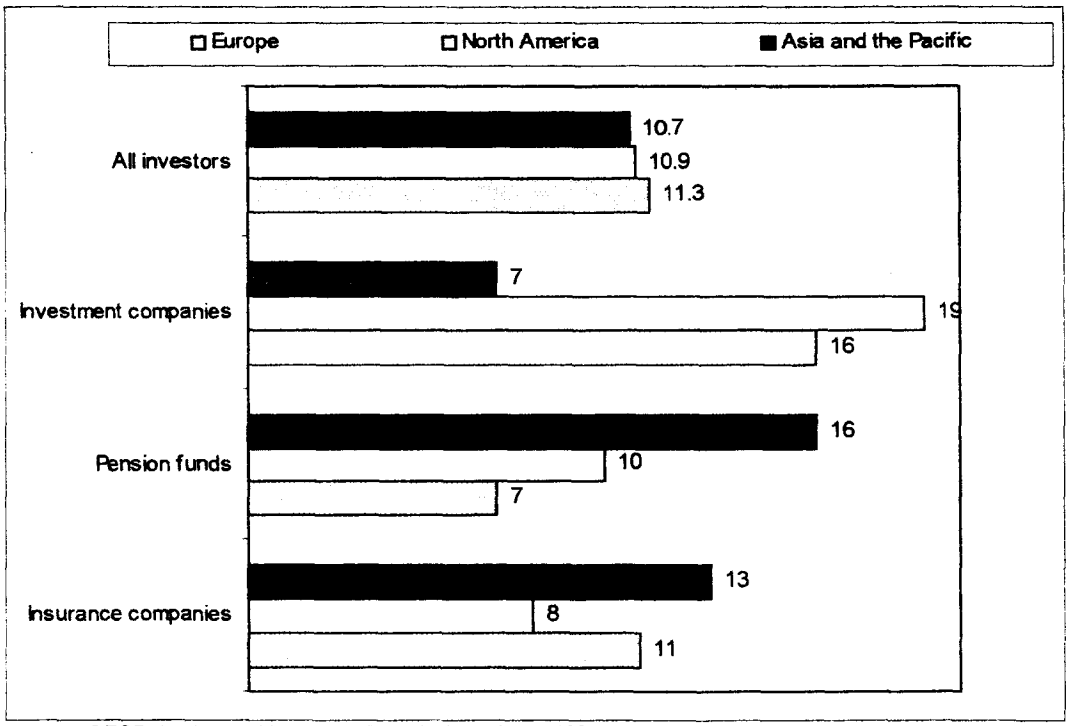
Source : International Monetary Fund, World Economic Outlook, May 1997.
Figures for 1997 and 1988 are World Bank estimates.

1.2.2 Higher institutional interest in international investing

Institutional investors such as life insurance companies, pension funds and investment funds have registered significant growth in size in the past decade. According to the estimates of OECD[3], total institutional assets in the OECD area have grown from $3.2 trillion in 1980 (38% of GDP) to $16.3 trillion (90% of GDP) in 1990, and to $24.3 trillion in 1995 (106.5% of GDP). In comparison to these holdings of institutional investors, the size of the global equity market was a mere $17.79 trillion in 1995. The average annual growth rate of institutional investors in the OECD region is set out below:

Figure 1.2

Average annual rate of growth of institutional investors in the OECD region



Source : OECD, Institutional Investors, Statistical Yearbook, 1997.

While it has been established that institutional investors play a significant role in the capital markets of their countries, it has been noted that the share of foreign securities in their portfolios has been increasing, particularly in the 1990s. In the United States[4], for instance, the allocation of pension assets to international equity and debt has gone up from 1.8% in 1984 to 14.6% in 1996. The share of international and global funds in the mutual fund industry has also moved up in the same period, from 3.8% to 13.6 %. There is a gradual and clear trend towards internationally diversified portfolios, among the large institutional investors. Portfolios of insurance companies are conservatively managed and do not have much international exposure. But pension fund portfolios have shown the highest appetite for international assets, driven by the need to diversify risk on the one hand, and enhance returns on the other.

Pension funds are increasingly becoming large investors in capital markets in many countries across the world, due to the growing problem of under-funded pension plans that are unable to service growing aging populations. The challenges posed by the aging populations of the developed countries on the social security systems and public policy, are now being very widely debated. The elderly dependency ratios (population aged 65 and above, as a percentage of population aged 15 - 64) for developed countries have been steadily increasing, and projections indicate that by the year 2050, dependency ratios in many developed countries will average at 65%, up from 50% in 1995[5]. In response to the need to fund pension plans, most countries have moved towards pension reforms, that envisage mandatory privately managed pension funds, that allocate assets in a manner that enhances returns, while managing risks prudently. International investments by large pension funds

have only begun to happen, and can be expected to substantially increase in the coming years. Pension funds may well become the largest international asset managers of the next century, driven by their fiduciary necessity to diversify and seek better returns.

1.2.3 Greater access to emerging markets

The late 1980s and the 1990s have seen the opening up of many emerging markets for investments by foreign institutional investors, and the setting up of stock exchanges and liberalisation of capital markets in many others. This has facilitated cross border investments into emerging markets, significantly. Table 1.3 summarises the changes in investment regulations over the period 1988 - 1996.

Large markets such as Brazil, India, Korea, Turkey and Taiwan were opened to foreign portfolio investment in 1990s. The only route available to investing in these markets were offshore funds. Some forms of restrictions are still prevalent in many emerging markets. In order to invest in Columbia, India and Taiwan, prior registration is required. In markets like China and Philippines only certain classes of shares are available to foreign investors. In markets like Chile, Korea and Indonesia, some restrictions on types of investors and limits on holdings apply. However, compared to the situation in the last decade, a series of deregulatory measures have been taken by emerging markets to attract foreign investors, removal of barriers to entry being the most important of them.

Table 1.3 - Degree of Access to Emerging Markets by Foreign Investors

	1988	1996
Argentina	Relatively Free Entry	Free
Brazil	Offshore Funds only	Free
Chile	Relatively free entry	Relatively Free Entry
Columbia	Closed for foreign investors	Authorised foreign investors only
Costa Rica	Relatively free entry	Free
Jamaica	Relatively free entry	Relatively Free Entry
Mexico	Special class of shares	Free
Peru	Closed for foreign investors	Free
Trini & Tobago	Relatively free entry	Relatively Free Entry
Venezuela	Relatively free entry	Relatively Free Entry
India	Offshore Funds only	Authorised foreign investors
Pakistan	Closed for foreign investors	Free
Korea	Offshore Funds only	Relatively Free Entry
Taiwan	Offshore Funds only	Authorised foreign investors
Thailand	Relatively free entry	Relatively Free Entry
Malaysia	Free	Free
Philippines	Special Class Of Shares	Special Class Of Shares Only
Indonesia	Relatively free entry	Relatively Free Entry
Nigeria	Closed for foreign investors	Free
Kenya	Relatively free entry	Relatively Free Entry
Sri Lanka	Relatively free entry	Relatively Free Entry
Turkey	Offshore Funds only	Free
Greece	Relatively free entry	Free
Bangladesh	Closed for foreign investors	Free
China	Closed for foreign investors	Special Class Of Shares Only

Source : IFC, Emerging Stock Markets Factbook, 1989 & 1997.

Free entry : No restrictions on foreign investors buying stocks; Relatively Free Entry : Some registration procedures or limits on foreign ownership; Special Classes : Foreign investment restricted to certain classes of shares; Authorised Investors : Prior approval by Regulatory authority required. Closed : Markets not open to foreign investments.

1.2.4 Wider choice of investment vehicles

Rapid changes in the international capital markets and the growing tendency towards globalisation of financial markets, have increased the access to emerging markets through multiple channels. International investors can now choose from emerging market equity that is listed on foreign stock exchanges, mutual funds that invest in emerging markets, offshore funds that focus on emerging equity and bond markets, investments in Global Depository Receipts and American Depository Receipts[1] issued by emerging market companies, private equity investments and direct investment in the emerging markets. Most of these choices emerged only in the last decade, before which, the only route available to most international investors was subscription to emerging market close-ended funds, which themselves were available only from the mid-eighties.

International bond issues by emerging markets have grown from 7.6% of total issuance in 1990 to 12.4% in 1996. The quantum of funds raised through bond issuance has also moved up from $ 20.4 billion in 1990 to $ 123 billion in 1996[6]. In the past 4 years, ADR/GDR issues from emerging market issuers have grown in popularity, growing from $3.4 billion in 1993 to $ 9 billion in 1996. In 1996 alone 144 ADR issues by emerging market companies were made. About 28% of global equity issuance is accounted for by emerging markets, and 70% of these issues are ADRs/GDRs[7]. International emerging market funds have grown from 449 funds

[1] GDRs and ADRs are dollar-denominated issues of equity from emerging markets, which are issued by depositories that buyout equity and subsequently offer DRs to international investors. These DRs are listed and traded on international exchanges, and can be converted into underlying equity at the behest of the investor. GDRs are issued and traded in markets outside the United States. ADRs are issued and listed on US stock exchanges.

with $ 29 billion in assets in 1992, to 1560 funds with $ 140 billion under management in 1996[8].

1.3 Growth of Emerging Markets

Emerging markets can be broadly classified into three categories : markets which have stock exchanges that were established long ago, but had not played a central role in resource allocation until the recent past; markets which have been newly established; and markets in developing countries which have grown significantly in the recent years.

Market capitalisation of emerging markets has grown phenomenally in the recent years, from $331.75 billion in 1987 to $2.226 trillion in 1996. The share of emerging markets in world market capitalisation has grown in the same period, from 4.24% to 11.03%, peaking at 12.66% in 1994. (See Table 1.4). In terms of the December 1996 figures, markets such as Brazil, Taiwan, South Africa and Korea have market capitalisations that are higher than some developed markets. The phenomenal growth in listed stocks in many emerging markets primarily comes from the privatisation programmes undertaken in many of them. As at the end of December 1996, listed stock in emerging markets exceeds the numbers for developed markets. While emerging markets as a whole registered a 97% increase in listed stock in the last decade, the developed markets saw a much smaller 12% increase. Emerging market capitalisation has registered a 571% growth in the last decade alone, compared to 140% for developed markets and 157% for the world as a whole.

Table 1.4 - Growth in Emerging Markets : Some Indicators

	Market Capitalisation ($ million)			Listed stocks		
Emerging Markets	**1987**	**1996**	**% change**	**1987**	**1996**	**% change**
Argentina	1519	44679	2841.34	206	147	-28.64
Brazil	16900	216990	1183.96	590	551	-6.61
Chile	5341	65940	1134.60	209	291	39.23
China	-	113755		-	540	
Columbia	1255	17137	1265.50	96	189	96.88
Czech	-	18077		-	1588	
Egypt	2150	14173	559.21	430	646	50.23
Greece	4464	24178	441.62	116	224	93.10
Hungary	-	5273		-	45	
India	17057	122605	618.80	5560	8800	58.27
Indonesia	68	91016	133747.1	24	253	954.17
Jordan	2643	4551	72.19	101	98	-2.97
Korea	32905	138817	321.87	389	760	95.37
Malaysia	18531	307179	1557.65	232	621	167.67
Mexico	8371	106540	1172.73	190	193	1.58
Nigeria	974	3560	265.50	100	183	83.00
Pakistan	1960	10639	442.81	379	782	106.33
Peru	831	12291	1379.06	197	231	17.26
Philippines	2948	80649	2635.72	138	2161	1465.94
Poland	-	8390		-	83	
Portugal	8857	24664	178.47	143	158	10.49
South Africa	128663	241571	87.75	838	626	-25.30
Sri Lanka	608	1848	203.95	168	235	39.88
Taiwan	48634	273608	462.59	141	382	170.92
Thailand	5485	99828	1720.02	125	454	263.20
Turkey	3221	30020	832.01	50	229	358.00
Venezuela	2278	10055	341.40	110	88	-20.00
Zimbabwe	718	3635	406.27	53	64	20.75
All Emerging Markets	331747	2225957	570.98	11296	22263	97.09
Developed Markets	7499071	17951705	139.39	17982	20141	12.01
World	7830818	20177662	157.67	29278	42404	44.83

Source : IFC, Emerging Markets Factbook, 1997.

1.4 Emerging Markets as a Distinct Asset Class

Emerging markets have emerged as a distinct asset class for international investors due to the risk-return trade-off available on them. It is well established that investment in equity provides higher returns than all the other asset classes like bonds, treasury instruments and real estate[9].

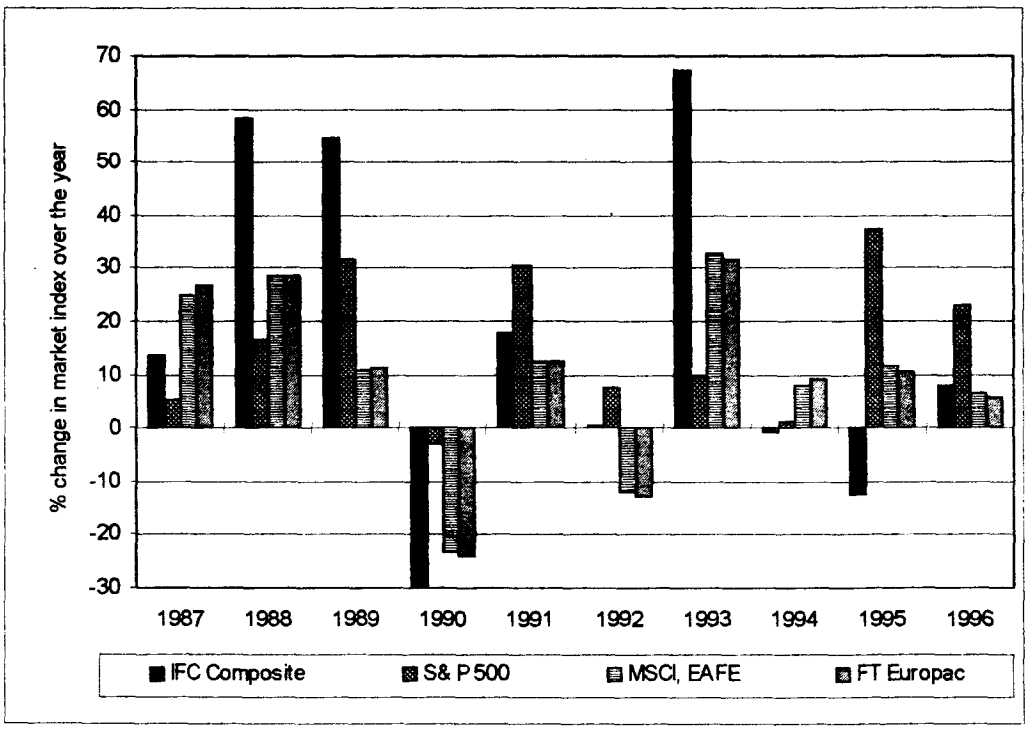
It would be useful to compare emerging market equity performance with what is known in the developed market context. Figure 1.3 below depicts performance of emerging markets in the last 10 years. It can be seen that the performance of emerging markets is at best mixed, with some years being better and some worse. There is also higher volatility in emerging market indices. It has been observed that emerging markets provide higher returns, albeit with higher risk, to international investors[2].

It is also important to note that what we have shown in Figure 1.3 is a summary measurement for all emerging markets. There are important regional and market-wise differences amongst emerging markets. In the past 10 years, 9 out of ten times, the highest return in any year has been in an emerging market. The differences in risk and return behaviour of emerging markets has led to some fine tuning in international investment strategies and the allocation now being market driven, rather than being regional or into emerging markets as one homogenous asset class.

[2] We will examine emerging market risk-return behavior in greater detail in Chapter 3.

Investors in emerging markets have to also contend with exchange rate fluctuations that can undermine the returns that are earned. In order to be able to delineate performance on comparable terms, most studies on international markets use dollar denominated returns. We have also adhered to the same convention in this study, and state all returns in dollar terms.

Figure 1.3 : Performance of Emerging and Developed Market Equity Indices : 1987 - 1996



Source : IFC, Emerging Stock Markets Factbook 1997.

1.5 Emerging Markets : Some Qualitative Considerations

International investors have begun to take note of emerging markets as a possible investment avenue only in the 1990s. Most investment expertise focuses on and still remains largely concentrated in developed markets. The flurry of activity in emerging markets, arising out of factors we have discussed above, has brought to focus the qualitative differences between emerging and developed markets. To an international investor, these differences would mean that returns that are possible from this asset class have to be tempered accordingly.

1.5.1 Limited Liquidity in markets

Emerging markets have grown in size and market capitalisation in the recent years, as we discussed in Section 1.3 above. But the extent of activity in many of these markets is very low, as evidenced in low traded volumes and low turnover ratios. This is due in part to the lack of local institutional investors in many markets and the huge state holding in many listed companies which have been recently privatised. In some other markets, market structures are new and evolving, leading to low liquidity and turnover. In some of the markets, the average size of the listed stock is so low, that liquidity and trading activity are also low. These factors technically imply that all listed stock may not be available for foreign investors, and that they would have to contend with a sub-set of listed stocks, which are liquid and actively traded. In most emerging markets such a sub-set is concentrated in few stocks. These markets are lopsided with a small number of stocks accounting for a major proportion of both market capitalisation and trading activity.

It can be seen from the Table 1.5 that there are vast qualitative differences among emerging markets. The average size of listed stock in few markets like Taiwan, Mexico and Malaysia are comparable to the world average, while the average for the asset class as a whole is just about $ 100 million, about one-tenth the average size of stocks in the developed markets. The level of activity in many emerging stock markets is as good as the world average. Turkey, Taiwan, China, India, Poland and Malaysia are prime examples. However, in many large markets, volume of activity is very small, Argentina, Columbia and South Africa being significant example of high market capitalisation, but low trading volume. There is an improvement in trading activity in many emerging markets in the decade under examination, indicative of the maturing of many of these markets during the period. Turkey, India, Indonesia and China are markets that have made significant improvements in liquidity during the period.

Market concentration is a significant problem in many emerging markets, with few stocks accounting for most of the market or most of the volume, reducing the scope for holding a diversified portfolio of stocks, and lopsided liquidity in listed stocks. The concentration is much higher in markets where privatisations of large companies have taken place, as in the Eastern European countries in particular. Trading concentration is high in many new markets like Russia, Venezuela, Morocco and Nigeria. India is a prime example of an old and otherwise well developed market with largest number of listed stocks, but smaller average size, resulting in high trading concentration.

Table 1.5 - Indicators of Liquidity in Emerging Markets

	Average Size of listed Stock ($ mn)		Turnover ratio		Market Concentration with respect to	
Markets	1987	1996	1987	1996	Mkt. Cap	Val. Traded
Argentina	7.37	303.94	0.17	0.10	50	57.4
Brazil	28.64	393.81	0.57	0.52	37.4	61.5
Chile	25.56	226.60	0.09	0.13	39.8	52.6
China	-	210.66	-	2.25	18.7	13.7
Columbia	13.07	90.67	0.06	0.08	44.1	62.7
Czech	-	11.38	-	0.47	54.4	4
Egypt	5.00	21.94	0.06	0.17	32.5	37.7
Greece	38.48	107.94	0.10	0.34	59.5	31.2
Hungary	-	117.18	-	0.31	80.8	64.3
India	3.07	13.93	0.40	0.89	20.4	74
Indonesia	2.83	359.75	0.04	0.35	51.1	36.2
Jordan	26.17	46.44	0.16	0.07	58.5	49.7
Korea	84.59	182.65	0.76	1.28	29.1	11.9
Malaysia	79.88	494.65	0.21	0.57	27.9	9.5
Mexico	44.06	552.02	1.86	0.40	33.3	43.6
Morocco	4.70	185.21	0.02	0.05	63.2	78.6
Nigeria	9.74	19.45	0.01	0.02	49.5	65.3
Pakistan	5.17	13.60	0.08	0.57	31.4	90.1
Peru	4.22	53.21	0.36	0.31	55	54.8
Philippines	21.36	37.32	0.52	0.32	35.3	28.8
Poland	-	101.08	-	0.66	53.1	34.1
Portugal	61.94	156.10	0.17	0.29	56.5	61.9
Russia	-	510.00	-	0.08	75.4	82.6
South Africa	153.54	385.90	0.07	0.11	27.4	27.9
Sri Lanka	3.62	7.86	0.02	0.07	38.1	61.3
Taiwan	344.92	716.25	1.73	1.72	31	17.8
Thailand	43.88	219.89	0.84	0.44	35.4	29.2
Turkey	64.42	131.09	0.04	1.23	43.9	31.6
Venezuela	20.71	114.26	0.06	0.13	70.7	71.8
Zimbabwe	13.55	56.80	0.03	0.07	62.1	50.8
All Emerging Markets	29.37	99.98	0.51	0.71	45.52	46.55
Developed Markets	417.03	891.30	0.76	0.67	na	na
World	267.46	475.84	0.75	0.67	na	na

Notes: Turnover ratio = (Value traded/ Market capitalisation). This measure indicates the number of times the market capitalisation is turned over in trading. Market concentration has been measured in two ways: The first column is in terms of market capitalisation, and represents the share of the top 10 listed stocks in the market capitalisation in the market. The second column is in terms of value traded, and measures the share of the top 10 stocks in trading volume on the markets.

1.5.2 Direct and Indirect Barriers to Entry

Though international flows to emerging markets have been largely facilitated by the policy and regulatory initiatives from the emerging markets themselves, some of the direct and indirect barriers to investment remain.

- Ceilings on foreign investments in listed stock continue to prevail in Brazil, Korea, Philippines, Taiwan, India, Indonesia, Thailand, Jordan and Zimbabwe.
- Long term capital gains tax on listed stock are levied in Chile, Hungary, India, Nigeria, Russia, Slovakia and Zimbabwe.
- Income from interest and dividends are subject to withholding taxes in Chile, Greece, India, Indonesia, Korea, Malaysia, Nigeria, Philippines, Poland, Portugal, Russia, Slovakia, Thailand, Taiwan and Zimbabwe.
- Indirect barriers in terms of lack of international institutional structures like electronic payment systems, clearing corporations, custodial services and depositories are prevalent in many emerging markets, making the global investor unfamiliar with local practices.
- Differences in accounting, audit and disclosure practices and regulatory oversight on companies create high levels of diversity among emerging markets.
- Legislation for contracts are not fully in place in many markets, and enforceability is poor in the newly framed security regulations of many emerging markets.
- Derivative markets have begun to function only recently in many emerging markets, limiting the ability of international investors to hedge their risks.

1.6 Chapter Summary

This chapter provides a statistical sketch of emerging markets, and puts together information that characterises emerging markets and the interest of international investors in these markets. There is enough documentation that emerging markets have grown in significance in the recent years, and international investor interest in these markets has been increasing. There is however limited research on benefits from investing in emerging markets.

Research has not conclusively established whether accepted notions on risk, return and diversification that have been well documented in the context of developed markets, can be applied to emerging markets. Given the sudden spurt in interest in emerging market investing, many questions regarding volatility, diversification and sustainability of benefits from investing in emerging markets remain little researched. These questions are important not only for international asset allocation, but also to an overall understanding of motivations for international investments. This study is an important contribution in this direction.

Endnotes:

[1] IFC, Emerging Stock Markets Factbook, 1988 & 1997.

[2] Source : World Bank, Global Development Finance, 1997 & World Debt Tables, 1997.

[3] OECD, Financial Market Trends, Vol. 68, November 1997.

Flow of Funds, Board of Governors of the Federal Reserve System, and Investment Company Institute.

[5] International Monetary Fund, Aging Populations and Public Pension Schemes, Sheetal Chand and Albert Jaeger, December 1996.

[6] OECD, Financial Market Trends, Various Issues.

[7] IMF, International Capital Markets, September 1997.

[8] Micropal emerging Market Fund Monitor, Micropal, June 1997.

[9] Ibbotson Associates, Stock Bills Bonds and Inflation :Yearbook , provides statistical accounts of performance of various asset classes in a time series that begins in 1929.

2. Benefits from Diversification into Emerging Markets Theories and Evidence*

Research on international investing has focussed predominantly on developed markets. There is extensive evidence on diversification and risk in international investments, in the context of European markets and American markets. Emerging markets have come into sharp focus only in the 1990s. Research on emerging markets is not as extensive, nor have all the issues been examined in detail. The lack of availability of data on emerging markets was an important deterrent to empirical research. The setting up of the IFC's Emerging Markets Data Base, and the growing coverage of emerging markets by the media, have spurred research in the recent years.

This chapter examines research on international diversification and the research issues in the context of both developed and emerging markets. The varied strands of evidence on international diversification are put together, while evolving research issues for the present study. The chapter is divided into two parts. In sections 2.1 to 2.6 we review research on diversification benefits and examine alternate approaches to understanding risk and asset pricing in the international context . Sections 2.7 to 2.9 describe the research problem and the data set. This chapter

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* An earlier version of this Chapter was accepted at the 9th Australasian Finance and Banking Conference, University of New South Wales, Sydney , December 1996, and published in the Journal of Foreign Exchange and International Finance, Vol XI, No.1, Apr. - June, 1997. (Shashikant and Ramesh, 1997a).

provides an overall perspective on the research issues that have been examined in the context of international investments and emerging markets. Specific work that focuses on the very set of experiments that we have undertaken, and research methodology that is used, is discussed prior to each set of results presented in the subsequent chapters.

2.1. The Case for International Diversification

The seminal works of Markovitz (1959) and Sharpe (1964) have contributed significantly to the understanding of risk, return and diversification and the application of these concepts in management of portfolios. It is now well accepted that a rational investor would hold the market portfolio; would diversify away unsystematic risks in his portfolio; and as long as assets that dominate the mean-variance frontier exist, can achieve a superior risk-reward ratio through diversification into such dominating assets. Investing internationally essentially means expansion in the opportunity set of risky assets available. Therefore, the core question is whether foreign risky assets impact the risk of a portfolio in a manner similar to the behaviour of domestic assets, or if there is a significant difference.

The case for international diversification was first presented in Levy and Sarnat (1970), Lessard (1973) and Solnik (1974a). The major arguments for international diversification are as follows:

a. The relative independence of world markets as evidenced by the lack of correlation in returns causes a reduction in portfolio risk, because it is the value of the covariance that determines the extent of portfolio risk. Therefore, as long as markets exhibit low correlation with one another, international diversification should provide significant risk reduction possibilities.

b. If the relative independence of markets is caused by the dominance of domestic factors in the pricing of securities, then international diversification would provide the opportunity to diversify away the systematic risk that is not diversifiable in the domestic markets.

c. If markets are independent, in a portfolio sense, it would mean that there are more asset classes with varying levels of risk and return. From this point of view, international diversification can achieve risk reduction without sacrificing the expected returns, leading to a superior risk-return trade off.

Lessard (1974) provided early evidence of the case for international diversification, by pointing out that world factors do not dominate asset returns, and that dominance of local factors keeps markets segmented and enables diversification across markets. Solnik (1974a) is the most widely cited paper on the case for international diversification. The risk in a portfolio drops as number of stocks in the portfolio increases, but beyond a certain point, the risk curve flattens out indicating that a certain level of systematic risk has to be borne, irrespective of the size of the portfolio. Solnik illustrated, using the price movements of 300 European stocks and all shares quoted on the New York Stock Exchange, that markets differ in terms of

how much of risk can be diversified away. Importantly, he showed that the level of systematic risk is lower in an internationally diversified portfolio.

Solnik and Noetzlin (1982) compared the performance of passive and active strategies for US investors over the period 1970-1980, using the Markovitz portfolio optimisation framework. They showed that diversifying internationally reduces risk. A pure passive strategy of investing in the Morgan Stanley Capital International World stock Index would have produced 50% higher returns, while reducing the risk. They also showed that the world market portfolio was not on the efficient frontier and that active asset allocation strategies would pay off in international diversification.

Ibbotson and Siegel (1983) illustrated the benefits of international diversification, by constructing a World Wealth portfolio. This portfolio comprised of all asset classes that were available to investors in the US. They demonstrated that this portfolio outperformed the median US pension fund, in both risk and return terms, over a twenty year period 1960-1980.

Other studies such as Jorion (1985), Grauer and Hakansson (1986) also indicate that active asset allocation strategies in international portfolios would produce superior risk-adjusted returns. Tapley (1986) provides a discussion of the case for international investments, and recommends a 20-40% exposure to foreign markets, and argues that objections to international diversification such as taxes and indirect barriers do not weaken the case for international investing. More recently, Solnik (1994) provides a concise account of the benefits of international diversification, in the context of the choices for the European Union to manage its assets.

2.2. Diversification and Emerging Markets

The surge in international portfolio investments into emerging markets has spurred a series of research into the factors influencing inclusion of emerging markets in international portfolios. (Park and Agtmeal (1992), Claessens and Gooptu (1993), Mobius (1994), and Shashikant and Suri (1996) examine the factors influencing the flow of investments into emerging markets.

One of the earliest studies on the benefits of investing in emerging markets was Levy and Samat (1970), illustrating the diversification benefits using the local stock market indices over the period 1951-1967. Lessard (1973) studied the Latin American markets over the period (1958 -1968) and found that including Latin American stocks in a US portfolio would provide significant diversification benefits. Errunza (1977) found that benefits from including emerging markets in a portfolio persist over long time periods, studying data from 1957-1972. Other early studies that have highlighted the diversification benefits from emerging markets are Agtmael and Errunza (1982) and Errunza (1983).

Bailey and Stulz (1990) analyse the benefits of diversifying into the Pacific rim markets, in the context of the increasing dominance of Japan in the world market capitalisation. Their study however includes 6 emerging markets in the Pacific Rim, apart from Japan and Hong Kong. They illustrate that a US investor holding the S&P Index would have reduced the standard deviation of his portfolio by a third, by diversifying into the Pacific Rim markets. Solnik (1991b) also looks at the diversification benefits from Pacific Basin markets, and draws similar conclusions.

The efficient frontier which excludes the Pacific basin markets is found to be strongly dominated by the efficient frontier which includes them. Significantly, investing in the emerging markets in the Pacific Basin was found to improve the risk-return trade-off substantially.

Rudd (1991) finds evidence of very little correlation between emerging markets and developed markets, and also highlights the pre-dominance of market factors in the returns from the emerging markets. Bailey and Lim (1992) and Diwan, Errunza and Senbet (1992) have studied the benefits available to international investors subscribing to the country funds from emerging markets. Divecha, Drach, and Stefek (1992) examined the risk and return attributes of about 4000 emerging market stocks and find that though the volatility in individual markets is high, low correlations that are exhibited with developed markets implies that modest investments can bring about substantial reduction in risk. They also find evidence of homogeneity within the markets, in that the domestic market factor dominates the return in these markets.

Spiedell and Sappenfield (1992) draw out the additional benefits from emerging market investments, by pointing out that developed market correlations are increasing while emerging markets remain rather segmented, offering superior diversification opportunities. Wilcox (1992) points out that even after assuming additional taxes and trading costs, a 15% allocation to emerging markets will benefit a typical pension portfolio. Errunza (1994) provides an overview of research and summarises the concerns in emerging market investments. He argues that diversification benefits from emerging markets are likely to persist and emphasises

country selection rather than stock picking as the strategy for performance enhancement. Harvey (1995b) demonstrates that emerging markets constitute a distinctive asset class in international investing, and that adding emerging market assets to a portfolio problem, significantly shifts the investment opportunity set. Studying more than 800 equities from 18 emerging markets over the period 1976-1992, Harvey illustrates that emerging markets are not integrated with the world capital markets, and therefore provide scope for superior diversification benefits. There seems to be virtual consensus on the benefits on international diversification in general and diversifying into emerging markets in particular.

2.3. Measuring Diversification Benefits

There are two well documented approaches to measuring and evaluating the benefits of international diversification. The first approach has been called the "non-asset-pricing approach" (Akdogan 1995 furthers this classification) because it observes the statistical relationships between markets, without making any assumptions regarding the asset pricing model that may underlie the returns. The most commonly used of these approaches is the examination of correlation co-efficient of asset returns across countries. There have been many studies that have illustrated the benefits of diversification using the correlations between returns from markets in various countries. The integration or segmentation of markets has been illustrated using the magnitude of the correlation coefficient. Lower correlation coefficients essentially mean that risk reduction through diversification would accrue irrespective of whether the assets are correctly priced or not. It can therefore be

established that unconditional portfolio risk can be diversified by adding emerging markets to a portfolio.

The prevalence of low correlation between markets has focused attention on the return generating process in the markets, and many studies have examined the influence of global and domestic factors on asset returns. If returns are influenced by domestic rather than global factors, low correlation between markets would persist, and it would be difficult to explain returns using an international asset pricing model. If global factors become increasingly important, returns can be explained using an international asset pricing model.

One of the frameworks that has been used in this context is the International Capital Asset Pricing Model. The ICAPM assumes that there is one dominant source of risk that is priced in the international markets, and that this risk can be measured using a benchmark portfolio of international assets. Stocks of various markets would be priced depending upon the beta coefficient that they exhibit with respect to the benchmark index. The ICAPM assumes complete integration of markets such that pricing of assets in the international markets is similar to the pricing of assets in the domestic context.

Lessard (1973), Alder and Dumas (1983), Solnik (1974b), Stulz (1981), provide important papers on ICAPM. Descriptions of recent studies on ICAPM can be found in Dumas (1993), Stulz (1992) and Solnik(1991a). If the cross section of expected returns from the markets is to be explained in terms of the ICAPM network, then the underlying risk has to be the covariance of returns from the emerging markets with

the world market portfolio. This would necessitate the assumption of complete integration, because under the assumptions of the model, assets with the same level of risk will provide the same level of return, irrespective of the market where it is issued or traded.

Lessard (1974) and Solnik and De Freitas (1986) researched the relative importance of industry, domestic and international factors on security returns, and concluded that though international factors had some influence on stock returns, domestic factors were a much stronger influence on them. These studies were before 1973, when the exchange rates were fixed. Subsequent studies also indicate the weaker influence of international factors on security returns. Solnik (1984) and Alder and Simon (1986) suggest a weak correlation between stock market indices and currency movements. In Solnik and de Fritas (1986), correlation of stock indices with world indices, currency movements and domestic indices were studied and it was found that the coefficient of determination was highest in the case of the domestic market index. These studies indicate that security returns are largely influenced by domestic rather than international factors, with the former explaining about 42% of returns on the average and the later explaining 18 - 23% of the returns. Grinold, Rudd and Stefak (1989), Drummer and Zimmerman (1992), and Heston and Rouwenhorst (1994) arrive at similar conclusions on dominance of national factors over global factors in asset pricing.

Ferson and Harvey (1994) study returns in 18 national markets, 16 of them from OECD countries, and Singapore, Malaysia and Hong Kong for risk factors that explain returns. They observe that the world market betas do not provide a good

explanation of the cross-sectional variance in average returns. Global risk factors, ex-post explain 15% to 26% of variance in returns, and vary across countries. They illustrate that a standard one-factor or two-factor asset pricing paradigm leads to large pricing errors and that the betas are unable to explain any of the cross sectional variation in expected returns.

2.3.1. The Special Case of Emerging Markets

The benefits from international diversification into emerging markets can be analysed from two different, yet related points of view. The first is that emerging markets represent an asset choice that has not been optimally used by international investors. This argument means that investing in emerging markets would enhance risk adjusted return and including emerging markets would move portfolios more closer to the efficient frontier. This argument essentially assumes integration, and that returns from emerging markets can be measured in terms of an asset pricing model.

The second argument is based on the segmentation of the emerging markets, and the premise that emerging markets represent a distinct asset class, whose return generating process does not fit into the integration-based asset pricing model, because global factors do not play a significant role in the pricing of emerging market assets. This view means that including emerging markets in the portfolio would not only reduce risk in a given portfolio, but would also shift the investment

opportunity set itself, such that returns are also at a higher level. Given the distinctive features of emerging markets, this view is gaining increasing acceptance.

In the context of emerging markets, the prevalence of higher levels of risk is well established. Therefore, assumption of higher risk can be justified only if, in equilibrium, it results in higher return. It would therefore seem appropriate that the returns from emerging market investment should be analysed in terms of an asset pricing model. The difficulty in pursuing this line of thinking is the fact that emerging markets exhibit certain characteristic features that make it difficult to analyse return in terms of an asset pricing model, that may hold good in the context of developed markets.

Divecha et al (1992), Bekart (1995), and Diwan et al(1992) assume full integration of emerging markets with world markets while examining the benefits of diversification. Chief among the factors that segment emerging markets are the direct and indirect barriers to investment which do not facilitate riskless arbitrage. Diversification benefits that should theoretically accrue, may not be realisable due to the presence of these barriers. There have been tests that have explicitly incorporated barriers in an asset pricing model. Jorion and Schwartz(1986) have classified barriers as direct and indirect, and using a methodology that allows tests of both full integration and full segmentation (see Stelhe 1977) found that the US and Canadian markets are not integrated, due to the presence of direct barriers. They find evidence of mild integration only in the case of inter-listed stocks. Their classification of direct and indirect barriers has been widely used in examining the asset pricing process in emerging markets.

The contribution of Errunza and Losq (1985, 1989) in understanding the effect of barriers on international asset pricing is significant. They assume that direct barriers which disable a class of investors to trade in a subset of securities are the only imperfection in the international markets. They find that such inaccessible securities display risk premiums proportional to the conditional market risk of these assets. They argue that securities which are accessible to domestic and foreign investors are priced as if the two markets are integrated and that securities that are not available to some investors earn superior risk premiums. They thus find a case of 'mild segmentation' in the international markets. Errunza et al (1992) find evidence that many emerging markets are neither completely segmented, nor completely integrated with the developed markets.

Bailey and Jagtiani(1994) also use this model to find a mild segmentation in the Thailand stocks. Claessens and Rhee (1994) , using Stelhe's method over the period 1989-1992 for 16 emerging markets, reject the hypothesis that emerging markets are integrated with world markets. Evidence therefore predominantly suggests that emerging markets are not integrated with world markets, and that ICAPM which imposes a null hypothesis of complete integration cannot explain the return generating process in these markets.

The segmentation of emerging markets is intuitively understood, given the presence of various legal and indirect barriers to investment. Another strand of research therefore focuses on understanding the risk-reward in emerging markets in terms of the peculiarities of these markets. Santis (1993) uses the Hansen-Jagannathan (1991) bounds to test the diversification benefits from emerging

markets, and reports that models which successfully price assets from industrialised countries may fail to price assets traded on emerging markets. Claessens et al (1993) find evidence of predictability in stock returns in emerging markets and some of the anomalies found for industrial countries, such as the small firm effect and turn-of-the -year effects.

The most extensive research on the risk-return trade-off from emerging markets and the risk characterisation of emerging market returns is from Campbell Harvey and Geert Bekaert. Bekaert (1995) reviews the impact of liberalisation and removal of barriers on emerging market risk and return, and finds little evidence of increase in return volatility after deregulation. Harvey (1995a) is one of the most comprehensive in this context. In a study of more than 800 equities from 20 emerging market countries, they find that emerging markets have higher average returns and volatility than developed markets. An examination of risk and returns shows that returns from emerging markets exhibit serial correlations much higher than what can be expected in the case of developed markets and there is evidence of predictability. There also is evidence of departure from normal distribution, in the returns of 14 out of 20 emerging markets examined. The study presents important evidence as to why emerging market equities have higher returns, and highlights the differences between emerging and developing markets.

Bekaert and Harvey (1995) extensively examine volatility in emerging markets and confirm that capital market liberalisation in emerging markets have increased correlation between markets, but have not driven up local market volatility. Bekaert et al (1997) find that traditional risk attributes do not explain emerging market

returns, and propose a multi-factor characterization of risk and return. Bekaert et al (1998) provide evidence that emerging market distributions are non-normally distributed.

Erb et al (1996) develop a country risk model that would establish the hurdle rate for investments with average risk in emerging markets. They find that beta of the country with respect to the market portfolio is not an appropriate measure, and that it can lead to gross under estimation of the cost of equity in segmented markets.

2.4. Sub-Optimal Asset Allocation

Our description of the benefits of international diversification and the risk reduction possibilities and the fact that these benefits have been illustrated by research over the last 20 odd years, would suggest that investors are now holding a substantial part of their portfolio in foreign assets. The fundamental assumption in modern portfolio theory is that investors diversify efficiently, and hold the market portfolio, which dominates the others in the mean-variance frontier. In reality however, the international holdings in many of the institutional portfolios, which are large, and are in most cases professionally managed, is much lower than the allocation that would be ordained on the basis of efficient diversification.

Cooper and Kaplanis (1995) show that for nine major markets, there is a heavy concentration of domestic stocks in the portfolios of investors. Chuhan (1994) points out that despite the demonstrated benefits of diversifying into emerging markets,

institutional investors from seven major industrial countries, invest hardly 0.2 % of their assets in emerging markets. Tesar and Werner (1993) also show that US investors' holding of emerging market equity is much lower than what can be expected if the market portfolio is held.

The concentration of domestic assets in a portfolio has come to be known as "home-bias." Home bias refers to a sub-optimal asset allocation in a portfolio, caused by a concentration of domestic assets rather than foreign assets. If the assumption that investors behave rationally has to hold, then home-bias must be caused by factors that offset the benefits from international diversification. Alder and Dumas (1983) and Stulz (1981b) concur that investors in different countries hold different portfolios because of the need to hedge against inflation and to avoid possible foreign exchange risks, because investors in different countries consume different bundles of goods and pay for them in different currencies. Black (1974), Stulz (1981b) and Cooper and Kaplanis (1986) identify the costs associated with cross border investing as the major cause for home-bias. Costs such as with-holding taxes, restrictions on repatriation, costs of procuring information, and costs of differential access are typically incurred by international investors, and home-bias is explained by the reduction in return due to these costs. Eldor, Pines and Schwartz (1988) and Stockman and Dellas (1987) associate home-bias with the existence of non-traded goods. They develop a model of general equilibrium incorporating nontraded goods, and demonstrate that home-bias is caused by the need to hedge against price uncertainties in the case of non traded goods.

Cooper and Kaplanis (1995) refute the argument that home bias is caused by the investors' desire to hedge purchasing power parity deviations as in Alder and Dumas (1983). They develop a model of international portfolio choice and equity market equilibrium that integrates costs in cross border investing and purchasing power parity deviations. They estimate with this model, the levels of cost required to generate home-bias in a portfolio at about 2.7%. In Cooper and Kaplanis (1995), they argue that dead-weight costs, in the form of withholding taxes and transaction and information costs are the chief source of home-bias. Segmentation of markets is therefore caused by costs and restrictions on international portfolio investment and other informational costs and imperfections.

In the context of the available literature on home-bias, and the evidence that investors do not hold much of emerging markets in their portfolio despite attractive diversification potential, it would be worthwhile to examine the home-bias with respect to emerging markets, and estimate the dead weight costs incurred by investors in these markets. Possible explanations for the low allocations to emerging markets may be available after examining the net return to investors after incurring these additional costs. The prevalence of higher costs of investing would also act as indirect barriers that would segment emerging markets. With the costs of information for instance falling over periods of time, as investors get more familiar with the emerging markets, it may be expected that the dead weight costs, and as a result the segmentation of these markets would reduce.

2.5. Behaviour Of Cross-country Correlation

Since diversification benefits are so closely tied to the covariance structure between markets, the key to the exploitation of these benefits would be the ability to forecast the future correlation structure and tailor asset allocation strategies accordingly. The Markovitz framework for portfolio optimisations presumes that ex-post estimates of covariance would be valid ex-ante. The inter-temporal instability of the correlation between market returns complicates this exercise. Evidence on the stability of correlation and covariance is mixed.

Earlier studies such as Levy and Samat (1970) Lessard (1973) show that correlations between markets have remained low over a long period of time. Watson (1980) finds evidence of intertemporal stability in correlation between markets. Bergstrom (1984) using the Capital International indices finds that international correlation structure has not changed significantly over periods of time. Markets that exhibited lower correlations continue to do so, over a large observation period 1959-1983. Shaked (1985) provides evidence that correlations between markets are unstable in the short run, but for longer holding periods they remain stable. Using monthly returns for 16 countries in the period 1960-1979, they argue that the underlying stability in correlation structure is temporarily disturbed by lagged response to economic shocks. Fischer and Palasvirta (1990) find high levels of correlation between 23 world markets in the period 1986-1988. The contagion effects created by the crash of 1987 significantly increased correlation between markets in that period.

Makridakis and Wheelwright (1974) find the correlation structure between 14 major stock exchanges in the period 1968-1970 to be unstable. Maldonado and Saunders (1981) studied the correlation between US and 4 other developed countries, and show that for investment horizons longer than 2 quarters, inter-country correlations are unstable. Kaplanis (1988) fits time series models to rolling correlation of equities in 15 markets. She finds that correlation is not constant over time and that rolling ex-post correlation could be used for asset allocation. Login and Solnik (1993) estimate a multivariate GARCH model and reject the hypothesis that correlation is constant. Erb et al (1994) examine the factors that may cause changes in correlation and find that equity cross-country correlations are related to the coherence between business cycles in the respective countries. They report that correlations are higher during recessions than during growth periods and that correlations are low when the business cycles of two countries are out of phase. Tang (1994) finds evidence of increase in correlation between markets with increase in holding period, and suggests that there may be delayed adjustment among the 11 markets studied, and that benefits of diversification would reduce with increase in the holding period.

Harvey (1991) measures the conditional risk of 17 countries with respect to a benchmark world portfolio and illustrates that risk exposures change over time and that the world price of covariance risk is not constant. Spiedell and Sappenfield (1992) argue that correlation between markets change over time and that during the happening of certain global events, market tend to exhibit higher levels of correlation. Odier and Solnik (1993) find that during periods of increased volatility, correlations between markets also increase. The volatility of stock prices is

therefore time-varying. However, Iben and Litterman (1994) examine changes in bond market volatilities in the G7 countries, for ascertaining if changes in international bond volatilities have created greater correlations between markets, thus reducing the benefits of diversification. They find the diversification benefits to be stable, despite a marked increase in volatility. Bruno Solnik (1993) provides evidence of predictable time variation in expected returns and risk, across eight developed markets. There was evidence of mean reversion for bonds, stocks and currencies over a 20 year period. The time variation in risk premiums has been attributed either to the lack of efficiency in the international markets or to the changes in investor risk perceptions over time.

2.6. Linkages between markets : Correlation and volatility

The globalisation of markets has spawned research on the linkages between markets. Compared to the scenario in the 1970s, there has been considerable globalisation of capital markets, with increase in cross-border listing, international investment, growth in facilitating technology for cross-border activity, and reduction in the concentration of activity in few markets. There have been many studies which examine the dynamics between various markets with a view to understanding the adjustment process of stock prices across the globe. The increasing linkages between markets have important implications for the inter-temporal behaviour of covariance and correlation attributes of returns.

One set of studies on the linkages between markets, concentrates on the dynamics between the stock market indices, with a view to observing changes in the

dependence pattern, over a period of time. Schollmer and Sand (1985) find dependence between European and US markets, using ARIMA cross-correlation analysis. Fischer and Palasvrita (1990) using cross-spectral analysis on 23 stock indices, find strong interdependence between US and European and Asian stock markets. Koch and Koch (1991) and Brocato (1994) find evidence of decline in the leadership of US in the world markets. All these studies point to significant alterations in the linkages between world markets since the 1980s. It is difficult to say whether the dependency exhibited by market indices would be consistent with the hypothesis of increased integration of world markets. But these studies clearly point to changes in the co-variability patterns of markets, particularly in the recent years, with important implications for international diversification.

Another set of studies specifically examine the implications of linkages between markets on the covariance between them. The 1987 crash facilitated the examination of transmission of volatility between markets, and its impact on inter-market correlations. A number of these studies point out that cross-market adjustments to exogenous disturbances get magnified due to the increased linkages between markets. (King and Wadhwani (1990), Bennet and Kelleher (1988), Schwert(1990). These studies have shown that information channels between markets enable rapid transmission of shocks than was previously possible, and create a psychological contagion that triggers simultaneous responses in markets, around the happening of global events.

Roll (1989) argues that results from the various studies of the stock market crash could suffer from a 'selection bias' in that an episode that was characterised by high

volatility and contagion among markets was chosen for analysis. Higher correlations between markets can be isolated to the October 1987 episode, but need not mean that national markets are linked more closely than they were before. Dwyer and Hafer (1988) also present evidence that market correlations have not increased except for the period immediately around the crash. Therefore, covariance among indices is very strong during such events. Solnik, Boucrelle and Fur (1996) study correlations between developed markets over 37 years and the behaviour of correlation during periods of high volatility. They find evidence of market contagion and that correlations increase during periods of high volatility.

In one of the early studies on intertemporal stability of covariance in emerging markets, Cheung and Ho(1991) use the Box's M test to study the stability of covariance structures over periods in time. In another paper that extends this study (See Cheung 1993) they find no evidence of normality in the return series for emerging markets and argue that it would be preferable to use non-parameteric tests to check for the stability of the covariance structures. They use the Sen and Puri (1968) tests to examine the equality of the covariances between developed and emerging markets. Studying 7 Pacific rim and 4 developed markets over the period 1977 to 1988, they are unable to reject the hypothesis that covariance matrices are equal over different time periods. They also find evidence of relative stability over time in the ranking of covariance between two markets.

Apart from studying the structure of correlation, recent methodologies for investigating inter-temporal associations between markets include testing for co-integration. Co-integration is a property possessed by non-stationary time series. If

two non-stationary time series are co-integrated, then there exists a linear combination relationship which is stationary. Co-integration means a possible allowance for departure from equilibrium in the short run, but not in the long run. Hung and Cheung (1995) uses the Johansen multivariate co-integration approach to analyse the interdependence of five major equity markets, using weekly observations from 1981 to 1991. They do not find evidence of co-integration when returns are measured in local currency terms, but interestingly find evidence of co-integration when dollar returns are used. They attribute this difference to the depreciation in the US dollar in the 1980s. Chatrath et al(1994) perform co-integration tests on India and developed markets, and find no evidence of comovement.

Emerging markets have witnessed contagion during the Mexican Peso crisis of December 1994, though the changes in the covariances have not been studied. It has not been examined whether the dominance of US investors in the emerging markets creates linkages arising out of common inputs used by the dominant investor. The Mexican Peso crisis in December 1994 and the South East Asian crisis in October 1997, caused reactions in many emerging markets. The linkages between emerging and developed markets, and the behaviour of emerging markets during global events would provide additional insights into the diversification benefits from investing in them.

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2.7. Important Research Issues

Despite overwhelming evidence on the benefits of international diversification, there is little evidence that global investors are holding the market portfolio. This sub-optimal choice has been investigated for over 2 decades, while the specific case of emerging markets has been studied only since the late eighties. It is only in the 1990s that many emerging markets have become available for investment by global investors. Research in this area addresses the distinguishing features of emerging markets, the diversification benefits and their explanation in terms of an asset pricing model, and the inter-temporal stability of risk attributes. (Bekaert et al, 1997).

While it is well accepted that international diversification would enhance the risk-return trade-off in a well diversified portfolio, the quantification of these benefits in the context of emerging markets, involves a study of the following:

A. Risk-return attributes of emerging markets and the distinctiveness, if any, in them. Most research on international diversification focuses on developed markets, and there is limited research on the applicability of these models in the context of emerging markets.

B. By virtue of being new and emerging, these markets are likely to exhibit higher levels of volatility and regime shifts arising from policy initiatives. It would be important to know whether past estimates of risk attributes

can be used in asset allocation, and whether risk attributes exhibit predictability.

C. In the context of the debate on integration and segmentation, and the conjecture that globalisation leads to higher levels of integration, it has to be seen if diversification benefits would persist. The impact of contagious increases in correlations during the happening of global events has to be factored into such an analysis.

D. Given that India is also an emerging market that has been attracting foreign portfolio investments, it would be useful to examine the risk-return process in India, and understand the diversification benefits to international investors. Such an understanding can aid policy decisions significantly.

This study addresses the above 4 objectives, and is an important contribution in the area of international investments in emerging markets.

2.8. Description of the Research Problem

In order to address the above research objectives, we examine the following research problems empirically[1]:

a. In order to understand the distinctiveness of emerging markets, we attempt a comparison of risk and return attributes of a set of developed and

[1] Appropriate research review other than those discussed in this chapter, and discussion of methodology for each of these issues is presented in the chapters that discuss these results.

emerging market returns. We compute log returns for the sample of markets and test the time series for normality, autocorrelation and time variation. We also test whether emerging market returns, risk and other attributes have altered over time, dividing the data set into two non-overlapping periods that represent pre and post liberalisation phases.

b. In order to choose an appropriate model for describing the diversification benefits it is necessary to test the applicability of an asset pricing model for emerging market returns. Using a single factor regression of returns, we test the applicability of the international capital asset pricing model for both developing and emerging markets. This would represent a joint test of integration and asset pricing. The results indicate that a non-asset pricing approach that would use correlations rather than an ICAPM model is superior in the emerging market context.

c. We examine the correlation structure of emerging and developed markets, in order to understand their direction and magnitude over varying holding periods, and verify the possible enhancement of diversification benefits, by including emerging markets as a distinctive asset class.

d. We test the dominance of emerging markets in an international portfolio, by plotting efficient frontiers of various international portfolio combinations.

e. We study the correlation structure of emerging markets for presence of time trend and for the impact of 1987 crash on the correlation pattern.

f. We test the intertemporal stability of emerging market correlations, using a country-by-country analysis of persistence in correlation structure, over varying holding periods.

g. We test for skewness in correlation structure as a possible explanation for contagion in international markets, and test for asymmetry in emerging and developed market correlations, using a semi-correlation analysis.

h. The ability to exploit benefits from international diversification lies in being able to use ex-post estimates for ex-ante asset allocation decisions. We examine the predictability in correlation structures using an multiple regression model of a set of pre-selected instrumental variables. We repeat this test for varying holding periods.

i. Using the model we developed for predictability of correlations we fit the model on ex-post observations and also make out-of -sample forecasts of emerging market correlations.

j. In order to verify the dominance of domestic factors as a possible explanation for persistence of diversification benefits, we first do a principal component analysis, to identify the dominant factors

k. We do a hierarchical decomposition of variance, using a multiple factor model. We measure the contribution of global and domestic factors to asset variances, using a sample of 84 Indian stocks.

l. We measure the beta coefficients of a sample of Indian stocks, to illustrate the dominance of the domestic market factor on asset returns, and verify the dominance of local factors in asset pricing.

2.9. Description of Data

The data set used for analysis consists of monthly returns for 20 emerging markets and 18 developed markets. We have used emerging markets for which data is available for atleast 5 years, as at the end of December 1996. Many markets like South Africa, China, Czech Republic, Poland, Russia and Hungary have become important in the recent years, but had to be excluded from the study since data is available only since 1993.

The data for emerging markets is drawn from the Emerging Markets Data Base of the International Finance Corporation. Other available emerging market databases are Baring Emerging Markets Indices and Morgan Stanley Capital International Emerging Market Indices. IFC has created various indices for emerging markets since January 1976. The data we have used is of the IFC Global return index, a market capitalisation weighted index, which is designed to represent the performance of active stocks in the emerging markets studied. The target aggregate

market capitalisation of the index is 60% to 75% of the total capitalisation of the listed stocks on the local stock exchange.

It has to however be noted that there are some problems with the IFC Indices. The IFC data for the period January 1976 - December 1981, were actually computed in 1981 when the indices where first constructed. Data for the period 1976-1981 therefore have a "look-back" bias. (Errunza and Losq (1985) and Harvey (1995) discuss this as a special type of survivorship bias).

Another issue is that the countries that have been chosen for inclusion in the IFC Index, are those where stock markets have existed and grown to significance over a period of time. Of the 115 emerging markets that have been identified by the IFC, indices have been constructed for only 44 markets, of which 9 are frontier markets. There is therefore a selection bias in the Index.

Thirdly, Goetzmann and Jorion (1996) have detailed a "re-emergence" in the index for emerging markets. Many emerging markets have a stock market history that is longer than that of many developed markets. They actually re-emerged in the 1990s, when their role was increased through a reforms process, and were opened for global investors. Therefore, assessing the returns based on data in the recent period may create significant differences in the values of the mean and variance between the pre and post re-emergence.

We use the IFC Global Indices despite these known limitations, since they represent data that is available for the longest period of time, and have been used by virtually

all well cited work on emerging markets. Bekaert et al (1997) find evidence of broad similarities amongst existing emerging market indices and the correlation between the various emerging market indices to be 95% on the average. Since our objective is to be able to examine emerging markets through the period of segmentation and integration and examine stability, predictability and persistence in diversification benefits, only the IFC Global index with its wide coverage and long time series data serves our requirement.

Monthly return data are available for 9 markets since January 1976 (Argentina, Brazil, Chile, Greece, India, Korea, Mexico, Thailand and Zimbabwe). Data for Jordan is available from January 1979. Indonesia is the market with the least number of data points, beginning January 1990. In the case of Columbia, Malaysia, Pakistan, Philippines, Taiwan Venezuela and Nigeria, data is available from 1985. Data for Turkey is from Jan 1987, and for Portugal from Feb. 1986.

The monthly return for 21 developed markets are from the Morgan Stanley Capital International Perspectives (MSCI). MSCI indices are market capitalisation weighted total return indices and are found to have very high correlations with certain indices like the NYSE Index and the Nikkei Index (Harvey 1991). MSCI is the most commonly used database on developed markets. Monthly return data for 18 developed markets and the MSCI world index is available from January 1976. Data for Finland and New Zealand are from 1988, for Singapore from 1993. Malaysia is included in the list of emerging markets. MSCI excludes investment companies and foreign domiciled companies, to avoid double counting.

All returns are computed on month-end values, assuming dividend reinvestment, and are denominated in US Dollars. All data are upto December 1996.

2.10. Chapter Summary

In this chapter we have reviewed research on international diversification both in the context of developed and emerging markets. Though the case for international diversification has been well established, most empirical research focusses on developed markets. There is limited evidence on the behaviour of emerging markets. We have identified 12 research issues, which we seek to address in this study, through empirical analysis of an internationally accepted data base on emerging and developed market returns, which we have described in this chapter.

3. Emerging Markets - Risk, Return and Diversification*

International investor interest in emerging markets has been largely spurred by the attractive returns that have been available from these markets, and the perceived potential arising out of becoming market-oriented in approach. The sustenance of global interest in emerging markets however has to come from a deeper understanding of the return generating process, the relative segmentation or integration of these markets with other developed markets and the inter-temporal stability of the risk and return characteristics.

This chapter attempts a presentation of risk and return characteristics of emerging markets and compares them with the developed markets. A series of statistical analysis is performed on the return series for all the emerging markets. We present the case for diversification into emerging markets and analyse the extent of integration of these markets with developed markets by computing correlations, and using a regression model.

We are able to identify certain peculiarities in the behaviour of risk and return, which are totally in contrast with what is known in the context of developed markets. This leads us to believe that models widely accepted and applied in the context of developed countries may not be applicable without necessary modifications in the emerging markets. Apart from return and volatility being much higher in emerging

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* This chapter updates and revises the findings of an earlier study published in the ICFAI Journal of Applied Finance, Vol. 3, No 2., July 1997 (Shashikant and Ramesh, 1997a).

markets, as compared to developed markets, they are also inter-temporally instable. Returns exhibit predictability and are not normally distributed. Correlations between developed and emerging markets are very low and suggest lack of integration. The data highlights the segmentation of emerging markets from developed markets and the case for diversification into emerging markets arises from the observed contrast in the risk-return characteristics of emerging markets.

In the context of an optimized efficient frontier of markets, we demonstrate the dominance of emerging market portfolios and the enhancement of diversification benefits by including emerging markets in an international portfolio. A single factor regression model in the International Capital Asset Pricing Model (ICAPM) framework, which applies well in the developed market context, fails to explain returns from emerging markets.

3.1 Behaviour of Emerging Market Risk and Return

The popular perception on returns from emerging markets is that they are much higher than those available in developing markets. We present the annualised returns from emerging markets in Table 3.1. Log returns are computed from the monthly indices for the period January 1976 (or as data became available) to December 1996, after including dividend, as simple holding period returns:

$$R_{it} = \ln \{(P_t/P_{(t-1)}) - 1\}.$$

and annualised as

$$\text{Annual Return} = (\text{Monthly Return}*100*12) - 1.$$

Risk is computed as the standard deviation of returns and is annualized as follows:

$$\text{Annualized standard deviation} = \text{Monthly Std. Dev} *100* \sqrt{12}.$$

Table 3.1

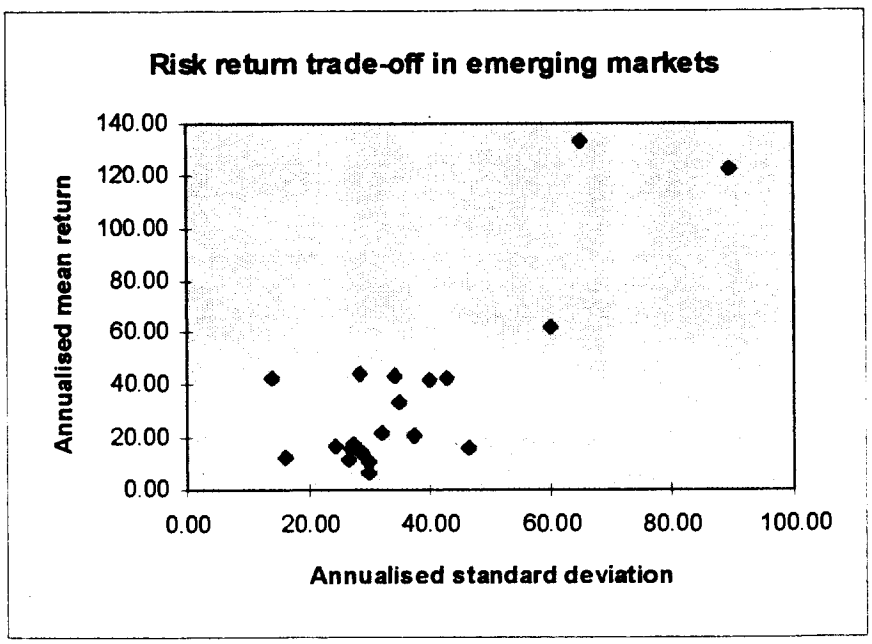
Risk and Return Statistics : Emerging Markets (in US $ terms)

	Period beginning	Annualised mean (%)	Annualised std.dev. (%)	Maximum monthly return	Minimum monthly return	Range
Argentina	1976.02	122.08	89.58	1.306	-0.496	1.802
Brazil	1976.02	133.64	65.23	0.695	-0.530	1.226
Chile	1976.02	43.43	34.02	0.512	-0.304	0.817
Columbia	1979.02	44.22	28.40	0.337	-0.180	0.517
Greece	1976.02	11.29	29.79	0.469	-0.314	0.783
India	1976.02	17.84	27.34	0.386	-0.282	0.668
Indonesia	1990.02	6.58	29.79	0.185	-0.230	0.415
Jordan	1985.02	12.79	16.14	0.167	-0.137	0.305
Korea	1976.02	14.16	28.90	0.370	-0.204	0.574
Malaysia	1985.02	12.07	26.73	0.242	-0.373	0.615
Mexico	1976.02	41.93	40.01	0.358	-0.534	0.892
Nigeria	1985.02	42.99	14.05	0.226	-0.040	0.266
Pakistan	1985.02	16.60	24.53	0.301	-0.172	0.473
Philippines	1985.02	33.45	34.75	0.413	-0.320	0.734
Portugal	1986.03	21.31	37.45	0.548	-0.394	0.943
Taiwan	1985.02	15.75	46.55	0.427	-0.443	0.869
Thailand	1976.02	15.98	26.91	0.283	-0.413	0.696
Turkey	1987.02	62.15	60.12	0.558	-0.365	0.923
Venezuela	1985.02	42.72	42.75	0.378	-0.612	0.990
Zimbabwe	1976.02	22.03	32.17	0.398	-0.324	0.722

The annualised return over the last 20 year period, is the highest in the case of Argentina and Brazil, at 122.08% and 133.64%. (Similar results have been reported by Harvey (1995). The lowest return is in Indonesia (6.58%), which also represents the smallest data set in our sample, data being available only since 1990. The high

levels of return have also been accompanied by high levels of risk, as evidenced by the standard deviations and the large range in monthly returns that have been reported in Table 3.1. Though returns are attractive in markets like Nigeria and Venezuela, these markets are very small and do not attract much investor interest. We have captured the risk-return trade-off in emerging markets in an XY graph that is presented in Figure 3.1 below. The plots in the graph are indicative of the relative risk and return in emerging markets.

Figure 3.1



The outliers in the above graph are Argentina and Brazil. Markets in Asia, namely, Taiwan, Korea, Malaysia, Indonesia, Pakistan and India have provided much lower return compared to the Latin American markets.

Table 3.2

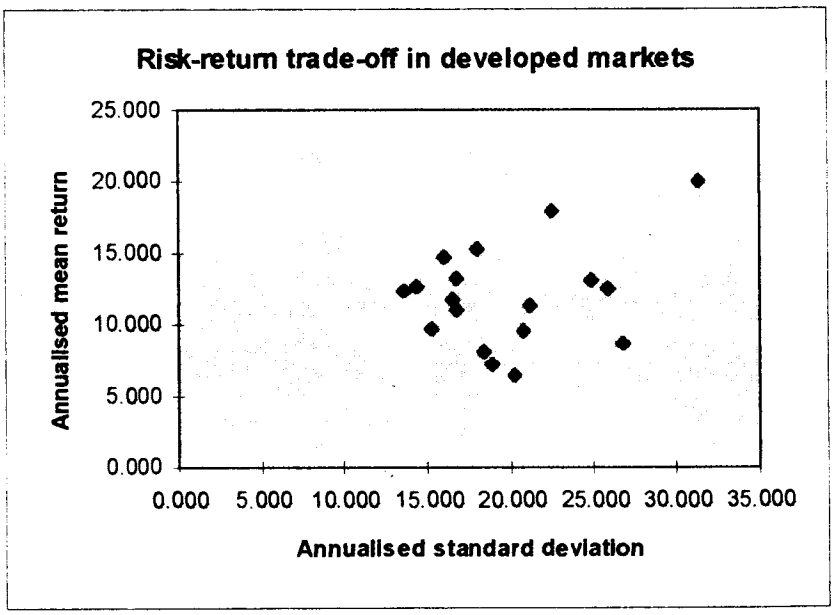
Summary Risk and Return Statistics : Developed Markets (In US $ terms)

	Period beginning	Annualised mean (%)	Annualised std dev (%)	Maximum monthly return	Minimum monthly return	Range
Australia	1976.02	13.343	21.574	0.189	-0.532	0.721
Austria	1976.02	6.446	20.212	0.250	-0.266	0.516
Belgium	1976.02	13.291	16.754	0.232	-0.260	0.492
Canada	1976.02	11.005	16.761	0.152	-0.243	0.395
Denmark	1976.02	11.822	16.466	0.139	-0.141	0.280
Finland	1988.02	8.673	26.758	0.240	-0.199	0.440
France	1976.02	9.550	20.801	0.199	-0.248	0.447
Hong Kong	1976.02	20.003	31.367	0.244	-0.571	0.815
Italy	1976.02	13.060	24.910	0.242	-0.197	0.440
Japan	1976.02	8.046	18.361	0.183	-0.218	0.401
Netherlands	1976.02	14.722	15.974	0.162	-0.252	0.415
Norway	1976.02	12.436	25.953	0.186	-0.352	0.539
Singapore	1993.02	7.263	18.917	0.206	-0.108	0.315
Spain	1976.02	11.299	21.136	0.239	-0.291	0.530
Sweden	1976.02	17.944	22.498	0.300	-0.242	0.542
Switzerland	1976.02	9.693	15.244	0.132	-0.264	0.396
UK	1976.02	15.364	18.043	0.173	-0.300	0.473
USA	1976.02	12.699	14.310	0.125	-0.239	0.363
MSCI World	1976.02	12.298	13.564	0.111	-0.186	0.297

In the case of developed markets, whose annualised returns are reported in Table 3.2, the highest returns have been observed in Hong Kong, at 20.86%. 10 out of the 20 emerging markets studied, record annualised returns that are higher than the highest value recorded for developed markets. However, standard deviation for all emerging markets is higher than the average obtained for developed markets.

The average return for all emerging markets was 36.76%, against 19.97% for developed markets. However the average risk associated with emerging markets was 36.65%, while the standard deviation in developed market return was much lower at 12.05%. It is therefore quite evident that emerging markets as an asset class do not exhibit a superior risk-return trade-off to global investors, but individual markets may behave differently. The risk-return trade-off in developed markets is shown in Figure 3.2 as an XY graph.

Figure 3.2



3.2 Risk and Return : Behaviour over time, Predictability and Normality

After quantifying the overall risk and return in emerging markets, we now turn to addressing few important research questions on their behaviour. There are three major concerns about risk and returns from emerging markets.

The first concern is whether risk and returns are time varying. There have been many conjectures about the behaviour of emerging market risk and return over time, the primary one being that liberalisation processes initiated in emerging markets have reduced the return, while increasing the volatility. Probable increase in volatility after opening up for global investors, is an important concern for policy makers in emerging markets. From the point of view of international investors, the rapid policy changes in the emerging markets have led to the belief that returns and risk are time-varying and therefore their is limited confidence in using past estimates for investment decisions.

The second concern is about the presence of predictable components in returns. There is limited evidence on the efficiency of emerging markets, and given that many of them are in the process of development, one research concern is whether returns contain predictable components.

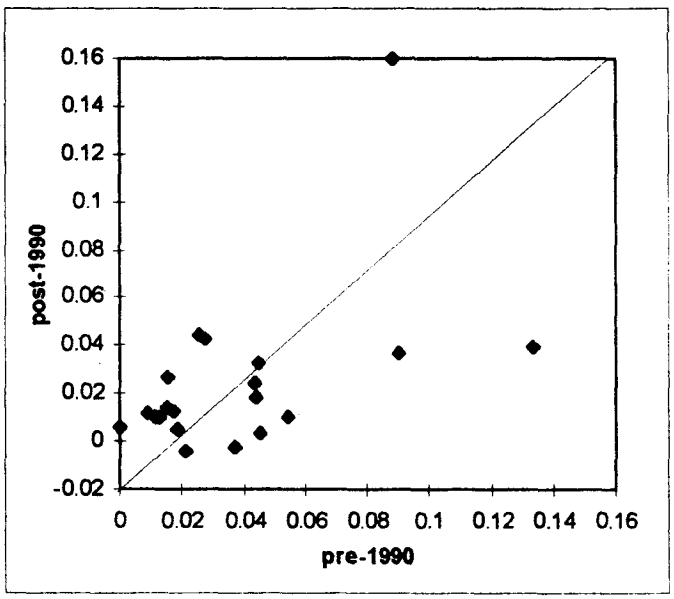
The third issue is whether the returns are normally distributed. The applicability of a mean-variance framework, pre-supposes normal distribution of returns. Lack of normality in emerging market returns would necessitate using alternative models to describe the return generation process and examine asset pricing in these markets.

3.2.1 Behaviour of risk and return over time

In order to obtain an overall view of behaviour of risk and return over time, we segregate the results into pre-1990 and post 1990 observations. (This is to factor into the data, the impact liberalisation of emerging markets in the 1990s. We use Bekeart (1995) for the timing of the liberalisation process in emerging markets). Figure 3.3 presents the five year values of annualised mean return, in an XY graph that captures the mean return in the pre and post-1990 period.

Figure 3.3

Behaviour of emerging market returns in the pre-and post 1990 period



Average monthly returns for 20 markets.
Data period Jan 1976 - Dec. 1996.

The scattered distribution of the points is indicative of a lack of pattern of either increase or decrease in mean returns in the 1990s. The central line represents a "no-change" scenario, on which markets would lie if the means in the two periods are identical. Points lying to the left of the line represent market where returns have increased in the post-1990 period, compared to the values obtained in the pre-1990 period. Points to the right of the central line represent markets where mean returns have actually fallen in the 1990s. Some markets like Korea, Thailand, Turkey and Argentina have seen significant drop in returns in the post 1990 period, returns in markets like Brazil (the furthermost point in the graph) have increased, while the pattern on the whole, does not support the view that returns have fallen since 1990. Most of the points are actually clustered around the central line.

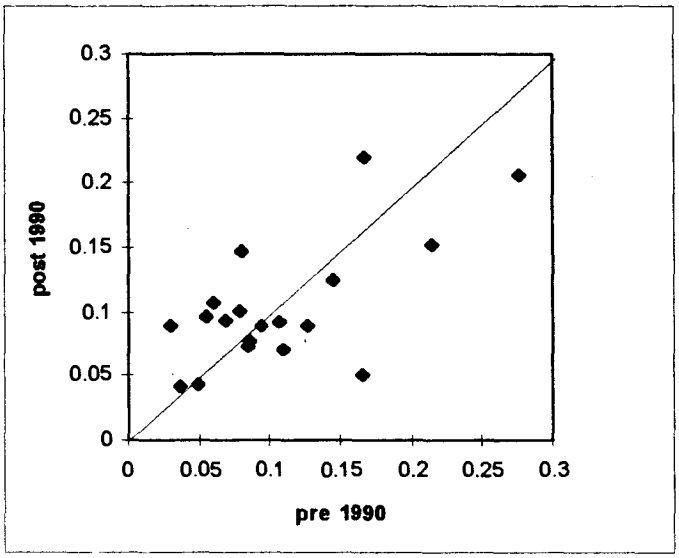
Country-by-country differences persist in behaviour of returns over time. We have therefore computed time varying returns, using rolling means for emerging markets, taking 5 years at a time. These figures are in Appendix A and what we see is a change in returns over time for some markets, and significant corrections in the recent periods for many markets.

We repeat a similar exercise for volatility and do not find evidence of increase in emerging market volatility in the post-liberalisation period. In fact, volatility in most markets in the post 1990 period is lower than in the pre-1990 period. It has to be remembered that our conclusion is based on a descriptive statistical view of the markets over time, and there is no attempt here to examine casual relationships. There is a good possibility that qualitative changes in institutional and market

structures that emerging markets went through in the 1990s (which we have described in Chapter 1), may have contributed to the reduction in volatility.

Figure 3.4

Behaviour of Emerging market volatility : Pre and Post 1990



Average monthly standard deviation for 20 markets.
Data period Jan 1976 - Dec. 1996.

We can see from Figure 3.4 above, that in 6 markets volatility has significantly dropped in the 1990s; in 3 of them it has increased; and in the remaining 11 markets there is no significant change in volatility in the 2 periods examined.

With a view to examining the behaviour of volatility over time in each of the emerging markets, we compute rolling 5 - year standard deviations for these

markets (Appendix B). We find that volatility varies over time in many of the markets examined. We can therefore conclude that risk and return in emerging markets have not increased or decreased in a uniform pattern, and we are unable find empirical support for the view that deregulation and globalisation have reduced return or increased risk. However, we find that both risk and return exhibit time-varying patterns, which is important in modelling the risk generating process in these markets.

3.2.2 Predictability in emerging market returns

The presence of time variability in risk and returns can be expected to induce predictability in emerging market returns, as was examined by Harvey (1991) and Ferson and Harvey (1993) in the context of developed markets. Predictability can also be caused by inefficiencies in emerging markets. There are not many studies that examine market efficiency in the context of emerging markets. In some markets, where such studies have been done, the results indicate lack of efficiency (For instance, Obaidullah (1993) in the Indian context, presents results of various studies that show the inapplicability of the efficient market hypothesis to Indian markets).

We have tested whether emerging markets exhibit the simplest and most well known form of predictability: serial correlation. We compute coefficients of the Markov first order auto-regressive process (AR(1) process) with various lags and estimate the auto-correlation function (ACF). The results are presented in Table 3.3.

Table 3.3

Serial correlation in Emerging market returns

	ρ1	ρ2	ρ3	ρ4	ρ12	ρ24
Argentina	0.08*	0.02	-0.07*	-0.06	0.17*	0.02
Brazil	0.08*	-0.05	0.02	-0.01	-0.01	0.23*
Chile	0.18*	-0.15*	0.01	-0.04	-0.05	-0.01
Columbia	0.42*	0.15*	0.1*	0.04	-0.04	-0.01
Greece	0.07*	-0.01	-0.14*	0.04	0.11*	-0.1
India	-0.08*	-0.05	-0.12*	0.08	-0.08	-0.06
Indonesia	0.24*	0.17*	0.12*	0.14*	0.16*	-0.09*
Jordan	0.01	0.03	0.07	-0.01	-0.03	-0.01
Korea	-0.04	0.06	-0.03	-0.03	-0.11*	-0.07
Malaysia	0.04	0.06	0.04	0.01	-0.007	-0.1
Mexico	-0.01	-0.01	0.07	0.15*	-0.02	-0.02
Nigeria	0.12*	0.08	0.04	0.01	-0.04	-0.02
Pakistan	0.32*	0.22*	0.16*	0.14*	-0.06	-0.02
Philippines	0.28*	0.16*	0.1*	0.13*	-0.06	-0.01
Portugal	0.26*	0.15*	0.06	0.04	0.03	-0.02
Taiwan	0.08	0.06	0.07	0.11*	0.1	-0.04
Thailand	0.12*	-0.04	-0.13	-0.06	-0.05	-0.08*
Turkey	0.24*	0.13*	0.11*	0.09	-0.17*	-0.06
Venezuela	0.27*	0.19*	0.12*	0.09	-0.06	-0.04
Zimbabwe	0.17*	0.28*	0.22*	0.15*	-0.03	-0.1

* significant at 5% level.

There is a strong evidence of serial correlation in emerging market returns, with 15 out of the 20 markets exhibiting statistically significant serial correlation at lag 1.

Except for Malaysia, Mexico and Jordan all emerging market returns exhibit the likelihood of having predictable components.

3.2.3 Distribution of returns

Emerging market returns are not completely explained by means and variances, but exhibit high levels of skewness and kurtosis. We have shown in Table 3.4 the skewness and kurtosis in emerging market returns, which lead us to believe that the returns may not be amenable to prediction by the normal distribution. Most emerging markets exhibit skewness and kurtosis values higher than the benchmark levels, though some developed markets too are not different.

We therefore use standard tests to examine whether emerging market returns are normally distributed. We first conduct the Jarque-Bera(JB) test of normality. In a normal distribution, skewness is zero and kurtosis is 3. The JB test is based on the principle that asymptotically, the statistic

$$JB = n\left[\frac{S^2}{6} + \frac{(K-3)^2}{24}\right]$$

follows the chi-square distribution with 2 degrees of freedom, where S represents Skewness and K represents Kurtosis. If the observed JB statistic is lower than the empirical critical value, and if p value of the computed chi-square statistic is lower than 0.05 (at 5% level of significance) we can reject the hypothesis that the returns are normally distributed. We also conduct the Kolmogorov - Smirnov (KS) distribution test, a standard goodness of fit test to judge how close the return distribution is to the normal distribution. At 5% level of significance we reject the

hypothesis that emerging market returns are normally distributed in 19 out of 20 markets using the JB tests and in 15 out of 20 markets using the KS test.

Table 3.4

Coefficients of skewness and kurtosis for emerging and developed markets

Emerging markets	Skewness	Kurtosis	Developed Markets	Skewness	Kurtosis
Argentina	1.574	4.376	Australia	-2.717	22.630
Brazil	0.561	0.515	Austria	0.238	4.783
Chile	0.536	2.275	Belgium	-0.023	5.767
Columbia	1.075	2.735	Canada	-0.810	4.186
Greece	1.251	5.873	Denmark	-0.122	0.664
India	0.468	2.617	Finland	0.005	0.503
Indonesia	-0.158	0.220	France	-0.389	1.616
Jordan	0.655	1.194	Hong Kong	0.323	0.789
Korea	0.703	1.258	Italy	-0.332	2.183
Malaysia	-0.877	3.965	Japan	-0.759	4.723
Mexico	-0.751	4.097	Malaysia	-0.681	2.311
Nigeria	2.200	7.784	Netherlands	1.002	3.416
Pakistan	0.529	3.388	Norway	-0.066	2.371
Philippines	0.397	2.870	Singapore	-1.067	6.178
Portugal	0.755	6.201	Spain	-1.001	5.111
Taiwan	-0.186	1.950	Sweden	-0.828	5.100
Thailand	-0.487	4.702	Switzerland	-0.646	2.654
Turkey	0.451	0.191	UK	0.354	2.550
Venezuela	-0.899	5.273	USA	-0.509	3.347
Zimbabwe	-0.195	1.926	MSCI World	-0.553	2.050

Computed on returns over the period Jan 1976 - Dec. 1996. Data series for individual countries begin as they became available (see Table 3.1). All data series end at Dec. 1996.

If the KS statistic is higher than the empirical critical value at 5% level of significance, we reject the hypothesis that returns are normally distributed. The results are in Table 3.5.

Table 3.5

Tests of Normality in Emerging Market Distributions

	JB Test Statistic	(p value)	K-S Test Statistic
Argentina	123.999*	<0.001	1.37*
Brazil	78.080*	<0.001	2.13*
Chile	17.574*	<0.001	0.76
Columbia	28.175*	<0.001	1.62*
Greece	152.458*	<0.001	1.48*
India	10.733*	0.003	1.52*
Indonesia	27.401*	<0.001	0.63
Jordan	44.806*	<0.001	1.6*
Korea	52.639*	<0.001	0.38
Malaysia	24.055*	<0.001	0.54
Mexico	36.305*	<0.001	1.1*
Nigeria	253.502*	<0.001	1.54*
Pakistan	7.630*	<0.001	1.64*
Philippines	3.875	0.003	1.06*
Portugal	68.358*	<0.001	1.23*
Taiwan	7.447*	0.004	0.87*
Thailand	40.380*	<0.001	1.36*
Turkey	43.518*	<0.001	1.21*
Venezuela	50.382*	<0.001	0.91*
Zimbabwe	13.693*	<0.001	0.58

* Significant at 5% level

Figure 3.5

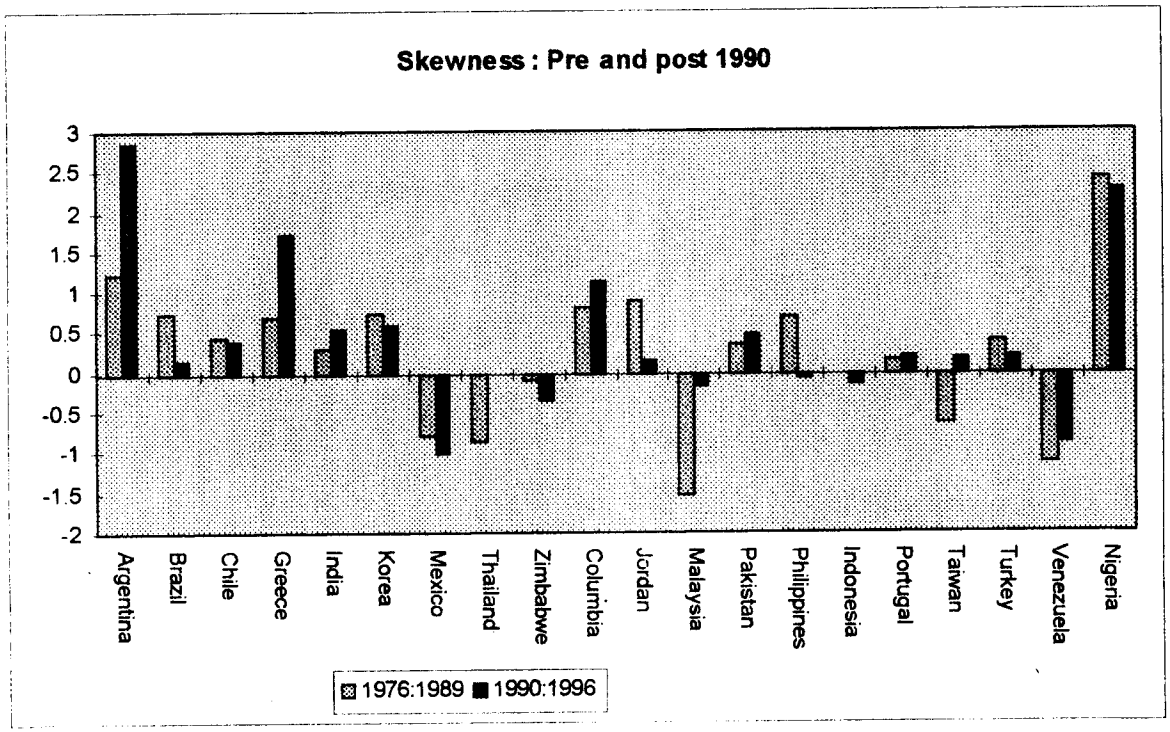
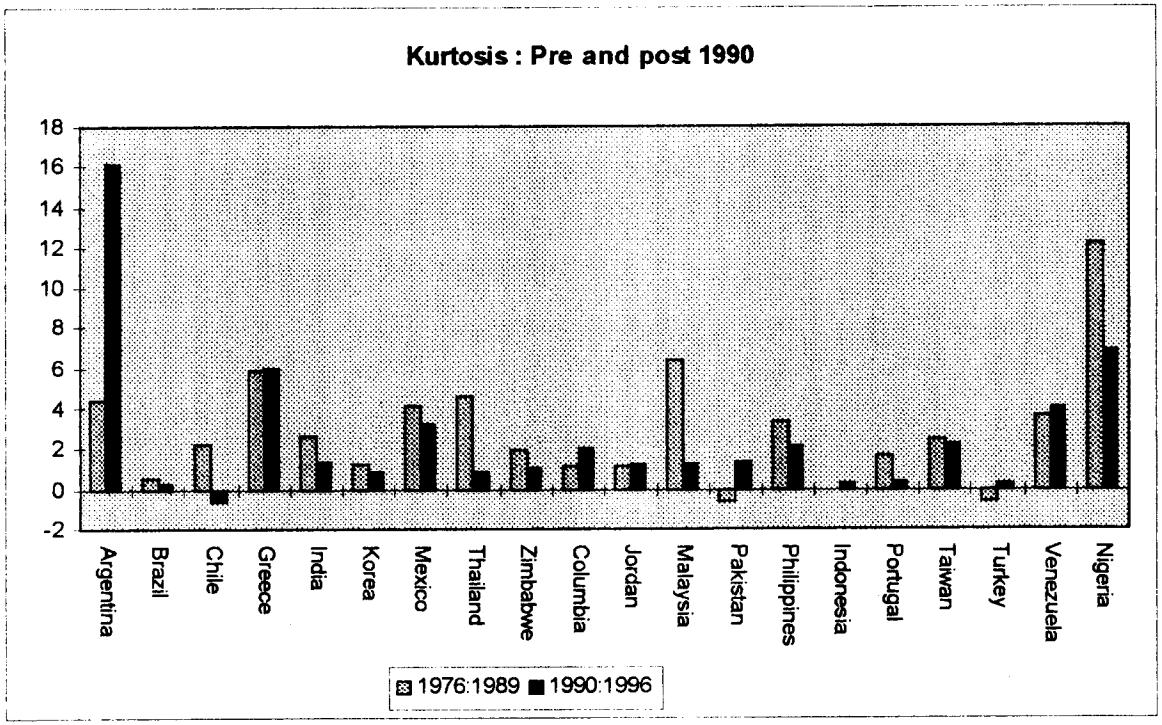

Skewness : Pre and post 1990
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
Argentina
Brazil
Chile
Greece
India
Korea
Mexico
Thailand
Zimbabwe
Columbia
Jordan
Malaysia
Pakistan
Philippines
Indonesia
Portugal
Taiwan
Turkey
Venezuela
Nigeria
1976:1989
1990:1996

Figure 3.6


Kurtosis : Pre and post 1990
18
16
14
12
10
8
6
4
2
0
-2
Argentina
Brazil
Chile
Greece
India
Korea
Mexico
Thailand
Zimbabwe
Columbia
Jordan
Malaysia
Pakistan
Philippines
Indonesia
Portugal
Taiwan
Turkey
Venezuela
Nigeria
1976:1989
1990:1996

3.3 Emerging Market Correlations

After considering the return distribution in emerging markets, we advance our analysis of emerging markets to the examination of correlations exhibited by these markets within themselves and with the developed markets. In the context of portfolio construction, the attributes of assets in terms of their risk and return alone do not explain the risk of the portfolio. The key determinant of portfolio risk, and hence the key variable that influences asset choice, is correlation that an asset exhibits with other assets competing for inclusion in a portfolio. Benefits from diversification depend on the correlation exhibited by assets in the portfolio. Diversifying into emerging markets will provide the scope to accentuate this benefit further, if the correlation of emerging markets with developed markets is lower than what is known in the context of developed markets. We compute the correlation between time series of returns of both emerging and developed markets over a ten year time period January 1987 to December 1996 (we choose this period as common data set for all 38 markets, except Indonesia, is available for this period).

Table 3.6 shows the correlation between developed markets over a 10 year period beginning 1987. The highest correlations are between UK and Netherlands and US and Canada, both at 0.78. In the case of other countries, it can be seen that higher correlations are evident in countries whose close economic ties are well known. Hong Kong's correlation with Singapore 0.74; Belgium's correlation with France is 0.72; and US and UK have a correlation of 0.76. The average correlation co-efficient across all the developed markets is 0.529.

Table 3.6

Developed Markets : Correlation over Jan 1987 - Dec 1996

	Aus	Aur	Bel	Can	Den	Finl	Fra	HK	Ita	Jap	Neth	Nor	Sing	Spa	Swe	Swtz	UK	USA
Australia	1.000																	
Austria	0.358	1.000																
Belgium	0.539	0.383	1.000															
Canada	0.691	0.317	0.563	1.000														
Denmark	0.362	0.285	0.490	0.403	1.000													
Finland	0.372	0.419	0.349	0.398	0.360	1.000												
France	0.511	0.438	0.726	0.555	0.490	0.313	1.000											
HK	0.653	0.402	0.520	0.663	0.303	0.341	0.478	1.000										
Italy	0.314	0.447	0.525	0.374	0.453	0.469	0.520	0.301	1.000									
Japan	0.326	0.136	0.409	0.376	0.430	0.254	0.396	0.282	0.415	1.000								
Nethrlnds	0.661	0.476	0.761	0.708	0.507	0.509	0.685	0.617	0.518	0.377	1.000							
Norway	0.601	0.468	0.626	0.575	0.482	0.541	0.567	0.491	0.468	0.353	0.734	1.000						
Singapore	0.588	0.466	0.368	0.403	0.335	0.181	0.469	0.741	0.305	0.285	0.522	0.329	1.000					
Spain	0.591	0.445	0.598	0.521	0.552	0.535	0.575	0.570	0.483	0.501	0.621	0.574	0.458	1.000				
Sweden	0.524	0.407	0.531	0.430	0.398	0.567	0.497	0.441	0.463	0.434	0.618	0.624	0.398	0.647	1.000			
Swtzrland	0.563	0.513	0.646	0.596	0.487	0.363	0.637	0.552	0.482	0.381	0.758	0.601	0.351	0.612	0.593	1.000		
UK	0.664	0.402	0.608	0.681	0.437	0.452	0.610	0.649	0.398	0.363	0.787	0.654	0.578	0.601	0.556	0.688	1.000	
USA	0.628	0.230	0.613	0.787	0.423	0.266	0.604	0.609	0.289	0.372	0.724	0.585	0.354	0.575	0.495	0.648	0.764	1.000
MSCIW	0.601	0.240	0.564	0.684	0.490	0.294	0.593	0.573	0.404	0.770	0.604	0.527	0.534	0.591	0.537	0.577	0.664	0.745

Table 3.7

Emerging Market Correlations (1987 - 1996)

	Arg	Brz	Chi	Gre	Ind	Kor	Mex	Tha	Zim	Col	Jor	Mal	Pak	Phi	Indo	Por	Tai	Tur	Ven	Nig
Arg	1.00																			
Brz	0.13	1.00																		
Chi	0.21	0.23	1.00																	
Gre	0.15	0.05	0.16	1.00																
Ind	0.15	0.12	0.19	0.07	1.00															
Kor	-0.09	0.02	0.11	-0.07	0.06	1.00														
Mex	0.23	0.11	0.38	0.23	0.07	0.21	1.00													
Tha	0.15	0.12	0.37	0.28	0.09	0.14	0.40	1.00												
Zim	0.09	0.11	0.17	-0.01	-0.07	0.07	0.09	-0.05	1.00											
Col	0.04	0.24	0.07	0.20	0.04	-0.01	0.05	0.09	0.08	1.00										
Jor	-0.13	0.11	0.05	0.11	-0.05	0.10	-0.03	0.14	-0.03	0.03	1.00									
Mal	0.08	0.12	0.32	0.13	0.07	0.26	0.43	0.62	0.00	0.05	0.15	1.00								
Pak	0.05	0.13	0.12	-0.01	0.12	0.07	0.12	0.21	0.08	0.37	0.10	0.19	1.00							
Phi	0.07	0.17	0.18	0.15	-0.05	0.08	0.17	0.42	0.05	0.13	0.17	0.53	0.20	1.00						
Indo	0.05	0.09	0.20	0.35	0.12	0.07	0.20	0.51	0.12	0.11	0.14	0.50	0.14	0.57	1.00					
Por	0.03	0.04	0.24	0.44	0.01	0.07	0.52	0.33	0.12	0.10	-0.02	0.29	0.05	0.00	0.34	1.00				
Tai	0.09	0.09	0.28	0.15	-0.04	0.09	0.38	0.42	-0.01	0.08	0.06	0.35	0.06	0.19	0.32	0.39	1.00			
Tur	0.19	0.13	0.05	0.24	0.14	0.05	0.17	0.26	-0.11	0.05	-0.05	0.27	0.06	0.14	0.30	0.26	0.21	1.00		
Ven	-0.02	-0.09	0.02	0.04	0.09	0.04	0.02	-0.02	0.23	0.24	-0.07	-0.03	0.14	-0.01	0.07	0.03	-0.11	0.00	1.00	
Nig	-0.03	0.02	0.09	0.11	-0.01	0.06	0.01	0.08	0.03	-0.06	0.05	0.04	0.08	0.18	0.12	-0.14	-0.08	0.00	-0.02	1.00

Table 3.8

Correlation of Emerging Markets with Developed Markets (1987 - 1996)

	Arg	Brz	Chi	Gre	Ind	Kor	Mex	Tha	Zim	Col	Jor	Mal	Pak	Phi	Indo	Por	Tai	Tur	Ven	Nig
Aus	0.09	0.16	0.27	0.24	0.04	0.12	0.44	0.49	0.02	0.04	0.12	0.56	0.09	0.29	0.27	0.35	0.37	0.17	-0.04	0
Aur	0.24	0.24	0.23	0.33	0.11	0.12	0.26	0.43	0.04	0.04	0.18	0.47	0.15	0.35	0.55	0.2	0.4	0.23	-0.16	0.14
Bel	0.02	0.06	0.29	0.18	-0.02	0.12	0.55	0.56	-0.06	-0.05	0.15	0.48	0.07	0.38	0.35	0.26	0.37	0.07	-0.1	0.06
Can	0.07	-0	0.25	0.22	-0.09	0.25	0.43	0.46	0.07	0.07	0.04	0.6	0.02	0.43	0.45	0.26	0.24	0.06	0.06	0.08
Den	0.16	0.05	0.15	0.11	0.03	0.13	0.27	0.28	0.15	0.05	0.26	0.36	0.09	0.28	0.28	0.16	0.18	0.09	-0.13	0.06
Fin	-0.01	0.14	0.05	0.09	-0.07	0.26	0.32	0.26	0.16	-0.02	0.14	0.35	0.06	0.37	0.36	0.14	0.24	0.03	-0.19	0.18
Fra	0.2	0.06	0.18	0.3	0.12	0.06	0.44	0.41	-0.04	-0.09	0.14	0.45	0	0.28	0.3	0.22	0.35	0.03	-0.09	0
HK	-0.05	0.18	0.41	0.2	-0.03	0.2	0.39	0.6	0	0.08	0.15	0.73	0.18	0.47	0.58	0.31	0.32	0.13	0.08	0.1
Ita	0.04	0.1	0.08	0.24	-0.02	0.19	0.23	0.41	0.06	0.08	0.19	0.33	0.08	0.26	0.32	0.22	0.29	0.05	-0.08	0.09
Jap	0.02	0.11	0.07	0.06	-0.18	0.28	0.35	0.3	0.14	-0.04	0.1	0.33	-0.05	0.19	0.08	0.32	0.32	0.04	-0.02	-0.01
Neth	0.08	0.08	0.28	0.24	0.04	0.21	0.51	0.53	0.07	-0.06	0.14	0.59	0.09	0.45	0.43	0.32	0.29	0.04	-0.09	0.15
Nor	0.16	0.2	0.33	0.24	0.07	0.19	0.52	0.4	0.18	0.01	0.08	0.5	0.05	0.25	0.37	0.4	0.32	0.08	-0.1	0.05
Sin	0.44	0.08	0.5	0.31	0.29	0.33	0.35	0.69	0.25	0.15	0.1	0.82	0.34	0.74	0.67	0.28	0.54	0.21	0.01	-0.04
Spa	0.17	0.12	0.31	0.27	0	0.11	0.46	0.43	0.14	0	0.1	0.49	0	0.35	0.29	0.33	0.32	0.15	-0.12	0.09
Swe	0.11	0.18	0.22	0.22	-0.04	0.21	0.43	0.4	0.06	-0.02	0.18	0.48	-0.01	0.27	0.25	0.31	0.26	0.11	-0.14	0.06
Swt	0.1	0.14	0.26	0.23	0.05	0.2	0.49	0.54	-0.05	0	0.24	0.52	0.05	0.33	0.39	0.31	0.29	0.02	-0.14	0.18
UK	0.07	0.05	0.3	0.18	0.01	0.29	0.49	0.49	0.04	-0.02	0.18	0.65	0.08	0.32	0.29	0.36	0.27	0.03	-0.06	0.12
USA	0.14	0.05	0.35	0.22	-0.06	0.17	0.49	0.45	0.01	0.05	0.13	0.56	0.04	0.36	0.32	0.31	0.21	0.01	-0.01	0.12
MSCIW	0	0.12	0.18	0.18	-0.11	0.27	0.4	0.41	0.07	0.04	0.18	0.55	0.03	0.35	0.22	0.36	0.29	0.08	-0.04	-0
Avg	0.11	0.11	0.25	0.21	0.01	0.19	0.41	0.45	0.07	0.02	0.15	0.52	0.07	0.35	0.36	0.29	0.31	0.09	-0.07	0.08

Correlations of emerging markets with one another is presented in Table 3.7. Except for some of the South east Asian markets which exhibit relatively higher correlations with one another (Philippines with Malaysia is 0.53; Malaysia with Indonesia is 0.62; and Indonesia with Thailand is 0.51), the overall correlation between emerging markets is very low. The average correlation for all emerging markets is 0.208, much smaller than what is known in the developed market context. We also find some markets like India and Korea exhibiting very low, as well as negative correlation with other emerging markets. The lack of correlation amongst emerging markets is one of first evidences of the lack of integration of these markets with one another, and their distinctiveness as an asset class.

In order to assess the attractiveness of emerging markets we now compute the correlation of emerging markets with developed markets. The results are in Table 3.8. the highest correlations are seen in South East Asia, with correlation of many of the markets with Singapore being much higher. However, we may have to read the numbers for Singapore with caution, given the low number of data points. The correlation in the case of most other emerging markets is very low. The average correlation of each emerging market with other developed markets is in last row of Table 3.8. It can be seen that markets like Venezuela (-0.07), India (0.01)and Columbia (0.02) have very negligible correlation with developed markets. The average correlation of emerging markets with developed markets is 0.194.

The prevalence of very low correlation provides the basis for the case of emerging markets in an international portfolio. Even assuming differences in the risk and return attributes, inclusion of emerging markets in international portfolios is bound to enhance

the diversification benefit, due to the near lack of correlation with developed markets. The diversification benefit from investing in emerging markets emerges from the lack of correlation of these markets with other markets.

3.4 Impact of Emerging Markets in International Portfolios

We have now analyzed risk, return and correlation of emerging and developed market returns. In order to demonstrate the impact of including emerging markets in an international portfolio, we construct efficient frontiers using the MSCI World Index as the proxy for a global portfolio of developed markets. The objective is to test whether the inclusion of emerging markets shifts a developed market portfolio to the left, in risk-return space, thus providing the scope to enhance return at lower risk or reduce risk at a given level of return. We test whether portfolios that include emerging markets dominate those that are constructed with developed markets.

We compute portfolio returns and variances using monthly returns over the last 10 year period for each of the 20 emerging markets for 100 portfolio combinations each. We begin with 100% allocation to MSCI World and gradually increase the allocation to the emerging market and decrease the allocation to MSCIW world, steeping up the allocation to emerging markets in the 100th portfolio, to 100%. We repeat this exercise for all the 20 emerging markets, working out risk and return for 20*100 = 2000 portfolio combinations. The results clearly demonstrate that including emerging markets in a global portfolio, will provide the diversification benefit of reducing risk while increasing return, upto a certain point, beyond which higher return can be earned only by bearing higher risk.

Portfolio return is measured as

$$r_{pt} = r_{it} W_{it} + r_{jt} W_{jt}$$

Portfolio risk is measured using variance as

$$\sigma^2_p = \sigma_i{}^2 W_i{}^2 + \sigma_j 2 W_j{}^2 + 2 \rho_{ij} \sigma_i \sigma_j W_i W_j$$

where ith asset is MSCI World Index ;

jth asset is the emerging market (j = 1,2,...20).

r_i and r_j are mean monthly returns (computed for t = 1,2, ...120).

σ_i and σ_j are mean monthly standard deviations (computed for t = 1,2, ...120).

σ_{ij} is the correlation between the ith and the jth assets.

Wi and Wj are the weights of the two assets in the portfolio, and have been varied from 0.01 to 1.

$i,j \neq 0$, i+j = 1 for every portfolio.

The behaviour of risk and return for 100 such portfolios for each of the 20 emerging markets is presented in Figure 3.7 (a to t). For each market, we have given the portfolio combination that represents the dominant portfolio in the efficient frontier, and the risk and return of the dominant portfolio.

We can see that there are 4 degrees in the impact of including emerging markets in an international portfolio. In the case of 11 markets, there is a significant diversification benefit, and the dominant portfolio has a significant allocation to emerging markets. In the case of virtually segmented markets like Venezuela, Nigeria and Jordan, the impact is the most significant. These markets are very small, and have not yet grown in significance. The most important segment however are emerging markets like India,

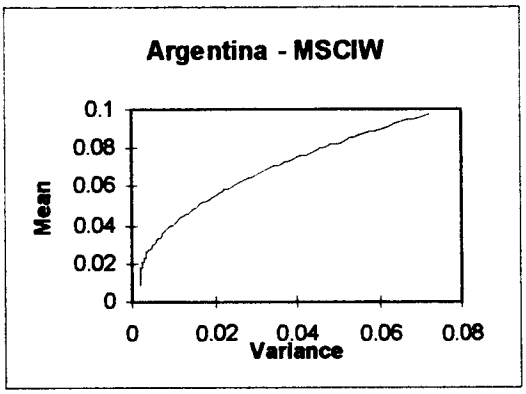
Columbia, Pakistan, Greece, Chile, Philippines and Zimbabwe which are growing and also exhibit low correlation and offer higher risk reduction possibilities. International investments should ideally flow into such markets.

The second set of markets are those where the allocation suggested by the efficient frontier is very small, at less than 3%. These are Argentina, Brazil, Thailand, Malaysia and Portugal, where higher returns are possible only by bearing higher risks. The third set of markets are those where the inclusion of emerging markets provide no diversification benefit at all, with risk and return increasing with allocations to emerging markets. The MSCI World itself is the dominant portfolio in these cases. The fourth set of markets, are those whose inclusion actually drives up the risk of the portfolio while driving down the return. The inclusion of these markets may actually be detrimental to international diversification. These markets are Korea and Indonesia.

Our results therefore establish the case for diversification into emerging markets. We now proceed to examine how we can empirically test the persistence of diversification benefits and their use in international portfolio allocation decisions. In order to be able to choose between the asset-pricing and non-asset pricing approaches to this problem, we first seek to test emerging markets for integration with world markets and the applicability of an international asset pricing model in explaining emerging market returns.

Figure 3.7 Efficient Frontiers - Impact of inclusion of Emerging Markets on Risk and Return

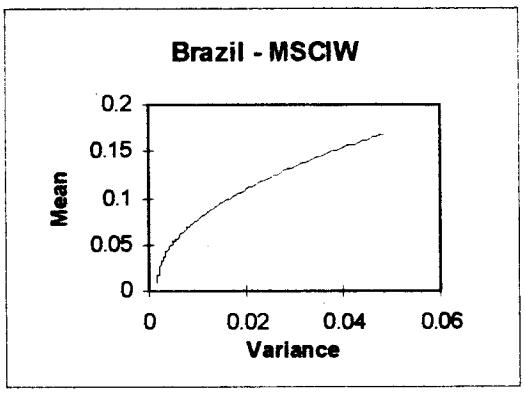
3.7 (a)



Dominant Portfolio : 97% MSCI; 3% ARG

$r_p = 0.010619$; $\sigma_p = 0.001753$

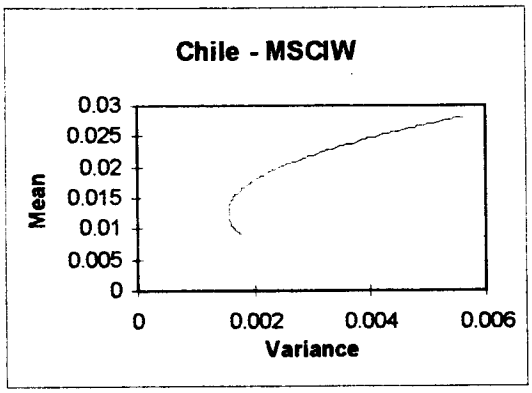
3.7 (b)



Dominant Portfolio : 98% MSCI; 2% Brazil

$r_p = 0.012034$; $\sigma_p = 0.001786$

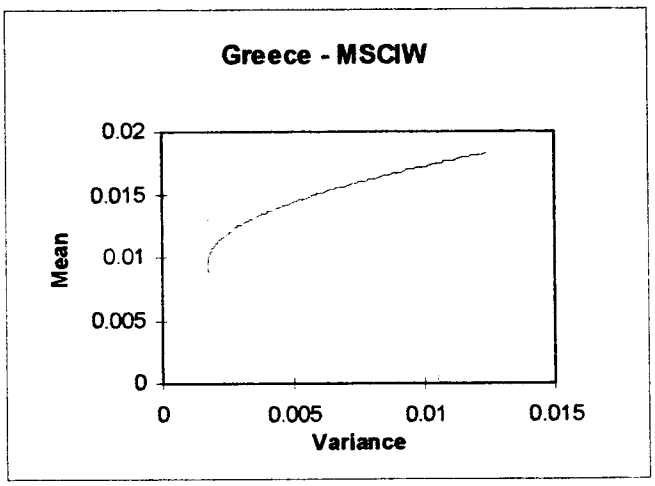
3.7 (c)



Dominant Portfolio : 79% MSCI; 21% Chile

r_p = 0.012901 ; σ_p = 0.001553

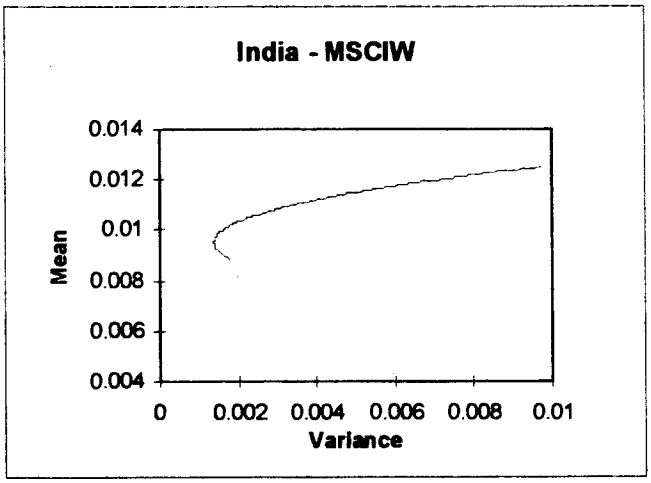
3.7 (d)



Dominant Portfolio : 92% MSCI; 8% Greece

r_p = 0.009589 ; σ_p = 0.001726

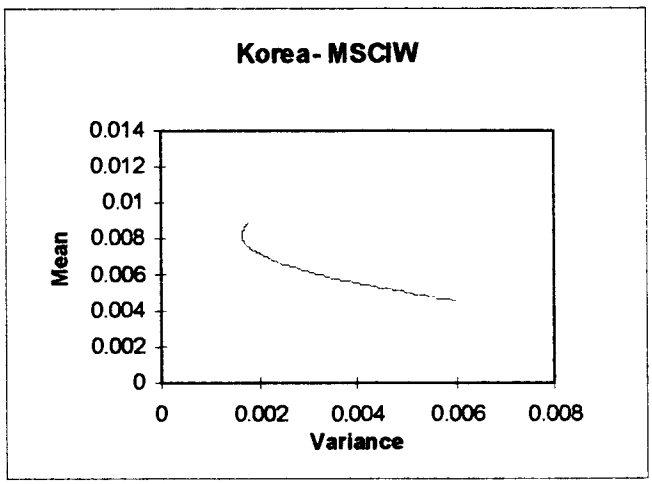
3.7 (e)



Dominant Portfolio : 82% MSCI; 18% India

r_p = 0.009493 ; σ_p = 0.001389

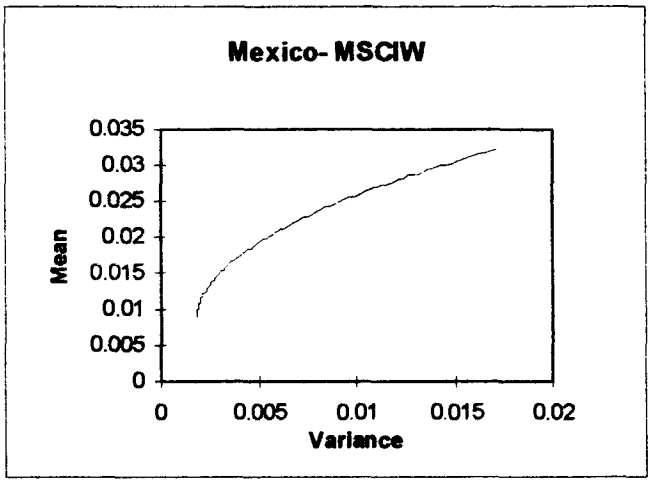
3.7 (f)



Dominant portfolio : MSCI World 100%

r_p = 0.008836 ; σ_p = 0.001794

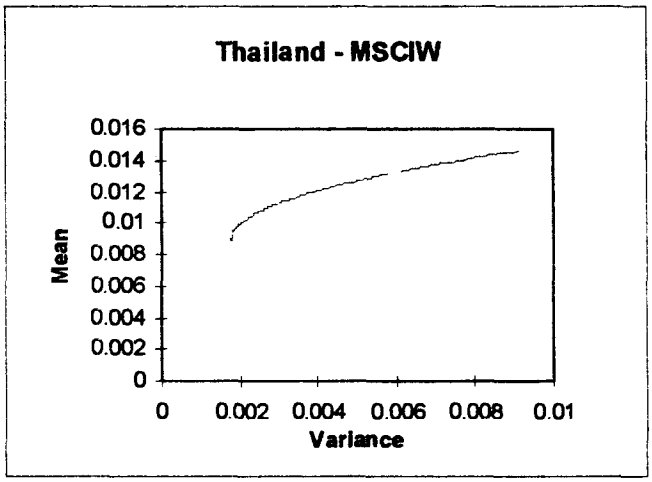
3.7 (g)



Dominant portfolio : MSCI World 100%

r_p = 0.008836 ; σ_p = 0.001794

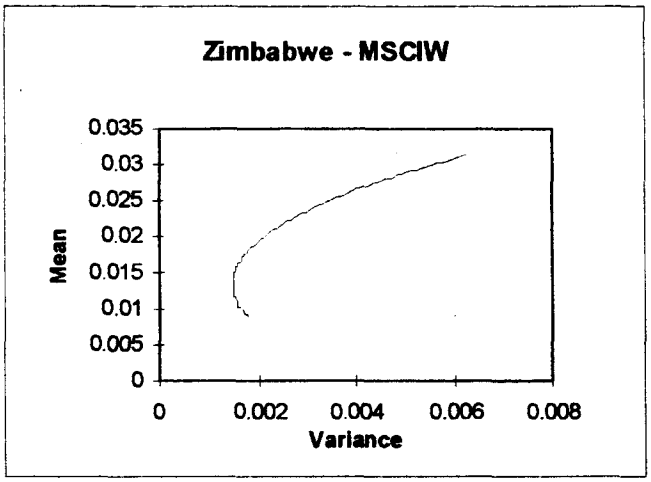
3.7 (h)



Dominant portfolio : MSCI W : 98%; Thailand 2%

r_p = 0.008951 ; σ_p = 0.001791

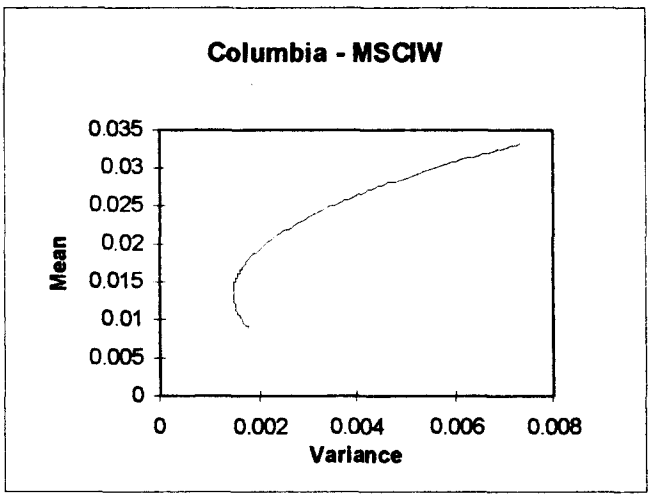
3.7 (i)



Dominant portfolio : MSCI W : 77%; Zimbabwe 23%

r_p = 0. 014006; σ_p = 0. 001482

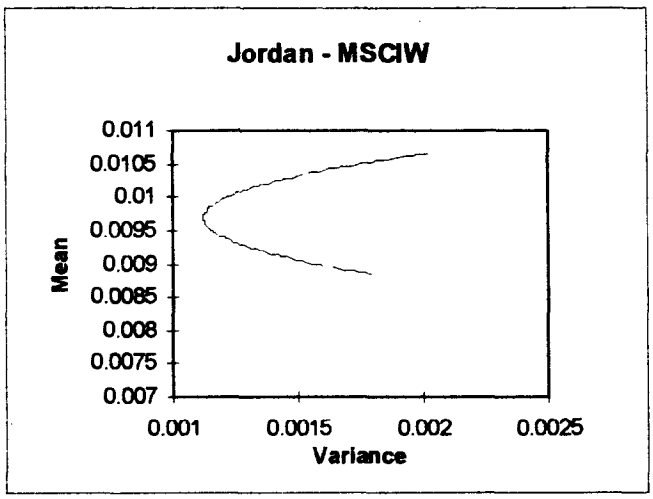
3.7 (j)



Dominant portfolio : MSCI W : 81%; Columbia 19%

r_p = 0. 013452; σ_p = 0. 001488

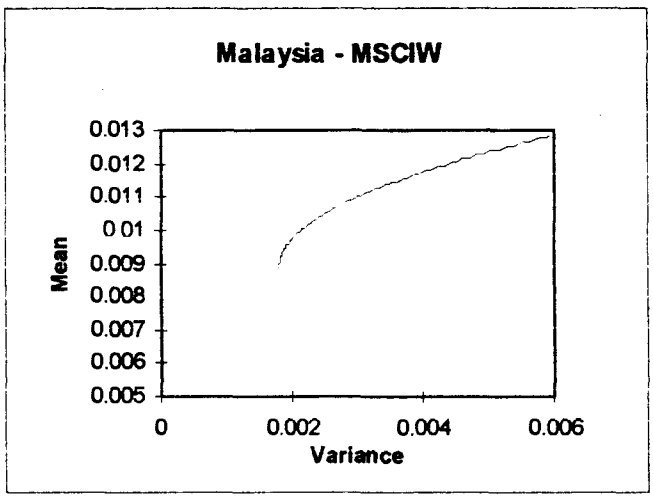
3.7 (k)



Dominant portfolio : MSCI W : 38%; Jordan 62%

r_p = 0. 009963; σ_p = 0. 001199

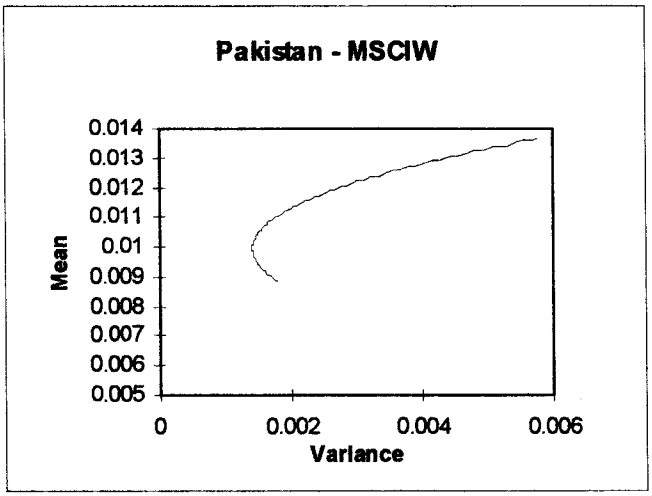
3.7 (l)



Dominant portfolio : MSCI W : 99%; Malaysia 1%

r_p = 0. 008876; σ_p = 0. 001794

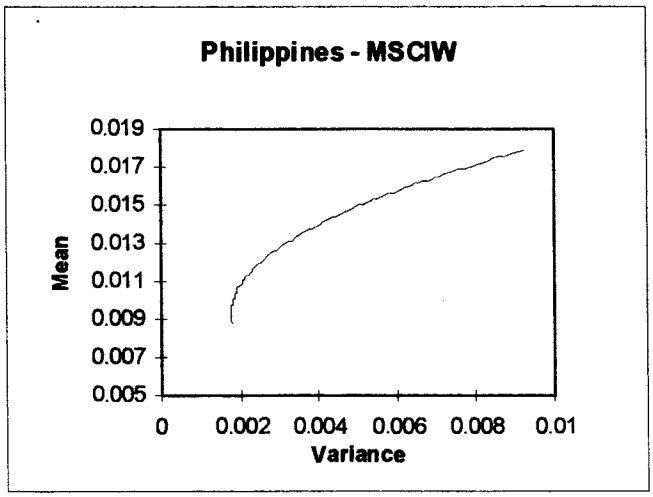
3.7 (m)



Dominant portfolio : MSCI W : 72%; Pakistan 28%

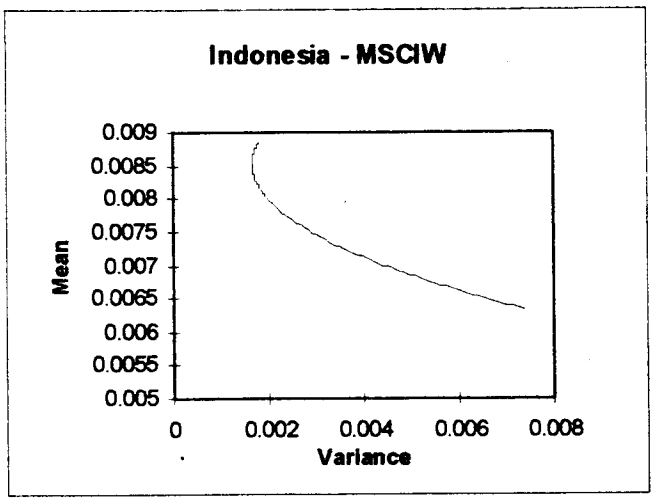
r_p = 0. 010187; σ_p = 0. 001427

3.7 (n)



Dominant portfolio : MSCI W : 95%;Philippines 5%

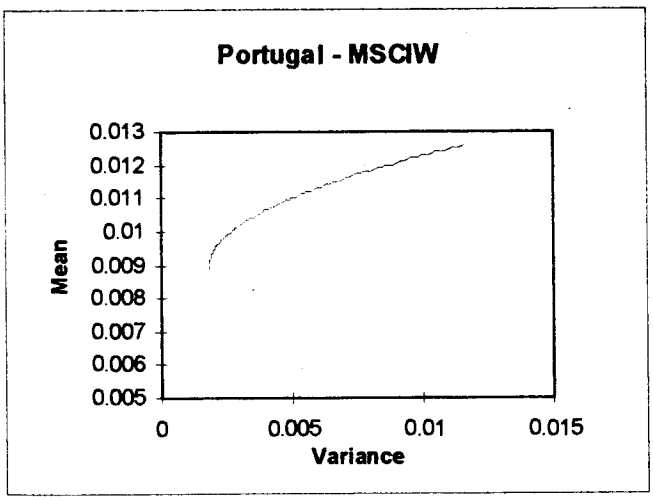
r_p = 0. 009286; σ_p = 0. 001776



Dominant portfolio : MSCI World 100%

r_p = 0.008836 ; σ_p = 0.001794

3.7 (p)

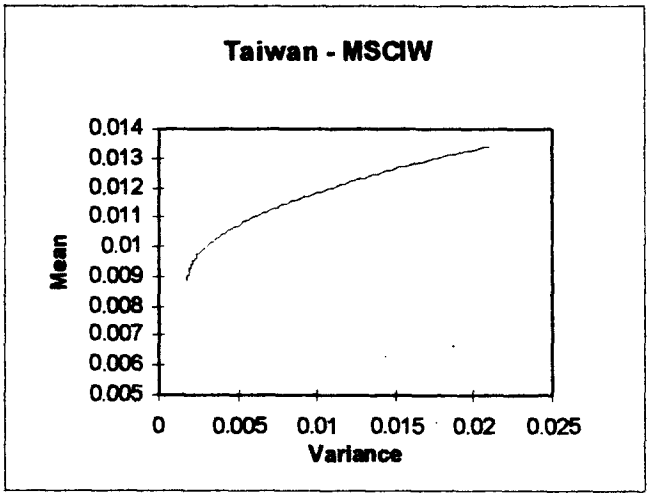


Dominant portfolio : MSCI World 97%; Portugal 3%

r_p = 0.008911 ; σ_p = 0.001792

3.7 (q)

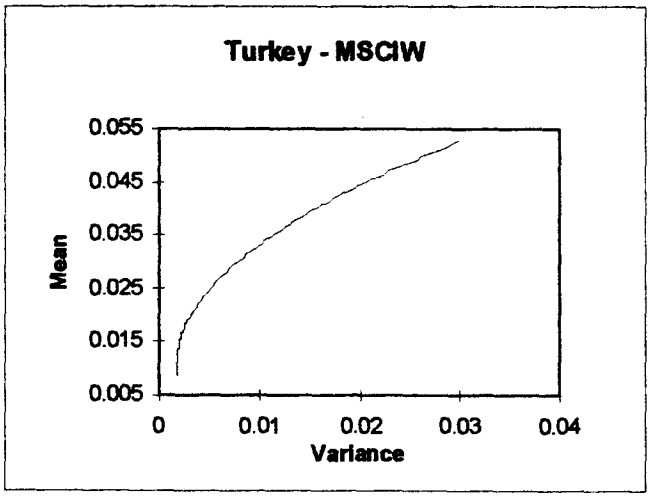
3.7 (q)



Dominant portfolio : MSCI World 100%

$r_p = 0.006836$; $\sigma_p = 0.001794$

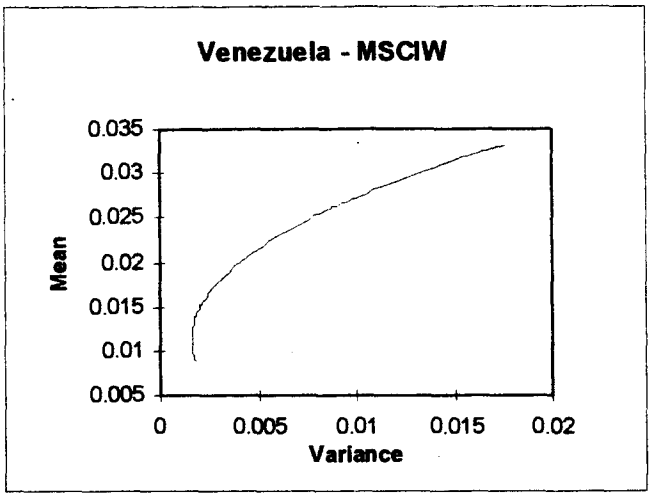
3.7 (r)



Dominant portfolio : MSCI World 95%; Turkey 5%

$r_p = 0.011026$; $\sigma_p = 0.001752$

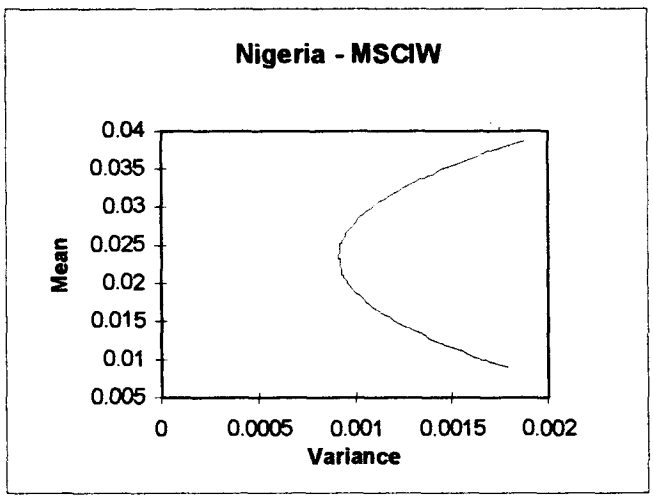
3.7 (s)



Dominant portfolio : MSCI World 89%; Venezuela 11%

$r_p = 0.011526$; $\sigma_p = 0.00159$

3.7 (t)



Dominant portfolio : MSCI World 48%; Nigeria 51%

$r_p = 0.024417$; $\sigma_p = 0.000922$

3.5 Single Factor Model of Asset Returns

The single factor Capital Asset Pricing Model (CAPM) as proposed by Sharpe(1964) and Lintner(1965), applied in the international context, assumes that market returns can be explained in terms of a benchmark world portfolio, and that international equity is priced relative to the world index, similar to the pricing of domestic assets in terms of a domestic index. In other words, the international CAPM assumes that assets in different markets are identically priced, and that two assets with identical risk characteristics will command an identical price, irrespective of the market in which they are traded. This amounts to an assumption of complete integration, and therefore, testing the ICAPM is also a joint test of the integration of world markets. Failure of the single factor ICAPM to explain the returns from emerging markets, therefore would also explain lack of integration and hence presence of unexploited diversification benefits in emerging markets.

There have been many joint tests of international integration and the ICAPM and results have been mixed. Harvey(1991) finds that cross sectional variance in industrial country returns can be explained by a single source of risk, while in Harvey(1995) emerging market returns do not follow a similar pattern. Other studies that jointly test integration and asset pricing are Stulz (1981), Bonsar-Neal, Brauer, Neal and Wheatley (1986), Campbell and Hamao (1992), Chan, Karolyi, and Stulz (1994), Heston, Rouwenhorst and Wessels (1995), Bekaert (1995), and Bekaert and Harvey (1995).

We propose a joint test of integration and asset pricing in emerging markets, using the ICAPM framework. A single factor model is estimated for developed and emerging markets, using the MSCI world index as the benchmark portfolio.

We first test the market model specified as follows:

$$r_{it} = \alpha_i + \beta_i r_{mt} + e_{it}$$

Estimates of βi would indicate the measure of systematic movement of emerging market (i) returns with the world market index (m). It is expected that αi would not be significantly different from zero and that the error term (e_{it}) would be uncorrelated with the other variables in the equation, and have a mean of zero.

The significance of the regression is tested with F values. Critical values of F are computed for each regression and if the observed value of F is greater than the critical value at 5% level of significance, we reject the null hypothesis that β_i is not a significant explanatory factor of returns from the market (i) being tested. The regression is significant if we are able to reject the null. The results are tabulated in Tables 3.9 and 3.10.

We then estimate β_i coefficients and report them along with the t-statistics and p-values at 5% level of significance. If the p-value is less than 0.05, we reject the null that MSCI World index is not a statistically significant explanatory variable of returns from the markets. Tests of the asset pricing model will depend on the significance of the regression of the single factor market model. We repeat the tests for two 5 year sub periods, 1987 - 1991 and 1992 - 1996.

Table 3.9

Significance of the Single-factor Regression : Emerging Markets

Results for the period Jan 1987 - Dec. 1991

	R Square	Adjusted R Square	Observed F*	Theoretical F at 5% level of significance
Argentina	0.0040	-0.0132	0.2316	0.6322
Brazil	0.0279	0.0112	1.6658*	0.2019
Chile	0.0473	0.0309	2.8804*	0.0950
Greece	0.0374	0.0208	2.2557*	0.1385
India	0.0023	-0.0149	0.1315	0.7182
Korea	0.1058	0.0904	6.8630*	0.0112
Mexico	0.2216	0.2082	16.5146*	0.0001
Thailand	0.3191	0.3074	27.1822*	0.0000
Zimbabwe	0.0270	0.0102	1.6110*	0.2094
Columbia	0.0059	-0.0112	0.3438	0.5599
Jordan	0.0573	0.0411	3.5282*	0.0654
Malaysia	0.4592	0.4499	49.2554*	0.0000
Pakistan	0.0001	-0.0172	0.0048	0.9449
Philippines	0.1304	0.1154	8.6940*	0.0046
Portugal	0.1347	0.1198	9.0280*	0.0039
Taiwan	0.0874	0.0717	5.5581*	0.0218
Turkey	0.0070	-0.0101	0.4114	0.5238
Venezuela	0.0112	-0.0059	0.6548*	0.4217
Nigeria	0.0055	-0.0116	0.3210	0.5732

* Significant at 5% level.

In 13 out of the 20 markets, the observed F is higher than the theoretical level. We therefore can reject the hypothesis that MSCIW is not a significant explanatory variable of returns in these emerging markets. In these cases, the regression is significant. However, the lower levels of sensitivity of emerging market returns to World Index, and hence the lower explanatory power of the regression, is evident from the very low R^2 exhibited for most markets. The highest adjusted R^2 is for Malaysia at 0.449. However in the other 7 emerging markets for the period 1987-1991, we are unable to reject the hypothesis. The results for the significance of the regression in the recent 5 year period 1991 - 1996 is in Table 3.10, and the results are similar. However the power of the regression is weak, as evident from the lower R^2 values in the second period as compared to the first.

The results for developed markets is in absolute contrast (Tables 3.11 and 3.12) . In all the 18 markets, the regression is significant. The observed F is higher than the critical value and we can therefore say that the MSCI World Index is a significant explanatory variable of the returns from the developed markets. We therefore reject the null hypothesis at 5% level of significance. The significance of the relationship between the two variables is also evident from the R^2 values which are positive and high in all the cases. We repeat the tests for the more recent period of 1992-1996, and observe similar results (Table 3.12).

On the basis of empirical examination, we are able to conclude that, at 5% level of significance, MSCI World index has a higher explanatory power for the returns of developed markets, and explains weakly a small fraction of emerging market returns.

Table 3.10

Significance of the Single-factor Regression : Emerging Markets

Results for the period Jan 1992 - Dec. 1996

	R Square	Adjusted R Square	F*	Theoretical F at 5% level of significance
Argentina	0.1652	0.1508	11.4756*	0.0013
Brazil	0.0000	-0.0172	0.0005	0.9825
Chile	0.0129	-0.0041	0.7562*	0.3881
Greece	0.0237	0.0068	1.4066*	0.2405
India	0.0489	0.0325	2.9810*	0.0896
Korea	0.0245	0.0077	1.4569*	0.2323
Mexico	0.0529	0.0366	3.2421*	0.0770
Thailand	0.0141	-0.0029	0.8318*	0.3655
Zimbabwe	0.1313	0.1163	8.7664*	0.0044
Columbia	0.0002	-0.0170	0.0138	0.9069
Jordan	0.0027	-0.0145	0.1558	0.6945
Malaysia	0.0888	0.0731	5.6526*	0.0207
Pakistan	0.0056	-0.0116	0.3243	0.5712
Philippines	0.1032	0.0877	6.6712*	0.0123
Portugal	0.1427	0.1279	9.6518*	0.0029
Taiwan	0.0699	0.0539	4.3616*	0.0412
Turkey	0.0069	-0.0103	0.4003	0.5294
Venezuela	0.0026	-0.0146	0.1494	0.7005
Nigeria	0.0104	-0.0067	0.6100*	0.4380
Indonesia	0.1022	0.0867	6.6044*	0.0128

Table 3.11

Significance of the Single -factor regression : Developed Markets

Results for the period Jan 1987 - Dec. 1991

	R Square	Adjusted R Square	F*	Theoretical F at 5% level of significance
Australia	0.3469	0.3356	30.8035	0.0000
Austria	0.0615	0.0453	3.7976	0.0562
Belgium	0.3987	0.3883	38.4559	0.0000
Canada	0.5119	0.5035	60.8375	0.0000
Denmark	0.2954	0.2832	24.3132	0.0000
France	0.4110	0.4009	40.4737	0.0000
Hong Kong	0.4261	0.4162	43.0620	0.0000
Italy	0.2790	0.2666	22.4429	0.0000
Japan	0.6612	0.6554	113.2169	0.0000
Netherlands	0.3695	0.3586	33.9930	0.0000
Norway	0.3192	0.3074	27.1879	0.0000
Spain	0.4041	0.3939	39.3359	0.0000
Sweden	0.3485	0.3373	31.0277	0.0000
Switzerland	0.4481	0.4386	47.0965	0.0000
UK	0.5174	0.5091	62.1767	0.0000
USA	0.5926	0.5855	84.3490	0.0000

In all the cases the observed F is higher than the theoretical value. The regressions are significant.

Table 3.12

Significance of the Single-factor regression : Developed Markets

Results for the period Jan 1992 - Dec. 1996

	R Square	Adjusted R Square	F*	Theoretical F at 5% level of significance
Australia	0.4355	0.4258	44.7510	0.0000
Austria	0.0454	0.0290	2.7609	0.1020
Belgium	0.1087	0.0934	7.0752	0.0101
Canada	0.3762	0.3654	34.9779	0.0000
Denmark	0.1623	0.1479	11.2394	0.0014
Finland	0.1107	0.0954	7.2233	0.0094
France	0.2204	0.2069	16.3933	0.0002
Hong Kong	0.1588	0.1443	10.9494	0.0016
Italy	0.0735	0.0576	4.6035	0.0361
Japan	0.5348	0.5267	66.6643	0.0000
Netherlands	0.3725	0.3617	34.4305	0.0000
Norway	0.1906	0.1766	13.6578	0.0005
Singapore	0.2848	0.2674	16.3286	0.0002
Spain	0.2649	0.2522	20.8979	0.0000
Sweden	0.2120	0.1984	15.6065	0.0002
Switzerland	0.0936	0.0779	5.9876	0.0175
UK	0.2327	0.2195	17.5887	0.0001
USA	0.4221	0.4121	42.3585	0.0000

In all the cases the observed F is higher than the theoretical value. The regressions are significant.

We now consider the estimates of the intercept and the co-efficient that has been estimated using the single factor model. We present the estimates along with their t statistics and p-value of the t statistics. The null hypothesis is that the MSCI World Index does not explain the returns from the markets examined. We expect the intercept to not be statistically significant from zero, and we expect the value of the beta co-efficient, which measures the extent to which MSCIW explains returns from the markets examined, to be significant. It the p-value is less than 0.05, we can reject the null hypothesis.

Let us consider the case of developed markets first. The results are in Tables 3.13 and 3.14. The p-values for the estimate of the intercept is higher than 0.05 in all cases. Therefore at 5% level of significance, we can say that the value of the intercept is not statistically different from zero. The value of the beta coefficient is within the normally accepted range of 05. to 1.5, and the p value of the coefficient is, in all cases, higher than 0.05. Therefore, at 5% level of significance, we can say that beta of the developed markets with MSCI is a significant explanatory variable of returns. We obtain similar results for the recent period of 1992-1996, except that in the case of US, Japan and Switzerland, we find that we are unable to say that the value of the intercept is statistically different from zero, at 5% level of significance. In the case of Austria, the p-value of the t-statistics of the beta coefficient is higher than 0.05, indicating lower explanatory power. But the value of the beta coefficients are in acceptable ranges. On the basis of our empirical tests, we conclude that in the case of developed markets, we

can use a cross sectional regression with MSCI World index, and model the returns in an ICAPM framework.

Table 3.13

Estimates of the intercept and β for Developed Markets

Results for the period Jan 1987 - Dec. 1991

	Intercept	t Stat	p-value	Beta co-efficient	t Stat	p-value
Australia	0.0004	0.0428	0.9660	0.9543	5.5501	0.0000
Austria	0.0038	0.3231	0.7478	0.4259	1.9487	0.0562
Belgium	0.0011	0.1583	0.8748	0.7769	6.2013	0.0000
Canada	-0.0003	-0.0632	0.9498	0.6722	7.7998	0.0000
Denmark	0.0096	1.5910	0.1170	0.5578	4.9308	0.0000
France	-0.0039	-0.5554	0.5808	0.8402	6.3619	0.0000
Hong Kong	0.0022	0.2151	0.8305	1.2381	6.5622	0.0000
Italy	-0.0103	-1.4945	0.1405	0.6124	4.7374	0.0000
Japan	-0.0081	-1.5031	0.1382	1.0729	10.6403	0.0000
Netherlands	0.0020	0.3567	0.7226	0.6284	5.8303	0.0000
Norway	-0.0009	-0.0921	0.9269	0.9374	5.2142	0.0000
Spain	-0.0031	-0.4248	0.6726	0.8698	6.2718	0.0000
Sweden	-0.0005	-0.0600	0.9523	0.8653	5.5702	0.0000
Switzerland	-0.0046	-0.7460	0.4587	0.8026	6.8627	0.0000
UK	0.0018	0.2970	0.7675	0.8826	7.8852	0.0000
USA	0.0050	1.0867	0.2817	0.7894	9.1842	0.0000

Table 3.14

Estimates of Intercept and β for Developed Markets

Results for the period Jan 1992 - Dec 1996

	Intercept	t Stat	p-value	X_1	t Stat	p-value
Australia	0.0005	0.1186	0.9060	0.8922	6.6896	0.0000
Austria	-0.0018	-0.2654	0.7917	0.3823	1.6616	0.1020
Belgium	0.0079	1.7367	0.0878	0.4064	2.6599	0.0101
Canada	0.0040	1.1068	0.2729	0.7171	5.9142	0.0000
Denmark	0.0024	0.4349	0.6652	0.6321	3.3525	0.0014
Finland	0.0137	1.2630	0.2117	0.9821	2.6876	0.0094
France	0.0006	0.1158	0.9082	0.7646	4.0489	0.0002
Hong Kong	0.0105	1.1163	0.2689	1.0501	3.3090	0.0016
Italy	0.0033	0.3688	0.7136	0.6544	2.1456	0.0361
Japan	-0.0144	-2.6193	0.0112	1.5192	8.1648	0.0000
Netherlands	0.0095	2.4920	0.0156	0.7563	5.8678	0.0000
Norway	0.0035	0.4639	0.6445	0.9304	3.6956	0.0005
Singapore	-0.0034	-0.4541	0.6522	1.0216	4.0409	0.0002
Spain	0.0062	0.9474	0.3474	1.0043	4.5714	0.0000
Sweden	0.0100	1.2683	0.2097	1.0545	3.9505	0.0002
Switzerland	0.0127	2.5977	0.0119	0.4027	2.4470	0.0175
UK	0.0058	1.3201	0.1920	0.6260	4.1939	0.0001
USA	0.0070	2.7303	0.0084	0.5653	6.5083	0.0000

The case of the emerging markets is a study in contrast. We present the results of the single factor regression along with the t-stats and the p-values in Tables 3.15 and 3.16. During the first 5 year period (1987 - 1991), we find that the p-values of the t statistics of the intercept term is higher than 0.05 in the case of Greece, India, Jordan, Korea, Malaysia, Philippines, Portugal and Taiwan. In these markets, we may reject the hypothesis that the intercept is significantly different from zero, at 5% level of confidence. However, in only 7 emerging markets we are able to obtain statistically significant estimates of the beta coefficient. These are Philippines, Taiwan, Thailand, Korea, Mexico, Malaysia and Portugal. In all the other markets we reject the hypothesis that return MSCI World Index is a significant explanatory variable of emerging market returns. In countries like Argentina, India, Venezuela, Nigeria and Zimbabwe, the beta co-efficient is actually negative. These were also the countries in which we observed very little or negative correlation with developed markets.

Recent data shows a perceptible change in the regression results. The intercepts are not statistically different from zero in all but 2 markets. However, the beta co-efficient is significant in 6 markets, only 4 of which are common to the earlier period. In Argentina, Indonesia, Malaysia, Taiwan, Philippines and Portugal, beta coefficient is statistically significant explanatory variable of emerging market returns, at 5% level of confidence. India continues to be the one market with negative beta coefficient. It can therefore be concluded that emerging markets do not exhibit high levels of integration with the developed markets, and that their returns cannot, except in few cases, be explained in terms of a single factor ICAPM model.

Table 3.15

Estimates of Intercept and β for Emerging Markets

Results for the period Jan 1987 - Dec 1991

	Intercept	t Stat	p-value	Beta coefficient	t Stat	p-value
Argentina	0.1963	4.3545	0.0001	-0.4072	-0.4812	0.6322
Brazil	0.1815	5.5450	0.0000	0.7929	1.2906	0.2019
Chile	0.0408	3.9740	0.0002	0.3272	1.6972	0.0950
Columbia	0.0511	4.6809	0.0000	0.1202	0.5863	0.5599
Greece	0.0250*	1.3384	0.1860	0.5268	1.5019	0.1385
India	0.0208*	1.8110	0.0753	-0.0782	-0.3627	0.7182
Jordan	0.0095*	1.4892	0.1418	0.2253	1.8783	0.0654
Korea	0.0046*	0.4381	0.6629	0.5130*	2.6197	0.0112
Malaysia	0.0017*	0.2085	0.8356	1.0664*	7.0182	0.0000
Mexico	0.0450	2.4588	0.0169	1.3964*	4.0638	0.0001
Nigeria	0.0315	6.2866	0.0000	-0.0533	-0.5665	0.5732
Pakistan	0.0285	3.5419	0.0008	0.0105	0.0694	0.9449
Philippines	0.0126*	0.9379	0.3522	0.7419*	2.9486	0.0046
Portugal	0.0038*	0.2151	0.8304	1.0042*	3.0047	0.0039
Taiwan	0.0094*	0.4085	0.6844	1.0135*	2.3576	0.0218
Thailand	0.0116*	1.0546	0.2960	1.0776*	5.2137	0.0000
Turkey	0.0550	2.1200	0.0383	0.3122	0.6414	0.5238
Venezuela	0.0528	3.3755	0.0013	-0.2378	-0.8092	0.4217
Zimbabwe	0.0391	5.3006	0.0000	-0.1759	-1.2692	0.2094

* significant at 5 % level.

Table 3.16

Estimates of Intercept and β for Emerging Markets

Results for the period Jan 1992 - Dec 1996

	Intercept	t Stat	p-value	Beta Co-efficient	t Stat	p-value
Argentina	-0.0106*	-0.7910	0.4322	1.5267*	3.3876	0.0013
Brazil	0.1489	5.9000	0.0000	0.0188	0.0221	0.9825
Chile	0.0103*	1.1344	0.2613	0.2672	0.8696	0.3881
Columbia	0.0145*	1.2508	0.2160	-0.0461	-0.1175	0.9069
Greece	0.0038*	0.4452	0.6579	0.3433	1.1860	0.2405
India	0.0125*	0.8566	0.3952	-0.8487	-1.7265	0.0896
Indonesia	0.0090*	0.9374	0.3524	0.8315*	2.5699	0.0128
Jordan	0.0092*	1.6845	0.0975	0.0726	0.3947	0.6945
Korea	-0.0035*	-0.3598	0.7203	0.3951	1.2070	0.2323
Malaysia	0.0080*	0.8649	0.3906	0.7435*	2.3775	0.0207
Mexico	0.0005*	0.0442	0.9649	0.7552	1.8006	0.0770
Nigeria	0.0450	7.0029	0.0000	0.1697	0.7810	0.4380
Pakistan	-0.0033*	-0.2823	0.7787	0.2274	0.5695	0.5712
Philippines	0.0083*	0.7858	0.4352	0.9262*	2.5829	0.0123
Portugal	0.0069*	1.1387	0.2595	0.6341*	3.1067	0.0029
Taiwan	0.0006*	0.0459	0.9635	0.9009*	2.0884	0.0412
Thailand	0.0048*	0.3928	0.6959	0.3772	0.9120	0.3655
Turkey	0.0437*	2.1724	0.0339	0.4300	0.6327	0.5294
Venezuela	0.0135*	0.6850	0.4961	0.2572	0.3865	0.7005
Zimbabwe	0.0140*	1.1358	0.2607	1.2300*	2.9608	0.0044

* significant at 5 % level.

The inability of a single factor ICAPM to explain returns from emerging markets can be explained variously. First, it could be due to the mis-specification of the model itself, as suggested by Roll and Ross (1994), who argue that the benchmark world portfolio may not be mean variance efficient. Second, the prevalence of barriers to investment in many emerging markets, may require that these barriers be explicitly incorporated in the model, as in Black(1974), Stulz(1981), Errunza and Losq(1985,1989) and Eun and Janakiraman(1986). Third, it may be difficult to test asset pricing if the risk and return attributes are time varying as suggested by Ferson and Harvey(1991), Bekaert and Harvey (1995, 1997). Fourth, it is likely that a multi-factor model may better explain asset pricing in the emerging markets. (See Ross (1976), Harvey (1995), Bekaert et al (1997) for instance).

3.6 Chapter Summary

The objective of this chapter was to distinguish the risk-return characteristics of emerging markets from developed markets, and empirically explain the case for diversifying into emerging markets. We present a set of stylised facts substantiated by empirical evidence on the behaviour of emerging market returns and risk. We demonstrate that emerging market exhibit distinct risk-return features, compared to what is known in the context of developed markets.

We present evidence that emerging markets exhibit six important features that distinguish them from developed markets: returns and volatility on an average, are higher than those obtained in developed markets; returns are autocorrelated and are not normally distributed; mean and variance of return are time-varying; correlation with both developed markets and other emerging markets is low; portfolios that include emerging

markets dominate the average developed market portfolio; and the explanatory power of a world index, of the returns from emerging markets is far weaker than it is in the case of developed markets.

These results lead us to adopt a non-asset pricing approach to examining the diversification benefit from emerging markets. We would not attempt to explain emerging market returns in terms of an asset pricing model, but instead do a statistical analysis of diversification benefits, which do no necessitate any assumption about the underlying return generating process.

4. Intertemporal Stability of Emerging Market Correlations*

Correlation between asset classes is the core variable that influences portfolio risk because including assets with low correlation significantly enhances the risk adjusted retum of the portfolio. One of the crucial questions in intemational asset allocation, based on the premise of low correlation between markets, is the whether correlation between markets is stable across time. The intertemporal behaviour of market correlation crucially determines whether ex-ante portfolio allocation can be done using ex-post estimates; whether the retum generating process as explained by an intemational asset pricing framework that builds on the correlation will correctly specify the retums from various markets; and whether trading and portfolio strategies based on past correlations will yield the desired results.

Empirical analysis of emerging market correlations in this chapter addresses four major areas of concem for benefits from intemational diversification. The first is the proposition that increasing integration between markets would result in an increase in correlations over time. This would mean a progressive decrease in diversification benefits over time. The second is that correlations increase during periods of high volatility in markets, and therefore the happening of events like the October 1987

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* Some of the results obtained in this chapter were presented at the 10th Australasian Finance and Banking Conference, University of New South Wales, Sydney, Dec. 1997. (Shashikant and Ramesh, 1997b).

crash, would alter the secular direction of correlations. If market exhibit contagion during the happening of such events, benefits from international diversification would not be available when they are needed the most. If such events are not sporadic, but persist over time, they would undermine the benefits of international diversification.

The third is that correlations are not symmetrically distributed, but behave differently in rising and falling markets. Asymmetry in correlation structure would mean that asset allocations based on correlations in a falling market, would be significantly different from those based on correlations in a rising market. The fourth is the variation of correlations over time, leading to intertemporal instability. The use of ex-post correlation estimates in ex-ante portfolio decisions would be difficult if correlations are time varying. Evidence on these propositions in the context of developed markets is first presented. We then test all these four propositions empirically, in the context of emerging markets.

4.1 Empirical research and evidence on international correlations

Intertemporal stability of international correlation has been extensively examined in the context of developed markets, with mixed results. There are essentially two strands of evidence in this context. The first seeks to document progressive increase in international correlation, based on the premise that globalisation of capital markets and removal of regulatory barriers would lead to greater integration of markets, and hence increase correlations between them. The second documents

the tendency of markets to move together during periods of higher volatility and during the happening of global events, and attributes increase in correlation to contagion and cross border transmission of volatility. While evidence on increase in international correlations is mixed, empirical evidence on contagion seems to confirm the tendency of markets to move together during the happening of certain events like the 1987 crash. Most of the empirical analysis on stability of correlation is however, in the context of developed markets.

In one of the earlier studies, Makridakis and Wheelright (1974) studied the correlations structure of 14 markets, using principal component analysis on daily data over the period 1968-1970 and found that correlations were unpredictable and unstable. Maldonado and Saunders (1983) examined correlations of US markets with 4 other developed markets, and could not reject the hypothesis that the correlation coefficients followed a random walk. They generated Box-Jenkins estimates of the autocorrelation function, upto the fourth order lag, and found that no autocorrelation coefficient was significant at the 5% level of confidence, and rejected the hypothesis that a stable underlying correlation structure was present.

Philipatos, Christofi and Christofi(1983) using both parametric and non-parametric tests on 14 developed markets over a 22 year period, concluded that correlation structures of developed markets were stable and consistent over time. Shaked (1985) studied the intertemporal stability of correlations between 14 developed markets over a 20 year period, and found that stability of correlations increases with time. Kaplanis (1988) examined the stability of both correlation and covariance structures using Box and Jenrich tests of equality of matrices, for 10 developed

countries over the period 1967-1982. She found the correlation structure to be more stable than the covariance structure. Cheung(1993) using the Sen and Puri(1968) tests for equality of covariance matrices, on local currency returns for 4 developed and 7 Far Eastern markets, could not reject the hypothesis that correlations were stable.

In a more recent and comprehensive study, Login and Solnik (1995), studied correlations of 7 major markets over the period 1960-1990, and found that international covariance and correlation matrices were unstable over time. They also examined the conditional correlation structure using a GARCH methodology, and found a modest but significant increase in correlations over the 30 year period, and rejected the hypothesis that the conditional correlation is constant. However, Solnik (1996) found that on updating the data to 1993, correlations have dropped back to a lower level, refuting the finding of their earlier study. The behaviour of international correlations therefore represents a puzzle, with empirical tests unable to categorically support any secular direction in their behaviour.

In the context of emerging markets, Beakart and Harvey (1997) examined emerging market volatility for 20 markets over the period 1976-1992, and found that capital market reforms often increase the correlation between emerging and developed markets, but do not increase the local market volatility. The low levels of correlation exhibited by emerging markets with developed markets is well documented (see Harvey (1995b), Beakart (1995), Shashikant and Suri (1996) for instance). There are however no studies on intertemporal stability of emerging market correlations.

4.2 Time Trend in Emerging Market Correlations

It has been argued that removal of regulatory barriers would lead to higher levels of intergration of emerging markets with developed markets. This has led to the proposition that emerging market correlations would have increased over time. We examine this proposition empirically, by testing whether emerging market correlations exhibit a time trend. Login and Solnik (1995) and Solnik et al (1996) have conducted similar empirical examinations of correlations in developed markets.

If there was a progressive increase in emerging market correlations over time, there would be a linear time trend in the correlations, which can be modelled to capture any increase in correlations over time. The utility of this model is limited to understanding whether correlations exhibit a secular direction over the period examined. Time trends are sensitive to the point from which the data begins. Time trends fitted to moving averages, like the rolling correlations deployed by us, as in Solnik et al (1996), would be affected by problems of autocorrelation of residuals. Since we do not intend to use the slope of the linear trend for any projection of correlations, we use the linear time trend model to test for changes in the trend of the correlations. We model the linear time trend in correlations as follows:

$$\rho_t = \beta_0 + \beta_{1t} + \varepsilon_t$$

The null hypothesis is stated as $H_0 = \beta_1 = 0$. Correlations do not exhibit a time trend if the coefficient β_1 is not statistically different from 0.

Table 4.1 Time Trend in Emerging Market Correlations

	No of Obs	β_0	t-stat	β_1	t-stat
Argentina	193	-0.09441	-4.66219	0.000975	1.6172
Brazil	193	-0.10041	-11.5004	0.001707	1.2021
Chile	193	0.036722	2.085656	0.000767	0.9822
Columbia	81	0.173093	9.328412	-0.00093	0.221
Greece	193	0.072637	6.547003	0.000334	1.5842
IFC Global Index	81	0.307227	7.838122	0.000524	0.335
India	193	0.135733	14.57467	-0.00185	0.6355
Indonesia	21	0.015811	4.045856	-0.0046	0.2154
Jordan	153	-0.09471	-4.45507	0.002173	0.1164
Korea	193	0.118662	10.37957	0.001007	0.5024
Malaysia	81	0.478975	15.46521	-0.00339	0.8512
Mexico	193	0.166083	8.870432	0.000791	1.6987
Nigeria	81	-0.38324	-17.8281	0.003505	0.554
Pakistan	81	-0.04778	-2.51751	0.000462	0.3014
Philippines	81	0.254962	9.110998	0.000822	0.102
Portugal	67	0.127495	2.529707	0.002332	0.224
Taiwan	81	0.172969	4.492506	0.000677	0.3025
Thailand	193	-0.0435	-1.70283	0.002393	1.924
Turkey	57	-0.0275	-0.61608	0.000306	0.9456
Venezuela	81	-0.42043	-9.20104	0.003206	0.6013
Zimbabwe	193	0.066536	2.764412	-0.00018	0.2251

The results of the regression of correlations against a constant and a time trend are in Table 4.1. We are unable to reject the hypothesis of lack of time trend in the case of all the emerging markets. None of the emerging markets exhibit a time

trend over the periods examined (We use the complete data set for the emerging markets, the first column in the table shows the number of months of data for each market). We therefore conclude that emerging market correlations have not shown any significant shift in direction over the years.

4.3 Impact of 1987 October Crash on Emerging Market Correlations

During the October 1987 crash, every major market collapsed and therefore moved in the same direction. It is accepted that an increase in correlation during periods of high volatility in the markets undermines the benefits from international diversification. However, if the changes in the direction of correlation during such events is temporary, and do not impact the secular direction of correlations, there is limited cause for concern. We therefore examine whether the sharp increase in correlations during the crash significantly altered the correlations between emerging markets and the MSCI World Index. We use the dummy variables approach, and estimate the model:

$$\rho_{ijt} = \delta_o + \delta_1 D_{(Oct\ 1987)} + \varepsilon_{it}$$

where the dummy variable $D_{(Oct\ 1987)}$ assumes the value of 1 for correlations that include the value for Oct 1987, and 0 for the others. We test the above model for correlation with MSCI World Index. The co-efficient δ_1 under the null that Oct. 1987 crash did not affect the correlation between emerging markets and the MSCI World Index, would not be statistically significant. The results are tabulated in Table 4.2. The coefficient of the dummy variable for the 1987 crash is not significant at 5% level, in the case of all emerging markets. Therefore, we can infer that the crash of 1987 did not bring about any secular change in the correlation of emerging markets.

We are unable to test the impact of the 1994 Mexican crisis, that had impacted emerging markets, due to the short time series of data after the event.

Table 4.2 Results of the Regression of the Dummy Variable for 1987 Crash

	Intercept	t-stat	δ_1	t-stat
Argentina	0.0121	12.225	-0.0053	-0.23
Brazil	0.1056	10.553	0.0014	0.157
Chile	0.1248	9.456	0.0036	0.149
Columbia	0.0246	2.498	0.0045	1.24
Greece	0.1587	15.227	0.0021	0.164
IFC Global Index	0.2145	13.465	0.0125	0.984
India	-0.0131	-9.452	-0.0023	-1.248
Indonesia	0.2561	11.025	0.0053	0.246
Jordan	-0.0157	-13.657	0.0012	0.348
Korea	0.2546	8.467	0.034	0.12
Malaysia	0.3527	5.241	0.0451	0.657
Mexico	0.3975	9.654	0.0964	0.361
Nigeria	-0.0054	7.285	-0.0461	-0.221
Pakistan	0.0519	14.269	-0.021	-0.015
Philippines	0.3264	15.228	0.0065	0.167
Portugal	0.0281	11.028	0.0048	0.954
Taiwan	0.1958	4.852	0.103	1.589
Thailand	0.3497	2.0169	0.0248	0.116
Turkey	0.0813	23.457	0.0019	0.015
Venezuela	-0.0283	-29.394	-0.0084	-0.053
Zimbabwe	0.0742	18.246	0.0011	0.049

4.4 Correlations and Holding Period

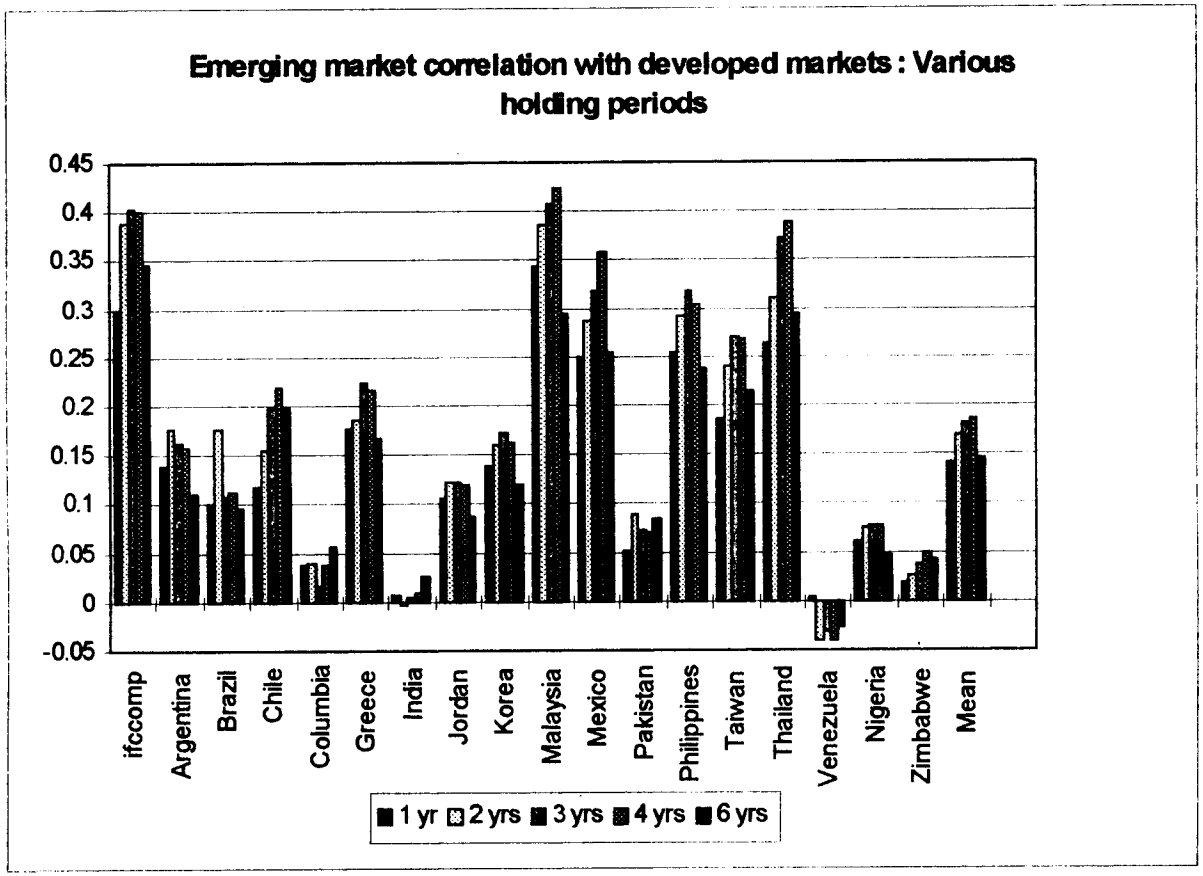
In the light of the argument in Maldonado and Saunders (1983) and in Shaked (1985) on the changes in correlation over varying holding periods, we test whether correlations alter significantly with changes in the holding period. We conduct this test on the entire correlation matrix comprising of emerging and developed markets, over the period 1976-1996. For each of the emerging market studied , we compute correlations with one another and with the developed markets for holding periods of 1, 2, 3, 4 and 6 years. The results are in Figure 4.1. We do not see any significant change in the value of the correlation over varying holding periods.

4.5 Semicorrelation in Emerging and Developed Market Returns

Measurement of portfolio risk has always considered the variance of the portfolio in its entirety, equally weighing returns that are above and below the mean. This approach essentially assumes symmetry in the return distribution. Though there have been some arguments that investors are more concerned about the downside risk than the positive above average returns, symmetry in the return distribution does not make it worthwhile to examine positive and negative variances separately.

In the recent years, particularly after the 1987 market crash, research on international markets has extensively documented the propensity for markets to fall together, in what is now known as the contagion effect. Research seems to indicate that correlations distribution is not symmetrical.

Figure 4.1


Emerging market correlation with developed markets : Various holding periods
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
ifccomp
Argentina
Brazil
Chile
Columbia
Greece
India
Jordan
Korea
Malaysia
Mexico
Pakistan
Philippines
Taiwan
Thailand
Venezuela
Nigeria
Zimbabwe
Mean
1 yr
2 yrs
3 yrs
4 yrs
6 yrs

Erb, Harvey and Viskanta (1994) have observed higher correlation in bear markets for the G-7 countries. Bookstabber and Clarke(1985) and Josephy and Aczel (1993) have examined semivariances and their implications for portfolio construction and evaluation. Harlow and Rao (1989) show that portfolios constructed after factoring the asymmetry in covariance perform better. In the context of emerging markets, the skewness in return distributions has been documented by Harvey (1995) and Shashikant and Ramesh (1997a). Since emerging market returns are not normally distributed, we proposed to examine whether correlation of emerging markets with other markets is also skewed or is symmetrical in both rising and falling phases.

We use a simple classification of return pairs into three classes : At a given time period t, If returns in both market(i) and market(j) are positive, we classify them as rising markets; if returns in both market(i) and market(j) are falling, we classify them falling markets; if return in one market (i) is rising when the other market (j) is falling or vice-versa, we classify them as mixed markets. We would expect the correlations under the first two of the above scenarios to be equal. We compute semicorrelation of each of the 40 markets with every other market, over the period 1970 January - 1996 December. (This represents the longest period examined and holds for most developed markets, other market correlations are computed as data became available).

Table 4.3

Semi-correlations : Developed Markets

	With Developed Markets		With Emerging Markets	
	Rising Markets	***Falling Markets***	***Rising Markets***	***Falling Markets***
Australia	0.169	0.516	0.092	0.289
Austria	0.052	0.359	0.147	0.235
Belgium	0.235	0.556	0.109	0.272
Canada	0.220	0.445	0.078	0.243
Denmark	0.128	0.356	0.053	0.247
Finland	0.169	0.267	0.116	0.059
France	0.215	0.507	0.080	0.252
Hong Kong	0.164	0.456	0.126	0.298
Italy	0.184	0.302	0.090	0.267
Japan	0.148	0.343	0.077	0.251
Netherlands	0.288	0.525	0.125	0.285
Norway	0.144	0.455	0.043	0.248
Singapore	0.263	0.172	0.398	0.219
Spain	0.189	0.538	0.122	0.318
Sweden	0.156	0.476	0.071	0.333
Switzerland	0.267	0.542	0.165	0.300
US	0.229	0.563	0.079	0.300
UK	0.240	0.518	0.115	0.339
MSCIW	0.303	0.568	0.099	0.305

Table 4.3 shows the correlation of developed markets with other developed markets. In the case of all developed markets, correlation in falling markets is larger than the correlation computed in rising markets.

The only exception is Singapore, but the limitation in this case is that the data set for Singapore is very small, beginning from January 1993. Developed market semicorrelations with other developed markets, and with emerging markets are unmistakably skewed. Markets exhibit higher correlations when they fall, which actually means that global investors would suffer a reduction in the benefit of international diversification when markets fall, than when markets rise. The results also point to the possibility of altering portfolio construction strategies, using semicorrelation rather than total correlations.

The semicorrelations of emerging markets, with other emerging markets and with developed markets is not symmetrical either, though we are unable to say that semicorrelations in falling markets are higher than in rising markets, in all cases. In the case of markets such as Columbia, Indonesia, Pakistan, and Zimbabwe, apart from the IFC Composite Index for emerging markets, the correlation with other emerging markets is higher in rising markets than in falling markets. Similarly emerging market semicorrelations with developed markets also present mixed results. In the case of Argentina, Brazil, Columbia, India, Jordan, Korea and Pakistan, correlations in rising markets are higher than in falling markets.

The results of semi correlation of emerging markets with all other markets is in Table 4.4. We have pictorially depicted the asymmetry in semicorrelations in Figures 4.2. to 4.5.

Table 4.4

Semi-correlation of Emerging Markets

	With Emerging Markets		With Developed Markets	
	Rising Markets	***Falling Markets***	***Rising Markets***	***Falling Markets***
Argentina	0.021	0.063	0.012	-0.014
Brazil	0.082	0.090	0.108	0.085
Chile	0.064	0.263	0.078	0.363
Columbia	0.085	0.021	0.068	-0.044
Greece	0.139	0.209	0.141	0.334
IFC COMP	0.232	0.208	0.208	0.647
India	0.017	0.094	0.055	0.016
Indonesia	0.168	0.071	0.232	0.328
Jordan	-0.014	0.058	0.095	0.037
Korea	-0.006	0.126	0.165	0.085
Malaysia	0.201	0.403	0.233	0.706
Mexico	0.081	0.223	0.136	0.509
Pakistan	0.049	0.023	0.077	0.045
Philippine	0.145	0.237	0.226	0.359
Portugal	0.162	0.301	0.229	0.479
Taiwan	0.176	0.284	0.150	0.570
Thailand	0.155	0.276	0.138	0.625
Turkey	0.080	0.138	0.069	0.139
Venezuela	-0.056	-0.057	-0.106	0.010
Nigeria	0.019	0.201	-0.001	0.068
Zimbabwe	0.038	0.006	0.106	0.245

Figure 4.2

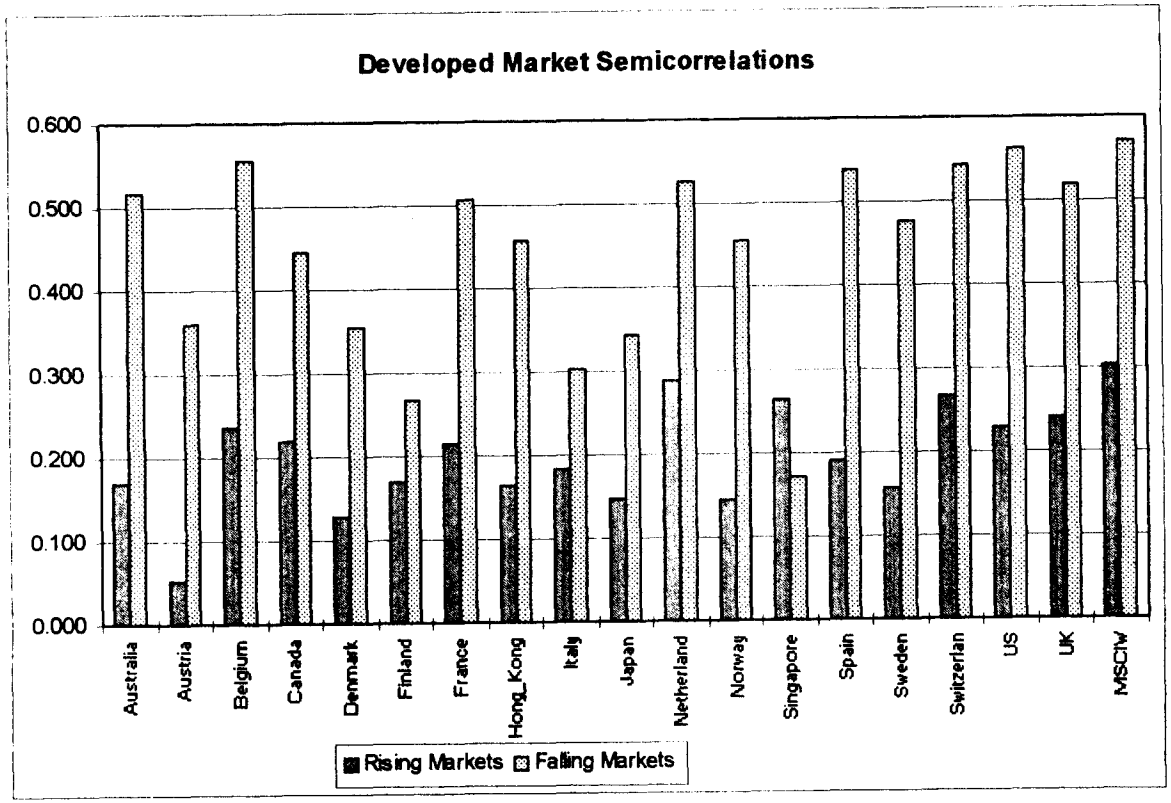

Developed Market Semicorrelations
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Australia
Austria
Belgium
Canada
Denmark
Finland
France
Hong_Kong
Italy
Japan
Netherland
Norway
Singapore
Spain
Sweden
Switzerlan
US
UK
MSCIw
Rising Markets
Falling Markets

Figure 4.3

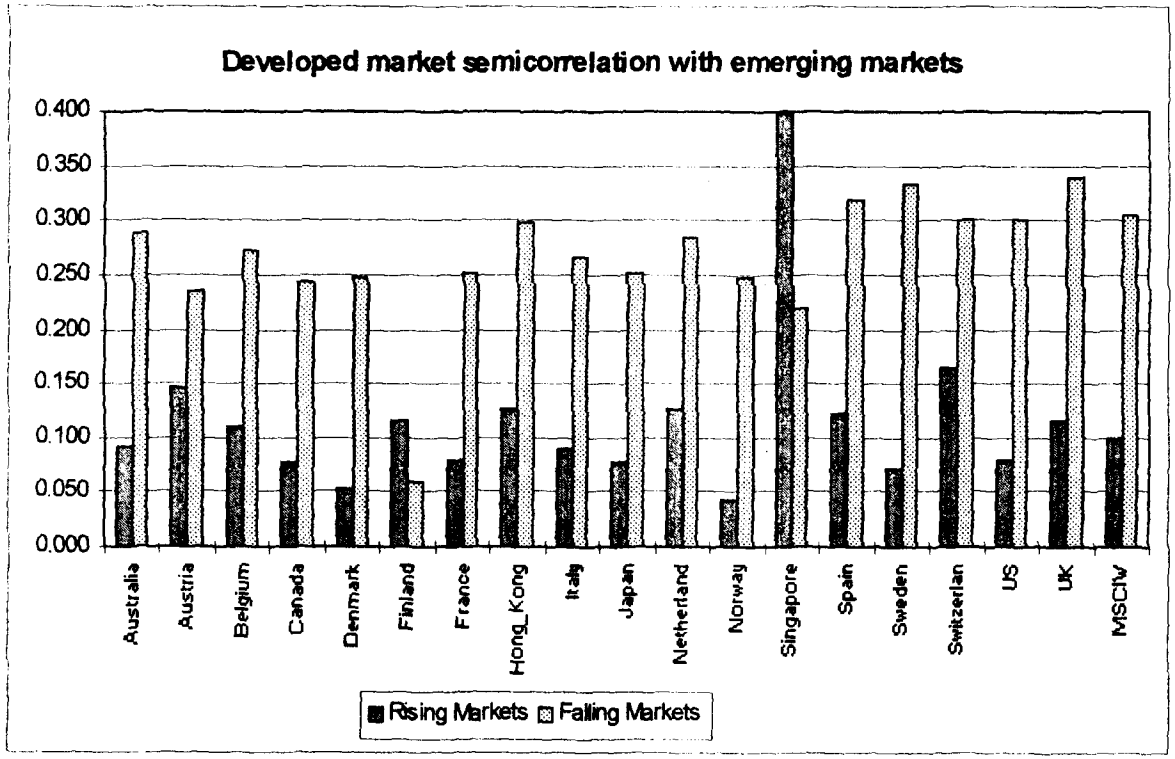

Developed market semicorrelation with emerging markets
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
Australia
Austria
Belgium
Canada
Denmark
Finland
France
Hong_Kong
Italy
Japan
Netherland
Norway
Singapore
Spain
Sweden
Switzerlan
US
UK
MSCIW
Rising Markets
Falling Markets

Figure 4.4

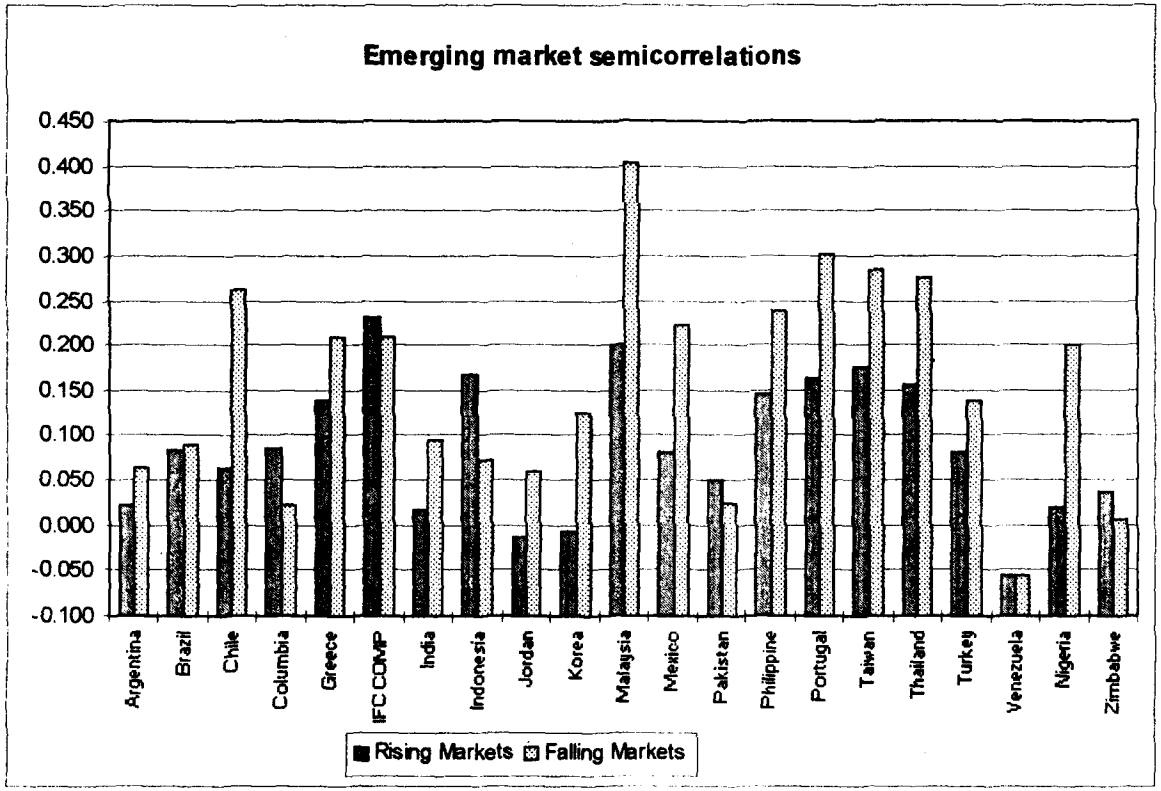
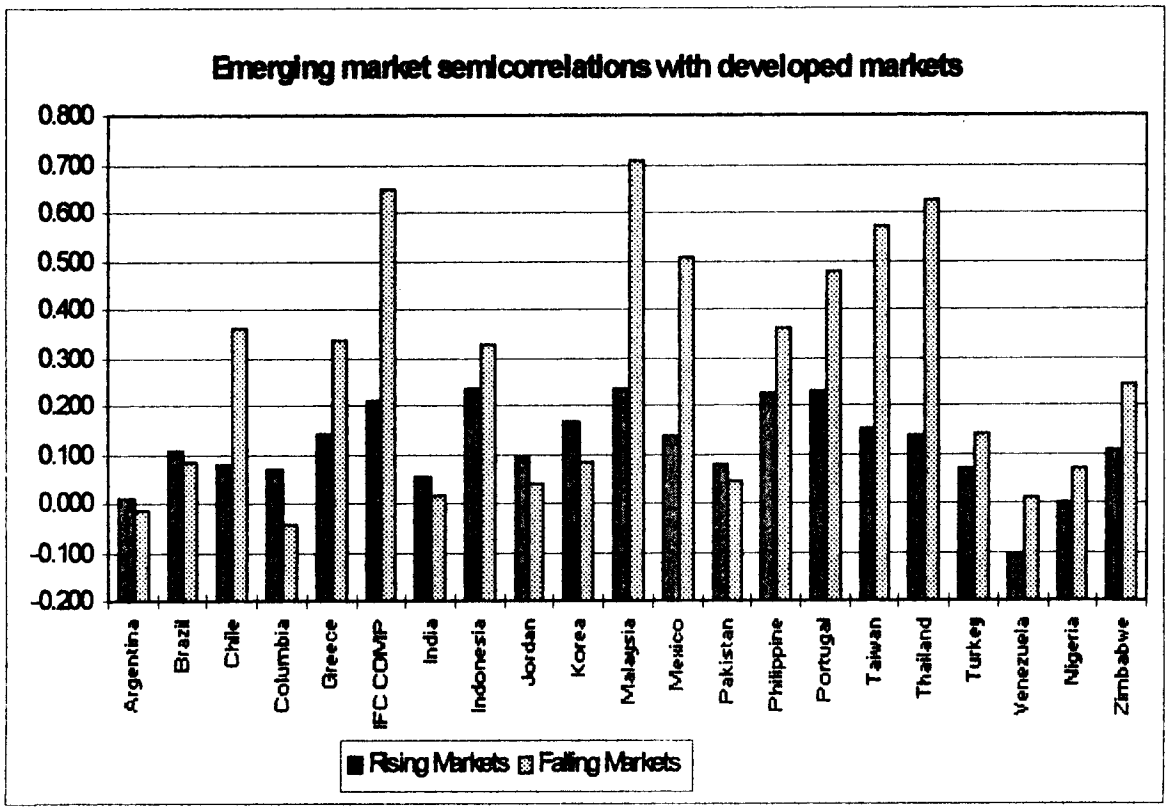

Emerging market semicorrelations
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
-0.050
-0.100
Argentina
Brazil
Chile
Columbia
Greece
IFC COMP
India
Indonesia
Jordan
Korea
Malaysia
Mexico
Pakistan
Philippine
Portugal
Taiwan
Thailand
Turkey
Venezuela
Nigeria
Zimbabwe
Rising Markets
Falling Markets

Figure 4.5


Emerging market semicorrelations with developed markets
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
-0.100
-0.200
Argentina
Brazil
Chile
Columbia
Greece
IFC COMP
India
Indonesia
Jordan
Korea
Malaysia
Mexico
Pakistan
Philippine
Portugal
Taiwan
Thailand
Turkey
Venezuela
Nigeria
Zimbabwe
Rising Markets
Falling Markets

4.6 Tests of intertemporal stability in emerging market correlations

We adopt the methodology used in Shaked (1985) to test the stability of the correlation coefficients. This methodology allows us to tests stability for the complete matrix on a market-by-market basis. This is important in the context of emerging markets, where we have already documented important differences in behaviour among markets. This methodology also provides us the scope to test the correlations with all markets, rather than the MSCI World Index alone, and is therefore more comprehensive in approach.

Correlation coefficients of the monthly returns of 18 emerging markets with other emerging markets, and each of the 16 developed markets are computed, for the period January 1985 to December 1996 (12 years). (Markets whose data set begin later than January 1985 have been excluded). The correlations are computed for varying sub-periods, namely 1 year, 2 years, 3 years, 4 years and 6 years. For each holding period, the returns data is sub-divided into k sub-periods. For a one year holding period for instance, the data for each country is divided into 12 sub-periods of 12 months each. Correlation coefficients are computed for each pair of countries, for the 12 month holding period.

The hypothesis that we set out to test is that several sample estimates of the correlation coefficient (r)are estimates of the same population correlation coefficient (ρ). If the correlation coefficients derived using varying holding periods are equal,

we can say that they are stable over time. This would also mean that the sample estimates are all estimates of the same population ρ.

The range of values that the correlation coefficient can take is -1 to +1. We do not use the normal distribution and the t tables, because we do not expect the correlations between countries to be zero. We therefore transform the correlation coefficients such that readily available statistical tables can be used to test the stated hypothesis. We first transform the sample estimate correlation coefficient (r) into a quantity (z), to develop a statistic that is distributed χ^2, using the following equation:

$$Z_{i,j,t} = (1/2) [\ln (1 + r_{i,j,t}) - \ln (1 - r_{i,j,t})] \quad \text{.....(1)}$$

The quantity Z is distributed approximately normal with a standard error of $s_z = 1/\sqrt{(n-3)}$.

The null hypothesis is that Z_t for a pair of countries are all estimates of the same μ with variances $\sigma_t^2 = 1/(n_t - 3)$.

If data for k sub-periods is tested , then

$$\Sigma W_t (z_t - z_w)^2 = \Sigma W_t z_t^2 - (\Sigma W_t z_t)^2 / \Sigma w_t \quad \text{.....(2)}$$

will be distributed χ^2 with (k-1)degrees of freedom, and will provide the test statistic after transforming Z_t to a χ^2 statistic.

W_t is the reciprocal of the standards deviation of Z_t where,

$z_w = \Sigma w_t z_t / \Sigma w_t$

Since $W_t = n_t - 3$, we can rewrite equation (2) as follows:

$\chi^2 = \Sigma(n_t - 3)Z_t^2 - [\Sigma (n_t - 3) z_t]^2 / \Sigma(n_t - 3)$ .....(3)

Using monthly log returns, we compute r_{ij} (j = 1,2,....34, $i \neq j$) for each holding period t (t = 1,2,...k). We then use equation (3) to arrive at a test statistic that is distributed χ^2 with (k-1) degrees of freedom.

For a one year holding period, we created 12 subsets (k = 12 and n_t =12). Correlation of each market with every other market in the sample was calculated for every subset, converted into Z values as explained above and the χ^2 statistics were calculated for each of the 612 possible pairs (18 emerging and 17 developed markets). For a two year holding period, k = 6, n_t = 24 and the calculation was redone to obtain 612 χ^2 values. We thus computed 612 values each for 1, 2, 4 and 6 year holding periods (these being the divisible periods in the 12 year sample that we have). We compared the observed values with the critical value at the applicable degrees of freedom for each holding period. The χ^2 values obtained for the various holding periods are in Tables 4.6 to 4.15.

The summary results are presented in Table 4.5. We are unable to reject the hypothesis that the sample correlations are all estimates of the same population correlation, in all the holding periods, in 86% of the cases, at 5% level of

significance. For a one year holding period, 506 out of 612 statistics are lower than the χ^2 value at 5% level of significance, which means that 83% of the values are statistically significant. The percentage of pair-wise statistics that are significant are 85%, 88%, 86% and 87% in the case of 2, 3,4 and 6 year holding periods.

Table 4.5

Results of the tests of stability of emerging market correlations

Number of significantly stable correlations - Countrywise results					
	Holding Period (in years)				
	1	2	3	4	6
IFC Comp	20	25	28	28	29
Argentina	28	24	23	23	21
Brazil	30	33	31	31	31
Chile	30	27	28	28	31
Columbia	31	33	33	33	30
Greece	28	32	28	28	29
India	31	31	30	30	31
Jordan	32	34	32	32	34
Korea	32	34	32	32	31
Malaysia	23	22	28	28	28
Mexico	18	20	30	30	31
Pakistan	32	34	34	34	33
Philippines	26	27	27	27	23
Taiwan	31	32	30	30	32
Thailand	19	16	29	29	28
Venezuela	33	34	31	31	29
Nigeria	31	34	33	33	33
Zimbabwe	31	28	31	31	24
Total	**506**	**520**	**538**	**538**	**528**
% to total	82.68	84.97	87.77	87.77	86.99

Table 4.6

χ^2 values for 1 year holding periods : Emerging Vs Developed Markets

	Aus	Ausr	Bel	Can	Den	Fra	HK	Ita	Jap	Neth	Nor	Spa	Swe	Swt	US	UK	MSCIW
IFC C	15.16	18.51	13.54	21.44	16.32	18.08	25.62	25.24	13.80	20.36	25.94	8.83	24.77	27.26	17.44	14.32	20.62
Arg	16.09	8.72	21.51	13.71	9.94	17.90	29.71	12.65	19.62	17.92	20.62	15.06	10.60	9.74	14.38	15.75	20.45
Braz	6.22	11.19	17.18	9.68	17.67	13.24	12.55	16.77	12.11	21.09	26.28	13.77	35.45	15.11	7.82	5.71	9.91
Chi	21.19	16.22	9.41	10.28	14.83	6.98	16.25	9.83	13.53	12.73	14.98	15.52	20.07	26.35	14.64	10.85	17.83
Col	14.25	12.08	6.48	10.34	4.72	13.48	16.33	8.39	3.26	12.02	7.11	18.73	7.18	13.11	6.37	18.76	4.04
Gre	4.66	34.84	16.59	13.50	22.34	16.54	10.19	12.46	9.28	11.54	9.61	16.35	16.25	13.60	6.82	16.43	10.51
Indi	4.31	9.99	5.89	12.39	10.82	6.40	9.48	9.15	27.20	12.01	12.04	7.23	3.97	13.63	9.76	13.14	21.54
Jor	6.71	12.68	9.82	11.61	11.54	14.32	8.34	14.78	15.40	14.28	6.89	10.40	7.88	5.92	11.60	14.12	14.08
Kor	9.90	12.92	4.90	7.82	14.22	10.15	9.46	14.27	8.20	8.99	3.38	9.27	15.27	11.87	8.38	9.00	6.51
Mal	15.52	21.75	23.91	21.17	12.92	23.73	29.71	15.85	15.84	15.99	17.21	18.69	14.21	33.78	16.77	19.94	23.11
Mex	12.08	24.57	20.62	19.00	21.56	21.94	25.64	23.56	20.27	17.01	23.05	25.16	22.81	20.95	15.74	18.78	28.55
Pak	6.30	13.15	9.32	8.60	5.94	13.86	13.45	6.04	8.02	13.07	14.63	12.26	19.98	11.40	17.65	10.80	6.72
Phil	13.93	39.00	20.76	11.66	11.23	7.75	16.55	13.00	7.05	17.85	5.71	6.57	9.23	18.63	12.05	5.58	3.15
Tai	9.67	13.59	4.85	11.79	11.67	10.32	20.43	18.16	10.85	6.36	12.27	5.44	6.42	9.29	4.88	4.03	8.84
Thai	22.78	22.85	18.97	12.22	17.55	14.22	27.17	26.90	21.53	22.63	11.82	20.29	34.10	25.86	25.45	12.46	33.79
Ven	9.64	9.87	8.67	8.93	7.28	7.96	3.95	6.90	14.61	3.97	4.80	4.48	11.00	4.20	8.14	6.47	7.48
Nig	14.89	6.83	8.88	4.97	15.76	4.10	12.30	8.59	14.02	8.88	7.48	10.11	15.83	15.19	4.45	11.00	4.78
Zim	12.75	14.18	12.73	17.99	7.27	16.96	9.16	15.60	13.06	12.73	11.92	13.98	12.53	11.02	15.88	11.75	23.46

Critical χ^2 value = 19.6751.

Table 4.7

χ^2 values for 1 year holding periods : Emerging Markets

	IFCC	Arg	Braz	Chi	Col	Gre	Indi	Jor	Kor	Mal	Mex	Pak	Phi	Tai	Thai	Ven	Nig	Zim
IFCC	-	17.42	29.77	13.34	18.74	27.30	17.23	17.75	10.83	14.70	27.30	10.97	20.23	30.35	23.48	7.14	15.02	7.12
Arg	17.42	-	16.27	15.17	8.10	2.52	7.62	8.25	9.28	6.91	33.62	17.37	16.75	8.83	9.91	7.58	12.06	21.32
Braz	29.77	16.27	-	8.66	10.98	12.90	11.51	6.57	8.52	4.81	19.14	8.50	7.70	7.39	9.79	10.12	8.70	8.68
Chi	13.34	15.17	8.66	-	17.29	13.18	16.16	15.72	13.52	9.57	18.68	9.28	8.03	6.68	13.48	4.94	23.56	9.66
Col	18.74	8.10	10.98	17.29	-	12.55	12.97	6.01	10.73	31.08	9.26	12.60	25.32	9.43	15.47	9.29	17.45	22.75
Gre	27.30	2.52	12.90	13.18	12.55	-	17.20	11.85	21.19	13.60	21.54	12.30	19.22	11.77	20.01	8.54	15.64	14.41
Indi	17.23	7.62	11.51	16.16	12.97	17.20	-	16.85	20.61	4.54	4.94	9.12	10.74	17.25	10.88	11.71	7.84	16.39
Jor	17.75	8.25	6.57	15.72	6.01	11.85	16.85	-	10.10	11.66	7.34	12.07	17.96	21.21	22.28	12.27	14.05	14.64
Kor	10.83	9.28	8.52	13.52	10.73	21.19	20.61	10.10	-	14.90	4.67	5.99	3.22	10.25	12.60	5.59	15.38	13.06
Mal	14.70	6.91	4.81	9.57	31.08	13.60	4.54	11.66	14.90	-	21.74	11.04	26.91	9.38	7.59	8.01	19.14	8.65
Mex	27.30	33.62	19.14	18.68	9.26	21.54	4.94	7.34	4.67	21.74	-	6.76	14.73	4.40	15.20	4.74	9.88	18.57
Pak	10.97	17.37	8.50	9.28	12.60	12.30	9.12	12.07	5.99	11.04	6.76	-	22.78	6.57	15.03	7.41	17.49	9.21
Phi	20.23	16.75	7.70	8.03	25.32	19.22	10.74	17.96	3.22	26.91	14.73	22.78	-	9.47	42.53	9.48	23.00	7.62
Tai	30.35	8.83	7.39	6.68	9.43	11.77	17.25	21.21	10.25	9.38	4.40	6.57	9.47	-	13.45	7.18	8.28	5.49
Thai	23.48	9.91	9.79	13.48	15.47	20.01	10.88	22.28	12.60	7.59	15.20	15.03	42.53	13.45	-	2.70	15.36	12.64
Ven	7.14	7.58	10.12	4.94	9.29	8.54	11.71	12.27	5.59	8.01	4.74	7.41	9.48	7.18	2.70	-	23.74	14.20
Nig	15.02	12.06	8.70	23.56	17.45	15.64	7.84	14.05	15.38	19.14	9.88	17.49	23.00	8.28	15.36	23.74	-	6.08
Zim	7.12	21.32	8.68	9.66	22.75	14.41	16.39	14.64	13.06	8.65	18.57	9.21	7.62	5.49	12.64	14.20	6.08	-

Critical χ^2 value = 19.6751.

Table 4.8

χ^2 values for 2 year holding periods : Emerging Vs Developed Markets

	Aus	Ausr	Bel	Can	Den	Fra	HK	Ita	Jap	Neth	Nor	Spa	Swe	Swt	US	UK	MSCIW
IFCC	5.81	9.96	4.65	6.75	3.05	6.65	19.50	6.98	5.16	9.32	8.71	4.30	3.96	8.61	4.98	6.43	4.23
Arg	11.76	3.52	16.32	8.84	2.56	15.09	15.72	5.34	7.64	12.18	11.35	15.67	9.52	7.13	9.64	13.61	13.75
Braz	1.08	3.25	12.02	1.93	10.50	2.05	4.51	8.16	2.30	7.09	9.35	2.24	4.49	4.36	4.09	1.94	2.88
Chi	9.16	4.85	7.57	7.03	4.15	2.02	13.94	5.59	1.98	12.76	12.91	11.16	9.39	22.93	13.45	7.79	2.97
Col	1.01	3.93	1.01	2.95	3.43	2.77	5.56	5.17	1.57	0.99	4.73	5.99	3.67	2.86	1.27	5.48	1.16
Gre	3.48	8.93	10.32	11.66	16.25	10.63	5.01	8.84	1.77	11.07	5.28	9.74	5.34	8.60	4.47	10.09	9.07
Indi	0.71	3.03	1.43	0.49	2.81	5.74	1.82	1.75	5.49	3.84	2.09	4.13	1.76	3.86	4.99	5.84	1.97
Jor	2.85	2.54	6.11	1.67	4.27	11.73	3.47	7.76	7.46	11.26	1.46	4.92	6.71	2.36	7.23	7.46	8.10
Kor	7.91	5.01	2.29	1.91	4.86	3.53	6.16	7.63	3.08	5.78	3.14	4.01	5.26	4.85	2.90	5.82	2.92
Mal	10.99	17.93	13.77	17.12	7.20	12.36	26.90	10.57	11.70	13.26	14.04	18.48	14.88	15.06	15.77	23.85	18.98
Mex	6.65	11.05	8.06	14.25	22.71	14.95	9.06	20.10	11.84	13.54	7.22	21.73	15.75	19.06	17.08	9.83	19.31
Pak	1.54	9.18	2.40	2.42	2.62	3.19	5.69	3.64	4.22	7.11	5.70	3.76	4.93	3.38	6.37	2.77	1.93
Phi	16.16	30.68	4.66	11.84	8.02	5.06	21.56	2.02	2.10	19.10	5.35	1.88	4.36	16.30	7.75	3.15	2.13
Tai	4.87	10.20	1.28	4.65	4.57	3.57	9.15	5.80	4.19	5.77	1.61	2.18	1.76	2.27	2.22	1.83	2.18
Thai	19.11	7.79	17.40	16.02	13.51	12.63	13.89	19.62	16.81	24.87	14.16	21.18	31.83	26.06	21.62	15.00	23.86
Ven	5.64	5.08	2.09	5.51	4.84	3.92	1.42	2.60	10.84	3.32	4.30	3.09	2.95	5.18	3.07	3.69	7.38
Nig	3.76	2.29	0.80	0.91	3.11	0.60	1.18	2.12	10.31	0.94	0.60	3.02	1.34	3.97	0.77	0.78	2.34
Zim	8.24	9.45	9.54	4.59	4.75	11.53	7.05	7.63	5.80	7.93	9.77	12.65	14.00	5.72	4.13	2.87	4.38

Critical χ^2 value = 12.5916

Table 4.9

χ^2 values for 2 year holding periods : Emerging Markets

	IFCC	Arg	Braz	Chi	Col	Gre	Indi	Jor	Kor	Mal	Mex	Pak	Phi	Tai	Thai	Ven	Nig	Zim
IFCC	-	13.88	18.97	10.75	3.92	16.46	13.14	6.09	6.92	5.59	19.31	7.75	20.61	28.98	20.40	9.21	0.29	9.28
Arg	13.88	-	4.96	14.85	2.63	1.02	5.99	5.59	7.86	5.85	25.01	4.07	10.37	6.55	9.53	3.64	3.54	14.97
Braz	18.97	4.96	-	5.81	10.70	11.16	4.92	1.43	4.03	2.37	9.41	4.00	5.52	3.33	7.81	9.20	4.16	4.51
Chi	10.75	14.85	5.81	--	8.01	4.70	11.66	11.03	5.32	5.95	13.13	1.77	3.44	3.30	8.96	2.03	11.40	5.37
Col	3.92	2.63	10.70	8.01	-	6.94	6.74	2.06	3.14	4.01	3.02	2.43	5.60	0.57	1.36	5.39	10.90	17.45
Gre	16.46	1.02	11.16	4.70	6.94	-	6.23	3.82	4.17	4.67	7.30	6.43	11.78	4.48	3.25	2.37	3.68	9.43
Indi	13.14	5.99	4.92	11.66	6.74	6.23	-	10.93	5.24	4.95	2.13	4.55	4.29	13.96	2.78	11.03	2.34	13.52
Jor	6.09	5.59	1.43	11.03	2.06	3.82	10.93	-	9.48	4.82	1.03	5.64	7.81	12.14	6.11	4.74	2.17	4.51
Kor	6.92	7.86	4.03	5.32	3.14	4.17	5.24	9.48	-	9.23	2.55	3.35	2.62	7.23	8.99	2.21	5.08	5.81
Mal	5.59	5.85	2.37	5.95	4.01	4.67	4.95	4.82	9.23	-	8.67	11.43	11.31	4.27	4.42	5.17	1.66	3.86
Mex	19.31	25.01	9.41	13.13	3.02	7.30	2.13	1.03	2.55	8.67	-	2.35	1.22	3.50	8.54	4.32	1.77	15.27
Pak	7.75	4.07	4.00	1.77	2.43	6.43	4.55	5.64	3.35	11.43	2.35	-	10.27	1.68	3.90	1.61	9.74	6.76
Phi	20.61	10.37	5.52	3.44	5.60	11.78	4.29	7.81	2.62	11.31	1.22	10.27	-	9.85	20.11	6.11	9.78	3.43
Tai	28.98	6.55	3.33	3.30	0.57	4.48	13.96	12.14	7.23	4.27	3.50	1.68	9.85	-	10.17	5.11	3.02	1.12
Thai	20.40	9.53	7.81	8.96	1.36	3.25	2.78	6.11	8.99	4.42	8.54	3.90	20.11	10.17	-	3.78	0.79	7.34
Ven	9.21	3.64	9.20	2.03	5.39	2.37	11.03	4.74	2.21	5.17	4.32	1.61	6.11	5.11	3.78	-	8.90	5.33
Nig	0.29	3.54	4.16	11.40	10.90	3.68	2.34	2.17	5.08	1.66	1.77	9.74	9.78	3.02	0.79	8.90	-	7.54
Zim	9.28	14.97	4.51	5.37	17.45	9.43	13.52	4.51	5.81	3.86	15.27	6.76	3.43	1.12	7.34	5.33	7.54	-

Critical χ^2 value = 12.5916

Table 4.10

χ^2 values for 3 year holding periods : Emerging Vs Developed Markets

	Aus	Ausr	Bel	Can	Den	Fra	HK	Ita	Jap	Neth	Nor	Spa	Swe	Swt	US	UK	MSCIW
IFCC	3.09	3.81	3.35	4.43	4.2	0.74	3.86	2.44	0.86	4.98	6.29	2.35	1.56	5.71	4.74	1.93	7.99
Arg	13	8.82	7.88	2.32	5.85	11.4	7.12	10.1	8.56	2.04	9.34	13.2	1.4	8.55	13.1	2.68	5.32
Braz	1.7	4.98	7.15	8.87	1.8	1.1	0.65	3.2	2.66	9.38	5.68	4.9	1.68	2.13	6.41	1.48	0.88
Chi	8.65	3.39	2.13	4.88	8.61	8.18	3.79	3.08	4.31	2.81	2.74	4.91	3.32	3.87	5.04	2.41	15.8
Col	0.51	7.69	2.18	3.44	2.09	6.57	2.27	1.08	0.72	4.9	7.79	2.08	0.71	1.45	0.94	3.41	1
Gre	1.99	8.44	3.48	3.36	1.76	0.98	6.87	7.77	0.77	3.9	1.06	2.56	13.6	6	6.59	4.52	1.38
Indi	4.72	2.56	0.82	2.91	2.18	3.65	4.04	1.66	9.06	0.87	1.6	0.82	2.85	1.37	0.76	3.29	1.35
Jor	7.87	3.11	5.32	1.39	4.03	3.89	1.55	3.54	7.11	6.67	2.53	5.78	2.63	2.12	3.91	1.27	0.15
Kor	3.25	2.22	3.99	3.27	3.07	2.65	1.61	5.25	3.34	0.81	1.11	1.31	6.53	0.28	1.42	0.99	1.7
Mal	4.2	4.15	6.35	4.99	7.98	3.56	13	2.59	8.13	10.2	0.07	0.14	4.15	2.54	1.95	5.64	5.23
Mex	2.69	3.41	1.99	1.66	2.44	0.9	10.4	2.8	2.94	0.69	6.99	0.08	2.29	4.01	1.6	0.19	6.77
Pak	0.22	2.35	0.87	0.6	4.52	3.03	3.13	4.67	2.88	1.09	1.63	1.11	0.8	0.77	0.39	1.82	0.27
Phi	0.88	0.72	3.17	5.13	1.23	0.47	2.02	4.05	0.98	1.58	11.6	1.3	2.55	3.02	1.45	8.27	4.32
Tai	0.97	0.49	1.5	0.71	1.3	0.56	2.12	2.08	1.79	1.73	2.92	1.05	0.58	1.78	2.02	4.34	5.13
Thai	6.72	2.78	7.39	3.66	14.9	6.23	3.5	3.7	9.14	7.13	7.98	1.51	4.53	1.85	3.06	1.68	14.2
Ven	5.69	3.65	2.54	4.94	4.25	1.28	4.91	1.46	6.72	2.12	1.76	0.87	3.57	5.13	0.34	2.61	6.69
Nig	0.83	0.66	0.84	0.72	1.32	0.64	0.1	0.85	2.83	0.22	4.28	0.16	4.28	0.54	3.14	1.54	0.71
Zim	4.24	2.29	1.32	3.3	9.15	11.3	4.87	7.42	5.98	7.15	2.52	11.9	6.64	3.3	7.28	1.28	7.19

Critical χ^2 value = 7.8147

Table 4.11

χ^2 values for 3 year holding periods : Emerging Markets

	IFCC	Arg	Braz	Chi	Col	Gre	Indi	Jor	Kor	Mal	Mex	Pak	Phi	Tai	Thai	Ven	Nig	Zim
IFCC	-	7.01	3.88	3.9	2.39	8.76	9.84	0.2	5.4	2.24	1.3	1.94	10.7	20.9	2.56	10.9	5.53	6.271
Arg	7.01	-	0.89	5.58	1.2	0.61	0.58	5.67	4.68	1.58	22.5	1.37	6.71	1.74	3.07	3.59	0.31	5.198
Braz	3.88	0.89	-	1.52	5.65	1.24	4.12	1.09	2.25	6.03	1.09	3.69	0.93	1.01	0.37	7.89	2.35	2.088
Chi	3.9	5.58	1.52	-	6.1	7.11	13.2	2.41	7.98	2.22	4.25	1	0.7	2.89	3.24	0.66	1.9	6.679
Col	2.39	1.2	5.65	6.1	-	3.29	3.22	2.49	2.3	4.22	2.23	2.81	5.86	2.03	4.33	3.65	3.55	13
Gre	8.76	0.61	1.24	7.11	3.29	-	5	3.57	9.91	3.21	14.9	6.16	6.07	8.78	4.95	1.7	4.25	1.494
Indi	9.84	0.58	4.12	13.2	3.22	5	-	11.5	5.29	1.49	0.41	2.85	2.2	5.98	1.54	3.87	0.97	7.692
Jor	0.2	5.67	1.09	2.41	2.49	3.57	11.5	-	3.76	2.18	0.37	5.5	5.58	1.62	0.41	3.58	0.94	4.269
Kor	5.4	4.68	2.25	7.98	2.3	9.91	5.29	3.76	-	5.15	0.39	2.47	1.71	3.17	3.25	2.77	6.42	6.594
Mal	2.24	1.58	6.03	2.22	4.22	3.21	1.49	2.18	5.15	-	8.97	3.92	8.11	1.78	1.01	7.17	5.89	3.108
Mex	1.3	22.5	1.09	4.25	2.23	14.9	0.41	0.37	0.39	8.97	-	0.89	1.04	4.43	6.41	3.97	6.15	6.66
Pak	1.94	1.37	3.69	1	2.81	6.16	2.85	5.5	2.47	3.92	0.89	-	2.58	0.42	0.26	0.49	5.25	1.242
Phi	10.7	6.71	0.93	0.7	5.86	6.07	2.2	5.58	1.71	8.11	1.04	2.58	-	9.67	16.3	7.92	2.95	1.845
Tai	20.9	1.74	1.01	2.89	2.03	8.78	5.98	1.62	3.17	1.78	4.43	0.42	9.67	-	3.57	3.81	8.51	4.302
Thai	2.56	3.07	0.37	3.24	4.33	4.95	1.54	0.41	3.25	1.01	6.41	0.26	16.3	3.57	-	2.41	5.86	1.482
Ven	10.9	3.59	7.89	0.66	3.65	1.7	3.87	3.58	2.77	7.17	3.97	0.49	7.92	3.81	2.41	-	4.01	6.285
Nig	5.53	0.31	2.35	1.9	3.55	4.25	0.97	0.94	6.42	5.89	6.15	5.25	2.95	8.51	5.86	4.01	-	4.463
Zim	6.27	5.2	2.09	6.68	13	1.49	7.69	4.27	6.59	3.11	6.66	1.24	1.84	4.3	1.48	6.29	4.46	-

Critical χ^2 value = 7.8147

Table 4.12

χ^2 values for 4 year holding periods : Emerging Vs Developed Markets

	Aus	Ausr	Bel	Can	Den	Fra	HK	Ita	Jap	Neth	Nor	Spa	Swe	Swt	US	UK	MSCIW
IFCC	2.09	5.09	0.59	0.77	0.83	1.01	7.05	0.52	0.61	0.13	0.19	0	1.86	0.78	0.46	2.05	0.24
Arg	4.81	2.66	14.6	8.69	1.75	9.83	11.6	2.08	6.95	12.3	9.69	13.6	5.51	3.14	5.95	11.7	12.6
Braz	0.06	0.13	4.24	0.26	2.33	0.25	1.6	4.2	0.44	1.6	0.11	0.18	1.94	1.18	4.19	0.86	1.21
Chi	3.25	0.6	4.94	1.93	1	0.83	0.87	1.62	1.5	3.75	1.47	4.91	3.5	5.28	2.16	3.51	2.39
Col	0.25	0.59	0.97	0.9	1.86	0.28	1.34	3.9	0.17	0.07	3.01	4.09	0.53	0.57	2	3.15	0.34
Gre	0.74	4.61	1.4	3.65	8.26	0.86	0.33	2.04	0.34	1.6	1.34	1.66	2.15	0.7	1.29	5.63	0.21
Indi	0.54	1.37	0.69	0.04	2.18	0.12	0.93	0.79	1.11	2.07	1.45	2.17	1.41	1.62	0.73	3.43	0.62
Jor	1.96	0.05	4.43	1.3	0.95	7.43	0.02	6.36	6.96	5.98	0.7	3.34	2.03	2.06	5.29	4.51	4.88
Kor	0.93	2.32	1.03	0.99	3.17	1.27	0.65	4.78	1.61	3.76	1.03	2.89	3.02	1.29	1.57	2.65	0.37
Mal	2.86	9.95	5.25	2.96	1.51	1.94	2.32	6.98	3.77	2.1	8.6	1.23	1.28	5.49	5.63	1.27	1.33
Mex	0.39	3.33	0.71	0.02	5.15	1.69	2.86	10.9	0	0.46	0.91	5.42	2.38	1.09	2.01	0.87	0.29
Pak	0.35	4.26	1.16	0.64	2.69	0.59	0.89	1.19	0.84	1.78	1.76	1.95	1.55	1.45	0.3	0.06	0.02
Phi	6.02	9.64	1.25	1.96	3.61	2.98	13.6	0.21	0.13	3.35	2.06	-0.69	2.01	5.76	2.95	0.37	0.21
Tai	1.02	6.19	0.12	0.7	2.57	0.62	2.44	0.64	1.46	1.26	0	0.38	0	0.4	0.2	0.39	0.07
Thai	6.96	3.16	2.13	0.1	0.14	1.24	9.5	5.41	1.41	0.04	1.28	0.51	0.52	1.28	0.1	0.4	0.15
Ven	0.24	2.6	0.91	0.62	0.5	0.05	0.67	0.16	1.59	0.72	2.56	0.57	2.11	3.79	1.57	3.73	0.6
Nig	0.05	1.25	0.23	0.02	0.29	0.17	0.06	0.06	5.64	0.81	0.06	0.2	0.02	0.3	0.31	0.2	1.48
Zim	4.1	2.78	8.22	1.41	1.21	5.98	1.29	4.66	1.1	6.12	8.42	10.1	13.2	4.46	1.08	1.75	1.88

Critical χ^2 value = 5.9915

Table 4.13

χ^2 values for 4 year holding periods : Emerging Markets

	IFCC	Arg	Braz	Chi	Col	Gre	Indi	Jor	Kor	Mal	Mex	Pak	Phi	Tai	Thai	Ven	Nig	Zim
IFCC	-	8.78	0.12	2.86	0.15	1.36	7.04	3.11	8	2.12	0.62	8.04	20.1	11.2	4.55	5.7	0.19	9.01
Arg	8.78	-	0.15	7.19	1.33	0.89	0.92	3.21	6.1	2.31	25	0.92	10.5	0.97	5.49	1.23	0.57	5.536
Braz	0.12	0.15	-	4.14	9.34	6.57	4.11	0.28	4.16	0.94	2.1	5.6	1.42	1.18	0.24	1.08	2.03	4.847
Chi	2.86	7.19	4.14	-	7.97	3.94	8.26	5.16	4.48	0.64	5.47	2.46	1.17	0.58	6.05	1.16	0.34	6.757
Col	0.15	1.33	9.34	7.97	-	3.02	7.57	0.49	1.63	0.71	1.93	0.77	2.32	0.23	0.41	0.34	1.35	17.66
Gre	0.94	0.82	6.57	3.64	2.66	-	4.14	3.01	0.19	0.5	2.41	6	1.48	1.46	-0.49	2.14	0.31	3.624
Indi	7.04	0.92	4.11	8.26	7.57	4.32	-	5.85	2.86	2.33	0.67	3.65	2.81	4.34	0.98	2.94	0.42	11.38
Jor	3.11	3.21	0.28	5.16	0.49	3.06	5.85	-	2.19	2.93	0.65	1.42	7.35	10.7	2.95	2.3	0.89	1.139
Kor	8	6.1	4.16	4.48	1.63	0.25	2.86	2.19	-	2.07	0.77	0.97	1.43	6.84	4.36	0.34	2.51	4.761
Mal	2.12	2.31	0.94	0.64	0.71	0.74	2.33	2.93	2.07	--	4.38	7.84	10.6	1.9	1.08	5.23	1.67	1.132
Mex	0.62	25	2.1	5.47	1.93	2.88	0.67	0.65	0.77	4.38	-	0.75	0.58	2.09	3.32	3.63	1.13	5.51
Pak	8.04	0.92	5.6	2.46	0.77	6.03	3.65	1.42	0.97	7.84	0.75	-	5.77	1.72	4.43	0.87	3.91	3.778
Phi	18.5	10.5	1.32	0.61	2.19	1.48	2.8	7.26	1.33	7.64	0.29	5.36	-	12.3	20.8	3.76	3.85	4.54
Tai	11.2	0.97	1.18	0.58	0.23	1.74	4.34	10.7	6.84	1.9	2.09	1.72	13	-	2.97	2.21	1.28	0.275
Thai	4.55	5.49	0.24	6.05	0.41	0.45	0.98	2.95	4.36	1.08	3.32	4.43	23.5	2.97	-	2.82	0.85	5.479
Ven	5.7	1.23	1.08	1.16	0.34	2.14	2.94	2.3	0.34	5.23	3.63	0.87	3.76	2.21	2.82	-	2.06	3.177
Nig	0.16	0.57	2	0.14	1.35	0.31	0.42	0.87	2.37	1.62	1.06	3.91	3.85	1.27	0.63	2.05	-	6.373
Zim	9.01	5.54	4.85	6.76	17.7	3.68	11.4	1.14	4.76	1.13	5.51	3.78	4.55	0.28	5.48	3.18	6.41	-!

Critical χ^2 value = 5.9915

Table 4.14

χ^2 values for 6 year holding periods : Emerging Vs Developed Markets

	Aus	Ausr	Bel	Can	Den	Fra	HK	Ita	Jap	Neth	Nor	Spa	Swe	Swt	US	UK	MSCIW
IFCC	0.27	1.18	0.05	1.17	0.16	1.65	2.24	0.54	0.46	0.78	0.02	0.08	1.95	0.17	0.52	0.3	0.02
Arg	6.65	0.69	7.96	2.43	0.51	8.71	6.86	0.17	2.64	4.57	4.22	7.61	2.32	2.4	5.84	7.8	8.57
Braz	0.11	0.84	0.13	0.01	0.34	0.61	0.25	0.06	0.18	0.01	0.01	0.01	0.18	0.47	0.02	0.13	0.52
Chi	0.03	0.14	0.27	2.62	1.15	0	0.43	0.09	0.79	0.5	0.74	0.3	0.63	0	1.39	0.58	0.54
Col	0.16	1.98	0	0.15	0.16	1.21	1.33	0.1	0.4	0.56	0.06	8.08	1.95	1.65	1.15	5.27	0.45
Gre	0.12	4.16	5.73	0.86	9.75	2.07	0.03	2.28	0.13	3.45	0.26	0.98	1.68	1.34	0	1.98	0.68
Indi	0	2.19	0.44	0	1.46	1	0.03	0.26	2.34	1.45	0.38	0.33	0.03	2.64	0.01	1.38	0.35
Jor	0.14	0.63	3.78	0.07	0.23	1.03	0.5	1.83	0.28	2.59	0.59	2.31	0.01	1.05	0.15	1.64	0
Kor	0	0.46	1.17	0.34	0.14	0.79	0.02	0.01	0	4.23	0.06	2.43	3.11	1.92	3.54	0.32	1.12
Mal	3.45	0.76	0.65	2.13	1.69	0.14	0.28	0.02	2.64	1.85	11.4	0.68	3.94	0.93	6.51	3.91	2.28
Mex	0.83	0.19	1.34	0.01	0.01	0.08	1.27	0.18	0.32	0.17	0.76	0.3	2.5	0.4	2.42	0.24	1.69
Pak	0.34	0.33	0	0.07	0.01	0.11	0.07	0.12	0.45	0.13	0.01	2.16	1.52	0.09	0.66	0.02	0.01
Phi	4.07	5.39	0.88	1.39	0.43	1.43	13.4	0.3	0.46	3.57	2.14	0.03	0.04	2.46	0.01	0.81	0.01
Tai	0.53	0.79	0	0.68	0.05	0.08	0.58	1.63	1.27	1.48	0.01	0.02	0.36	0.01	1.1	0	0.04
Thai	7.24	0.99	0.91	1.47	2.63	0.49	0.06	0.15	5.86	1.18	3.7	2.24	8.69	1.05	1.83	2.21	4.02
Ven	1.43	1.34	0.17	3.01	1.46	0.21	0.23	0.74	7.39	0.14	0.03	0.33	0.53	2.81	0.37	0.24	4.35
Nig	0	0.16	0.11	0.12	0.69	0	0.08	0.13	2.95	0.21	0	0.36	0.02	0.16	0.01	0.1	1.23
Zim	4.41	0.02	3.99	2.75	3.39	4.3	0.28	3.08	4.47	6.41	4.32	9.55	7.47	2.12	1.46	1.57	3.76

Critical χ^2 value = 3.8415

Table 4.15

χ^2 values for 6 year holding periods : Emerging Markets

	IFCC	Arg	Braz	Chi	Col	Gre	Indi	Jor	Kor	Mal	Mex	Pak	Phi	Tai	Thai	Ven	Nig	Zim
IFCC	-	0.5	0.35	0.04	0.18	3.8	7.77	0.45	3.91	1.19	0	1.24	10.5	4.11	0.91	5.63	0.06	3.524
Arg	0.5	-	0.53	7.17	0.43	0.01	0.35	1.07	0.86	0.01	6.89	0.4	4.72	0.24	0.76	3.12	0.02	1.672
Braz	0.35	0.53	-	0.61	6.6	0.06	3.83	0.21	0.1	0.74	2.62	3.01	0.74	0.48	0.44	4.73	5.08	0.245
Chi	0.04	7.17	0.61	-	4.64	0	7.4	1.24	0.24	1.1	0.89	0.03	0.09	2.9	0.09	0	0.01	1.12
Col	0.18	0.43	6.6	4.64	-	2.17	0.5	0.01	0.14	0.02	1	1.65	0.5	0.05	0.53	1.59	0.3	0.018
Gre	3.8	0.01	0.06	0	2.17	-	4.24	0.42	2.59	0.44	2.7	0.43	4.65	1.07	0.23	0	0.01	0.057
Indi	7.77	0.35	3.83	7.4	0.5	4.24	-	0.3	1.91	1.14	0.56	0.19	0.48	2.11	2.1	0.89	0.12	0.737
Jor	0.45	1.07	0.21	1.24	0.01	0.42	0.3	-	1.9	0.31	0	0.74	0.94	0.04	0.82	1.96	0.11	0.064
Kor	3.91	0.86	0.1	0.24	0.14	2.59	1.91	1.9	-	0.06	0.09	0.05	1.69	1.66	1.72	1.86	2.45	4.127
Mal	1.19	0.01	0.74	1.1	0.02	0.44	1.14	0.31	0.06	-	3.2	3.74	9.35	0.71	0.03	0.54	0.54	0.078
Mex	0	6.89	2.62	0.89	1	2.7	0.56	0	0.09	3.2	-	0.02	0.07	2.9	4.62	0.01	0.86	5.385
Pak	1.24	0.4	3.01	0.03	1.65	0.43	0.19	0.74	0.05	3.74	0.02	-	4	0.06	0.62	0.08	2.13	0.021
Phi	10.5	4.72	0.74	0.09	0.5	4.65	0.48	0.94	1.69	9.35	0.07	4	-	5.82	10.2	4.79	0.93	0.803
Tai	4.11	0.24	0.48	2.9	0.05	1.07	2.11	0.04	1.66	0.71	2.9	0.06	5.82	-	0.91	2.39	0.11	1.073
Thai	0.91	0.76	0.44	0.09	0.53	0.23	2.1	0.82	1.72	0.03	4.62	0.62	10.2	0.91	-	0.61	0.04	0.096
Ven	5.63	3.12	4.73	0	1.59	0	0.89	1.96	1.86	0.54	0.01	0.08	4.79	2.39	0.61	-	0.26	3.805
Nig	0.06	0.02	5.08	0.01	0.3	0.01	0.12	0.11	2.45	0.54	0.86	2.13	0.93	0.11	0.04	0.26	-	3.017
Zim	3.52	1.67	0.25	1.12	0.02	0.06	0.74	0.06	4.13	0.08	5.39	0.02	0.8	1.07	0.1	3.81	3.02	-

Critical χ^2 value = 3.8415

This result is in contrast with what Shaked (1985) obtained in the context of developed markets. His results show a significant increase in the stability of the correlation as the holding period increases. For a one year holding period Shaked observes lack of stability in the correlation. Our results show that emerging market correlations are remarkably stable for all the holding periods examined. In the case of Mexico and Thailand we can say that stability has increases with the increase in holding periods. Smaller markets like Nigeria, Jordan and Venezuela exhibit high levels of Stability even for a 1 year holding period. This result is of immense practical significance to global investors who can use past estimates to predict future estimates of emerging market correlations.

4.7 Chapter Summary

Behaviour of international market correlations is crucial in describing the return generating process, from a conceptual point of view, and to international asset allocation and portfolio construction from a practical point of view. Though there is complete agreement on the benefits of international diversification, arising from low correlations between markets, research on behaviour of correlation between markets do not agree on the time varying behaviour of correlation. Most of these studies focus on developed markets.

There are no comprehensive studies yet, on the behaviour of emerging market correlations. We have presented five important results in this chapter. The first is that emerging market correlations have not increased over time. Empirical analysis

for linear time trend in correlations, fails to reject lack of linear trend in correlations. The second result is the impact of global events like the 1987 crash on international correlations. Performing a regression using a dummy variable for 1987, we are unable to find empirical support for the contention that co-movement of markets in Oct. 1987, has impacted the direction or magnitude of international correlations. Thirdly, we present results of emerging market correlations with all the markets in the sample over varying holding periods of 1, 2, 3,4, and 6 years and find no evidence of significant change in correlations with changes in holding period.

Fourthly, we examine the behaviour of correlations over rising and falling markets through an analysis of semi-correlations. Market correlations are higher in falling markets, than in rising markets. While developed markets exhibit significant semi correlations, the results for emerging markets is somewhat mixed. Fifthly, we examine whether correlations are intertemporally stable. We have departed from the usual approach of studies on correlation structures, which examine correlations from the point of view of one or few markets, and analyse the entire correlation matrix. We find that emerging market correlations are intertemporally stable over varying holding periods. For holding periods ranging from 1 to 6 years, emerging market correlations are stable in 86% of cases.

The results point to higher levels of stability and predictability in emerging market correlations, and represent a new strand of evidence with important implications for international asset allocation, and description of the return generating process in emerging markets.

5. Predictability of Emerging Market Correlations

Predictable time variance in equity returns has been extensively examined, and it has been found that expected returns significantly depend on a set of information variables such as dividend yield and interest rates (interest rate variables include yields and spreads). Some of the well cited studies in this context are Breen, Glosten and Jagannathan (1989), Fama and French (1988) and Ferson and Harvey (1991). The linear relationship between the expected returns and the vector of information variables provides a clue to the possible predictable components in return correlations across markets. In this chapter, we use an instrumental variables approach, based on this intuitive understanding, to test for predictability in emerging market correlations and attempt a model for forecasting emerging market correlations.

In the context of developed markets, Harvey (1991) uses an information set consisting of lagged returns on MSCI World Index, return on U. S 3 month Treasury bill minus the 1-month return, the yield spread between Moody's Baa and Aaa rated bonds, and the S&P 500's dividend yield minus the 1-month US Treasury bill return as the information variables. He finds expected returns to be significantly affected by the world information variables. He repeats the tests with a set of local information variables, such as lagged US dollar returns, change in foreign exchange rate versus the dollar, dividend yield and the local short term interest rate. He finds that world factors dominate the variations in returns for developed markets.

Repeating the tests for emerging markets in Harvey (1995) he finds that local information variables importantly influence emerging market returns and that a combination of global and local variables explains most of return variations. Login and Solnik (1995) extend the implications of predictability in returns to the predictability in developed market correlations. Using a multivariate GARCH process, they model international correlations including a set of information variables such as dividend yield and interest rates, with a view to testing constant conditional correlation in developed markets. Erb, Harvey and Viskanta (1993) use the instrumental variables approach to forecast international correlations for the G7 countries. They are also able to forecast correlations on the basis of this model. There are no studies in the context of emerging markets on predictability of correlations.

5.1 Lagged Correlations as Predictors of Correlation

Based on our understanding of constant correlation in emerging markets, as empirically tested in Chapter 4, we begin with the hypothesis that past correlations can explain future correlations, and use a simple lagged correlation model:

$$\rho_{ijt} = \alpha_i + \beta_1 \rho_{ij\,(t-n)} + \varepsilon_{it}$$

The length of the lag depends on the forecasting horizon, and is set equal to the chosen horizon. 12 month lag is used to forecast 1 year correlations, and so on. If correlations exhibit a mean reverting behaviour, lagged correlations should be significant predictors of correlations.

We restrict our tests to the 9 emerging markets for which data for 21 years is available, since these represent the longest data set capable of being tested for predictability and forecast over time horizons upto 5 years. We examine correlations with respect to the MSCI World Index. The results of the single variable model are in Tables 5.1 to 5.3.

We find one year lags to provide statistically significant β_1 values in the case of 6 out of 9 markets. In the case of India, Zimbabwe, and Mexico, we find that the one year lag is a poor predictor of future correlations. In the case of Thailand and India, the observed F statistics (not reported here) is lower than the critical value of F, rendering the regression itself unreliable. The adjusted R^2 in all the cases is very small, indicating that lagged correlations explain a very insignificant percentage of the future correlations.

Table 5.1

Lagged correlations as predictors : 1 year lag

	Adj. R^2	Intercept	t-stat	β_1	t-stat
Argentina	0.02749	0.065968	2.838749*	0.193131	2.728525*
Brazil	0.027477	0.093634	5.314075*	-0.17713	-2.72794*
Chile	0.085048	0.0441	1.972904	-0.29172	-4.71099*
Greece	0.013559	0.102454	5.376696*	-0.13337	-2.03323*
India	-0.00429	-0.00591	-0.31941	0.010535	0.161786
Korea	0.031882	0.221994	10.56066*	-0.18793	-2.91693*
Mexico	0.001702	0.114363	4.518967*	-0.07871	-1.17841
Thailand	0.027477	0.093634	5.314075*	-0.17713	-2.72794*
Zimbabwe	-0.00102	0.02703	1.081217	-0.0583	-0.87669

* significant at 5% level.

We therefore test the usefulness of past coefficients, using longer lags, to examine if the predictability improves. The results for 3 and 5 year lags are in Tables 5.2 and 5.3. In the 3 year lags, we find that the coefficients are significant in all cases except for Thailand, but the R^2 is still very low, giving us little confidence to use the regression equation for forecasting. The results of the 5 year lag are in table 5.3. The R^2 values are much higher, and the values of the co-efficient are significant in all cases except Zimbabwe.

We therefore find that using past correlations to predict the future correlations is quite sensitive to the lag used, and the results improve as the period of lag is increased. We are however not satisfied with the power of the predictor, given the low R^2 values, and therefore seek to use more instrumental variables to forecast future correlations.

Table 5.2

Lagged correlations as predictors : 3 year lag

	Adj. R^2	Intercept	t-stat	β_1	t-stat
Argentina	0.073868	0.078007	4.695632*	0.585521	3.918781*
Brazil	0.065731	0.065168	6.145394*	0.267792	3.696486*
Chile	0.126155	0.1679	13.58612*	-0.3316	-5.19482*
Greece	0.05461	0.136688	11.36828*	-0.28468	-3.37602*
India	0.045838	-0.05639	-6.17858*	0.190501	3.105995*
Korea	0.154656	0.295323	16.70197*	-0.39765	-5.82505*
Mexico	0.038619	0.267266	12.40781*	-0.20568	-2.86893*
Thailand	-0.00262	0.224394	10.64692*	-0.04707	-0.7276
Zimbabwe	0.034076	0.042412	2.53273*	-0.22551	-2.71109*

* significant at 5% level.

Table 5.3

Lagged correlations as predictors : 5 year lag

	Adj R^2	Intercept	t-stat	β_1	t-stat
Argentina	0.380968	-0.0734	-5.14194*	-1.24597	-9.06841*
Brazil	0.200399	0.116419	16.02849*	0.626305	5.838003*
Chile	0.362814	0.223489	20.70501*	-0.50776	-8.72701*
Greece	0.320515	0.169867	17.9232*	-0.5878	-7.95391*
India	0.090616	-0.11426	-22.5165*	0.158556	3.762079*
Korea	0.036405	0.293597	17.65204*	-0.20256	-2.44684*
Mexico	0.253346	0.378304	19.02473*	-0.49227	-6.76673*
Thailand	-0.00162	0.285151	13.76693*	-0.06707	-0.88713
Zimbabwe	0.677942	0.016639	1.90063	-0.8638	-16.6992*

* significant at 5% level.

5.2 Predictability of correlations using domestic and international instrumental variables

We use the instrumental variables approach as in Erb et al (1993) to test for predictability of emerging market correlations. We use a set of pre-selected instrumental variables which have been chosen to reflect a combination of global and domestic factors. We choose not to maximise the fit for the emerging markets examined, but instead focus on deriving results from using the same set of variables for each of the emerging markets studied. This is to avoid data mining and data snooping problems in using ex-post data in our model. Based on the findings of Fama and French (1988) on mean reversion in expected returns and serial correlations over long time horizons, we introduce lagged returns of emerging

markets and MSCI Index as predictors in the forecasting equation. Harvey (1991) found that using dividend yields as predictors enhanced the forecasting ability of the equation. We therefore use dividend yields as the fourth instrumental variable. All the instrumental variables are lagged according to the holding period that is chosen. To obtain a forecast equation for a 5 year correlations, we use 60 month lagged values of the defined variables.

The multi-factor model of instrumental variables used to capture the predictability of emerging market correlations is specified as follows:

$$\rho_{ijt} = \alpha_i + \beta_1 \rho_{ij(t-n)} + \beta_2 r_i + \beta_3 r_j + \beta_4 d_i + \varepsilon_t$$

where $\rho_{ij(t-n)}$ is the lagged correlation for the chosen holding period; r_i is the average return for the emerging market considered, for the period equal to the lag, rolled monthly for the lag period; r_j is the average return for the developed market considered, for the period equal to the lag, rolled monthly for the lag period; d_i is the average dividend for the emerging market considered, for the period equal to the lag, rolled monthly for the lag period.

We use the rolling values as suggested by Kaplanis (1988) in order to capture the movement in the variables on a continual basis. We test the model on a set of developed markets which have been the dominant investors in the emerging markets. These markets are US, UK and Japan. We also test the model using the MSCI World Index value to study the predictability of emerging market correlations

with respect to the broad developed market index. The results are presented for varying lag periods of 1, 3 and 5 years in Tables 5.4 to 5.16.

5.2.1 Results of the multi-factor model for 1 year holding period

We consider the predictability of 1-year correlations with the help of the predictor variables for the 9 emerging markets in the sample, with 4 identified developed markets, including the MSCI World Index. The results are in Tables 5.4 (a to d). We have shaded the variable that has the highest significance in the model. The t-statistics is reported in brackets below the co-efficients.

Table 5.4

Regression results for 1 year holding period

5.4. a With MSCIW

	Adjusted R^2	Intercept	Lagged Correlation (X_1)	Lagged Local Return (X_2)	Lagged Global Return (X_3)	Lagged Dividend Yield (X_4)
Argentina	0.3233	-0.0386 (-0.8431)	0.0583 (0.7778)	-1.5451 (-7.0034)	7.6765 (4.1711)	13.9415 (7.3984)
Brazil	0.0842	0.2004 (3.6005)	-0.2684 (-4.0186)	0.0634 (0.3233)	-1.1612 (-0.7936)	-1.7261 (-3.2795)
Chile	0.0839	0.0564 (0.8135)	-0.2711 (-4.2643)	-0.4430 (-0.8231)	2.8600 (1.4591)	-0.5300 (-0.4377)
Greece	0.1511	0.2518 (5.8077)	-0.2599 (-3.7384)	1.508 (2.6914)	3.0602 (1.9815)	-3.2494 (-5.0939)
India	0.0622	-0.0726 (-1.5334)	-0.0794 (-1.1798)	-1.5301 (-2.097)	-3.4016 (-2.1862)	4.6957 (3.3479)
Korea	0.172	0.3731 (10.6429)	-0.264 (-4.3451)	-2.7057 (-3.7856)	2.5484 (1.7022)	-3.0178 (-5.15)
Mexico	0.1972	0.2354 (4.8463)	-0.1786 (-2.5292)	2.2537 (3.8991)	-2.5867 (-1.0266)	-3.5866 (-5.6209)
Thailand	0.0849	-0.0744 (-1.041)	0.1497 (1.9928)	4.4231 (3.6315)	8.1967 (3.0342)	-0.627 (-0.684)
Zimbabwe	0.2467	0.2724 (5.3201)	-0.2382 (-3.7981)	-4.4724 (-8.1188)	-2.6212 (-1.3293)	-1.3997 (-3.0667)

The results of the regression with MSCI World Index show that the most significant variables entering the equation are local, rather than global variables. The co-efficient of the variable lagged return on MSCI Index (X3) is not significant for all the countries except Argentina and Thailand. The variables that are most significant are dividend yield for Argentina, India, Greece, Mexico, and Korea; the local returns (x2) in the case of Zimbabwe and Thailand; and the lagged correlation in the case of Brazil and Chile. However a number of the instrumental variables , including the local variables are not statistically significant in many cases.

5.4.b. With Japan

	Adjusted R^2	Intercept	Lagged Correlation (X_1)	Lagged Local Return (X_2)	Lagged Japan Return (X_3)	Lagged Dividend Yield (X_4)
Argentina	0.189	0.0305 (0.8001)	0.1974 (2.6176)	-0.9751 (-5.1151)	1.5835 (1.3668)	8.6554 (4.696)
Brazil	0.1635	0.4443 (6.514)	-0.1464 (-2.6477)	-0.7157 (-2.9367)	1.6684 (1.3272)	-4.4482 (-6.6706)
Chile	0.2345	-0.0844 (-1.5771)	-0.3273 (-5.3983)	-1.4707 (-3.4355)	5.8387 (5.0651)	3.7723 (3.8378)
Greece	0.1583	0.2305 (5.3869)	-0.3252 (-4.8128)	1.2961 (2.1728)	2.7321 (2.3451)	-4.0413 (-5.8959)
India	0.0874	-0.1338 (-2.4945)	0.1636 (2.1738)	-0.7501 (-0.8473)	-2.0473 (-1.5077)	4.7575 (2.5004)
Korea	0.2214	0.3858 (12.9697)	-0.2894 (-4.4369)	-2.1503 (-3.3013)	-2.1476 (-2.1393)	-1.5024 (-2.9667)
Mexico	0.2313	0.1888 (4.5373)	-0.1168 (-1.5454)	2.794 (6.2708)	-6.5352 (-4.4526)	-2.4458 (-4.3516)
Thailand	0.1944	-0.0035 (-0.0611)	0.0402 (0.6069)	5.6375 (5.5595)	3.7719 (2.4651)	-1.9941 (-2.4647)
Zimbabwe	0.0871	0.1547 (3.1381)	-0.2628 (-3.9069)	-1.6083 (-3.0876)	1.5712 (1.1648)	-1.5015 (-3.1694)

The results for predictability of correlations with Japan (5.4.b) confirm what we found earlier. The most significant variables in the equation are local variables, with each of the local variables being the most significant in three emerging markets each.

5.4. c. With US

	Adjusted R^2	Intercept	Lagged Correlation (X_1)	Lagged Local Return (X_2)	Lagged US Return (X_3)	Lagged Dividend Yield (X_4)
Argentina	0.3259	-0.0517 (-1.4541)	0.0076 (0.1162)	-1.1367 (-6.2954)	9.6524 (5.4173)	13.7366 (7.9253)
Brazil	0.056	0.0124 (0.2131)	-0.0492 (-0.7272)	0.0546 (0.2508)	6.9260 (3.929)	-0.5693 (-1.0158)
Chile	0.0347	0.058 (0.7509)	-0.1031 (-1.5176)	0.2531 (0.4278)	-7.8329 (-3.2166)	1.603 (1.1957)
Greece	0.1584	0.1162 (3.6577)	-0.3098 (-4.9832)	1.9022 (4.2917)	-0.5693 (-0.4175)	0.3836 (0.8211)
India	0.0257	-0.00118 (-0.2615)	-0.1098 (-1.6101)	-1.4515 (-2.1118)	-0.784 (-0.492)	0.6204 (0.5056)
Korea	0.0452	0.122 (2.9036)	-0.2015 (-3.1392)	0.1652 (0.2119)	3.8831 (2.1462)	-0.5462 (-0.7814)
Mexico	0.2907	0.2712 (5.998)	-0.1241 (-1.9794)	2.0344 (4.5651)	3.3436 (1.6033)	-4.4568 (-7.5774)
Thailand	0.2417	-0.0326 (-0.4592)	0.45 (7.4796)	4.0644 (3.553)	12.5557 (4.9858)	-1.3201 (-1.5304)
Zimbabwe	0.0735	0.0993 (1.8964)	-0.0485 (-0.7348)	-2.4782 (-4.6411)	0.1242 (0.0571)	-0.5148 (-1.1097)

Predictability of correlations with the US returns, for 1 year holding periods (Table 5.4. c) shows that none of the variables is significant in the case of India. US returns are significant, in a departure from what we saw earlier, in the case of Brazil and Chile. Lagged correlations are significant only in the case of Thailand, Korea and Greece, and are not significant in all the other cases. Dividend yields are not

significant predictors in all countries except Argentina and Mexico. The adjusted R^2 is very low for all except the Latin American countries.

The results for UK are in Table 5.4. d, and are similar for the dominance of local factors. Lagged correlations are most significant in the case of Chile, India and Zimbabwe. Dividend yields are most significant in the case of Argentina, Korea and Mexico. Local returns are important in the case of Brazil, Thailand and Greece. The results of the model for 1 year holding period correlations therefore seem to point to a dominance of local rather than global factors, and mixed results as to which one of them is most significant in predicting future correlations.

5. 4. d. With UK

	Adjusted R^2	Intercept	Lagged Correlation (X_1)	Lagged Local Return (X_2)	Lagged UK Return (X_3)	Lagged Dividend Yield (X_4)
Argentina	0.2817	0.0403 (0.9809)	0.1633 (2.4333)	-1.0189 (-5.43)	1.5506 (0.9783)	11.3271 (6.3525)
Brazil	0.199	0.3937 (8.053)	-0.195 (-2.9764)	-1.3324 (-7.6206)	-0.2674 (-0.2119)	-1.416 (-3.4087)
Chile	0.0434	0.1944 (2.5677)	-0.2688 (-3.6448)	0.0197 (0.0366)	-5.2021 (-2.3255)	-1.0636 (-0.8778)
Greece	0.0347	0.1649 (3.0792)	-0.0449 (-0.6323)	2.0664 (2.7612)	-2.3176 (-1.1361)	-0.5199 (-0.7017)
India	0.0551	0.1031 (2.0291)	0.1683 (2.5863)	-0.154 (-0.1943)	-4.8916 (-2.0693)	0.525 (0.3622)
Korea	0.2636	0.325 (8.4297)	-0.1157 (-1.941)	-2.9801 (-4.407)	7.4298 (4.5722)	-4.7207 (-7.576)
Mexico	0.1977	0.3827 (6.4409)	-0.2695 (-3.6181)	2.3075 (4.3324)	-4.5589 (-1.801)	-4.305 (-5.5666)
Thailand	0.1477	0.2382 (3.6882)	0.0708 (1.0683)	5.0734 (4.4637)	-10.2320 (-4.1246)	-0.2691 (-0.3133)
Zimbabwe	0.2457	0.1099 (2.8560)	-0.3955 (-6.5609)	-1.9389 (-5.0505)	3.2138 (2.0727)	-1.6534 (-4.6719)

5.2.2 Results of the multi-factor model for 3 year holding period

We repeat the test of the model for 3 year rolling correlations and the results are in Table 5.5 (a to d). We find that the adjusted R^2 increases with the increase in the holding period. We can also see that the returns of the developed markets enters the equation as significant variable. In the case of correlations with MSCIW, we find that for Zimbabwe, Thailand and Chile, lagged return on MSCI World is the most significant predictor variable. Interestingly, for these countries, the local returns do not enter the model significantly. Lagged correlations do not enter the model as a significant variable, in all the markets examined. The tests are repeated for correlations with Japan, US and UK and the results are similar, in that global variables do enter the equation as significant variables . The results are in Tables 5.5. b to 5.5.d.

Table 5.5 Regression results for 3 year holding period

5. 5. a With MSCI World Index

	Adjusted R^2	Intercept	Lagged Correlation (X_1)	Lagged local return (X_2)	Lagged global return (X_3)	Lagged Dividend Yield (X_4)
Argentina	0.4726	0.0170 (0.3089)	0.5922 (3.506)	0.1588 (0.5048)	-8.9441 (-3.345)	12.4409 (3.8665)
Brazil	0.5723	0.0116 (0.2383)	-0.6239 (-6.7224)	1.546 (9.5739)	3.992 (3.3724)	-1.8645 (-4.7318)
Chile	0.2763	0.233 (3.7836)	-0.3179 (-4.1568)	-0.6126 (-1.5751)	7.6825 (5.0522)	-2.3834 (-2.1533)
Greece	0.1400	0.0704 (2.2613)	-0.1828 (-1.7957)	1.9727 (3.9271)	-3.9217 (-2.567)	1.3179 (2.7076)
India	0.0452	-0.0856 (-1.1073)	0.1749 (1.1741)	1.5725 (1.2586)	-1.0611 (-0.7369)	0.3725 (0.173)
Korea	0.7787	0.5001 (25.6542)	-0.6705 (-16.3788)	2.251 (4.2812)	2.7524 (2.5401)	-4.5695 (-19.6344)
Mexico	0.683	0.342 (8.8879)	-0.4972 (-8.8822)	4.1139 (9.448)	-2.9432 (-1.586)	-3.02 (-7.3099)
Thailand	0.6112	0.1567 (3.3889)	0.134 (2.7239)	-1.8951 (-1.6307)	29.9913 (14.6417)	-4.0758 (-6.9672)
Zimbabwe	0.6909	0.5236 (17.7609)	-0.2536 (-2.9111)	-1.290 (-1.7576)	-16.4951 (-10.1446)	-2.7126 (-9.5517)

5.5. b. With Japan

	Adjusted R^2	Intercept	Lagged correlation (X_1)	Lagged local return(X_2)	Lagged Japan return (X_3)	Lagged dividend yield (X_4)
Argentina	0.7597	0.2670 (13.2477)	-0.6107 (-7.0966)	-0.8545 (-4.8444)	-12.0289 (-16.7282)	-1.7014 (-0.774)
Brazil	0.8098	0.3225 (8.8555)	-0.7745 (-16.7463)	-0.246 (1.8856)	-1.284 (-2.1334)	-4.3728 (-15.2789)
Chile	0.7819	0.3108 (12.8899)	-0.514 (-11.5389)	0.9926 (5.3269)	5.1345 (12.5271)	-4.1547 (-8.6799)
Greece	0.1534	0.1263 (4.4033)	-0.4845 (-5.0900)	1.0636 (2.6413)	-0.0812 (-0.1175)	-1.6665 (-4.0886)
India	0.3176	-0.458 (-4.6489)	-0.0494 (-0.3694)	2.0078 (1.0772)	-7.7847 (-3.2367)	12.0957 (3.5458)
Korea	0.4313	0.4047 (13.3392)	-0.3841 (-5.3567)	4.9398 (5.2871)	-6.5293 (-4.9152)	-1.4622 (-3.7292)
Mexico	0.6462	0.2045 (5.2413)	-0.3201 (-4.5979)	4.711 (11.1447)	-1.5224 (-1.2192)	-3.3512 (-6.8083)
Thailand	0.5815	-0.2053 (-3.0051)	0.4359 (5.6226)	4.6198 (3.1795)	16.6571 (9.7146)	0.5743 (0.6396)
Zimbabwe	0.7196	0.1656 (6.2158)	-0.4589 (-6.2469)	-0.2152 (-0.4312)	-11.7024 (-13.4758)	-0.4722 (-1.8667)

5. 5. c. With US

	Adjusted R^2	Intercept	Lagged correlation (X_1)	Lagged local return(X_2)	Lagged US return (X_3)	Lagged dividend yield (X_4)
Argentina	0.7551	-0.2994 (-10.6850)	0.9847 (15.2482)	1.5335 (7.5184)	14.2898 (7.1204)	2.4493 (1.2887)
Brazil	0.3779	-0.1329 (-2.4779)	-1.0469 (-9.5004)	1.8673 (7.9067)	7.4562 (3.0151)	-1.1344 (-2.4659)
Chile	0.486	-0.4047 (-5.2531)	0.1807 (2.5299)	1.8881 (4.1369)	37.7934 (12.1528)	1.3267 (0.9337)
Greece	0.5912	-0.057 (-3.1584)	-0.2459 (-4.3999)	2.1456 (5.1991)	-5.3366 (-2.6068)	4.1055 (12.8928)
India	0.3186	-0.2408 (-5.9903)	-0.5945 (-8.9152)	2.9665 (3.5202)	-0.3403 (-0.2091)	4.5989 (6.0541)
Korea	0.7087	0.0945 (3.8746)	-0.6285 (-13.2532)	6.1806 (15.3205)	10.4097 (7.4158)	-1.1354 (-4.4326)
Mexico	0.7153	0.2387 (5.0016)	-0.4063 (-7.6001)	5.0247 (14.4026)	3.8670 (1.4839)	-2.9449 (-6.5731)
Thailand	0.4172	0.1429 (2.3797)	-0.2178 (-5.1486)	4.0843 (3.2814)	32.2762 (8.8433)	-3.8536 (-5.5100)
Zimbabwe	0.5558	0.4295 (13.5676)	-0.3169 (-4.2808)	-4.3732 (-7.375)	-6.6341 (-2.5329)	-2.5889 (-9.2625)

5. 5. d. With UK

	Adjusted R^2	Intercept	Lagged correlation (X_1)	Lagged local return (X_2)	Lagged UK return(X_3)	Lagged dividend yield (X_4)
Argentina	0.4998	0.3014 (5.2857)	0.7216 (5.8684)	1.1307 (3.4317)	-20.4865 (-7.458)	-3.3108 (-1.0451)
Brazil	0.2997	0.2779 (5.1229)	-0.6892 (-8.3321)	-0.6515 (-3.5868)	-1.6595 (-1.1189)	-0.2704 (-0.8816)
Chile	0.2342	-0.2159 (-2.226)	-0.3459 (-3.8694)	1.9735 (3.8089)	7.7476 (2.366)	4.1475 (2.8538)
Greece	0.3024	0.3865 (9.0362)	-0.7406 (-8.9692)	-1.4411 (-2.1825)	-9.2212 (-3.2432)	-0.083 (-0.1638)
India	0.3239	0.1679 (3.3479)	0.2117 (2.4097)	3.0634 (2.5535)	1.1047 (0.4593)	-8.6338 (-5.9222)
Korea	0.7884	0.649 (17.7544)	-0.732 (-11.955)	5.168 (12.6558)	-8.6265 (-6.2845)	-5.0382 (-15.6778)
Mexico	0.4971	0.6065 (7.472)	-0.7544 (-6.7767)	5.2199 (9.5046)	-11.9413 (-2.6482)	-4.8964 (-6.2379)
Thailand	0.1568	0.1462 (2.0004)	0.3519 (3.7077)	-2.0768 (-1.0199)	25.5718 (4.7732)	-3.5851 (-3.4730)
Zimbabwe	0.5201	0.3655 (11.8675)	-0.4652 (-5.1376)	-2.7790 (-4.8893)	-3.9471 (-2.0026)	-2.5688 (-9.5511)

5.2.3 Results of the multi-factor model for 5 year holding period

We now repeat the tests of predictability using instrumental variables for rolling correlations with 5 year holding period. We report the results in Table 5.6 (a to d). We find the R^2 values to have significantly improved, and find that both global and local variables enter the equation significantly. The significance of the variables has improved in all the cases, as is evident from the higher levels of significance of the t-statistics in the case of all the markets. This pattern is evident across the results of the model with the 4 developed markets studied. We therefore conclude that predictability of return correlations is high for emerging markets.

Table 5.6 Results of the multi-factor model for 5 year holding period

5.6.a. With MSCI

	Adjusted R^2	Intercept	Lagged correlation (X_1)	Lagged local return (X_2)	Lagged global return (X_3)	Lagged dividend yield (X_4)
Argentina	0.8000	-0.2809 (-6.1300)	-0.5555 (-3.6085)	2.0014 (4.8842)	-9.2156 (-3.2414)	13.2157 (3.5979)
Brazil	0.8264	0.0090 (0.2599)	-0.3762 (-4.0855)	0.6092 (4.5126)	11.0512 (12.5287)	-1.3485 (-4.8521)
Chile	0.7539	-0.1166 (-2.5566)	-0.9192 (-13.9876)	-4.0971 (-14.4005)	4.1316 (3.4242)	8.3617 (9.0239)
Greece	0.4768	0.1738 (7.5882)	-0.7489 (-9.2292)	2.5029 (5.9954)	-1.9462 (-1.0397)	0.195 (0.4813)
India	0.3334	-0.3438 (-4.8057)	-0.3327 (-2.6641)	-3.2675 (-1.9756)	-0.9417 (-0.7193)	9.0837 (5.1825)
Korea	0.8100	0.192 (7.8864)	-0.467 (-9.3641)	3.1474 (5.7786)	8.8023 (8.9012)	-0.4749 (-1.9899)
Mexico	0.6165	-0.6618 (-6.1000)	0.4716 (3.626)	5.2168 (6.2683)	-3.6533 (-0.9389)	10.2299 (8.7027)
Thailand	0.7304	-0.7794 (-10.095)	0.2171 (3.7068)	-0.8159 (-0.35)	23.8824 (7.3702)	9.1214 (9.5811)
Zimbabwe	0.9253	0.4144 (10.7385)	-0.6441 (-11.1704)	0.1466 (0.2509)	-6.1486 (-4.2893)	-2.892 (-14.2706)

5. 6. b. With Japan

	Adjusted R^2	Intercept	Lagged correlation (X_1)	Lagged local return(X_2)	Lagged global return(X_3)	Lagged dividend yield(X_4)
Argentina	0.5939	0.0467 (1.1109)	-0.4219 (-3.3402)	1.3825 (4.4494)	-11.599 (-8.5105)	-4.8713 (-1.3102)
Brazil	0.7856	0.1578 (3.7783)	-0.4707 (-7.5681)	0.215 (1.4148)	4.3381 (5.7403)	-2.5083 (-7.7165)
Chile	0.6586	0.4014 (11.1573)	-0.6402 (-4.8829)	-2.4394 (-7.1901)	-1.2033 (-1.2615)	-2.1335 (-2.3204)
Greece	0.6872	-0.0130 (-0.7274)	-0.5910 (-8.7136)	1.6576 (7.4732)	2.8715 (2.7024)	-0.2334 (-0.6838)
India	0.5637	-0.7323 (-8.9801)	-0.83564 (-10.157)	-4.56069 (-3.4234)	-11.8582 (-10.2643)	21.8699 (8.9383)
Korea	0.8354	0.2989 (7.595)	-0.2992 (-3.2553)	4.6033 (7.056)	3.2134 (2.7882)	-1.6628 (-6.8578)
Mexico	0.7606	-0.7463 (-13.4885)	0.8581 (8.9793)	4.9703 (11.1765)	-4.4839 (-2.3088)	11.5467 (16.0473)
Thailand	0.7747	-1.2056 (-13.5174)	0.2398 (2.8023)	7.7055 (3.4703)	11.6666 (4.2546)	14.2748 (12.3639)
Zimbabwe	0.8100	0.1567 (5.3137)	-0.5161 (-5.0949)	4.0531 (4.8984)	-6.9282 (-4.1615)	-1.2289 (-4.3100)

5.6. b. With US

	Adjusted R^2	Intercept	Lagged correlation (X_1)	Lagged local return (X_2)	Lagged global return(X_3)	Lagged dividend yield (X_4)
Argentina	0.9109	-0.4567 (-21.4535)	-0.013 (-0.1114)	3.4411 (14.427)	6.9126 (2.7050)	7.7581 (3.7175)
Brazil	0.4915	0.0805 (2.0836)	-0.2011 (-1.7444)	-0.4297 (-1.9652)	15.4064 (9.2526)	-1.6656 (-5.2823)
Chile	0.8237	-0.4023 (-5.7081)	-0.27287 (-4.1837)	-3.6047 (-10.5082)	29.7936 (14.4546)	8.0151 (5.4116)
Greece	0.5689	0.0841 (4.1687)	-0.7499 (10.1701)	2.2557 (3.8957)	8.9876 (3.4050)	0.6012 (1.5725)
India	0.5775	-0.3536 (-10.8458)	-0.5662 (-6.234)	-0.6196 (-0.5413)	4.0573 (2.5203)	8.2063 (13.1579)
Korea	0.8008	-0.1317 (-4.6485)	-0.4884 (-8.4349)	3.9315 (7.9245)	13.2848 (10.8716)	3.0641 (10.9472)
Mexico	0.884	-0.8197 (-14.7399)	0.5520 (8.9663)	1.0883 (2.3295)	35.9664 (10.4524)	8.9883 (11.1672)
Thailand	0.8551	-0.6498 (-11.506)	0.1754 (5.7542)	-0.1942 (-0.1407)	40.2994 (13.5149)	5.994 (7.938)
Zimbabwe	0.8762	0.3371 (15.3296)	-0.4416 (-7.3108)	-0.7766 (-1.6916)	2.2208 (0.9849)	-3.2662 (-11.443)

5.6.d. With UK

	Adjusted R^2	Intercept	Lagged correlation (X_1)	Lagged local return (X_2)	Lagged global return(X_3)	Lagged dividend yield (X_4)
Argentina	0.9073	-0.2130 (-5.5943)	-0.5723 (-6.1328)	1.0036 (3.7533)	-4.1944 (-2.1761)	21.3269 (8.6463)
Brazil	0.3561	0.347 (6.7974)	-0.6609 (-7.0114)	-1.0388 (-4.6719)	-5.3414 (-4.6138)	-0.0581 (-0.2174)
Chile	0.6596	-0.6309 (-7.0388)	-0.5199 (-6.1672)	-5.2306 (-10.8058)	13.5094 (4.1791)	15.3036 (10.484)
Greece	0.4788	0.5532 (9.6323)	-1.0491 (-10.5003)	-0.3097 (-0.5391)	-19.7992 (-5.0267)	0.5068 (1.0504)
India	0.7674	0.2202 (8.5961)	-0.3431 (-4.9769)	-4.1505 (-3.9588)	-3.8736 (-2.2237)	-4.4124 (-4.2274)
Korea	0.7184	0.2826 (4.3184)	-0.6110 (-5.2825)	4.0497 (5.5004)	12.5386 (5.2967)	-4.0689 (-8.4983)
Mexico	0.538	-0.5377 (-4.7156)	0.5121 (3.7229)	5.8626 (8.1583)	-22.8347 (-3.3116)	14.1533 (9.9127)
Thailand	0.6785	-0.7833 (-10.3729	0.3775 (4.5907)	4.1183 (1.635)	14.1499 (2.4232)	10.2936 (7.4129)
Zimbabwe	0.8653	0.173 (7.9966)	-0.6217 (-10.2579)	0.7923 (2.1834)	-7.5684 (-4.5457)	-0.8223 (-3.9539)

5.3 Forecasting Emerging Market Correlations

We now attempt an application of our model for predicting emerging market correlations to see how well it fits the actual values of correlations obtained ex-post. We also make some out-of-sample forecasts of correlations, using the 5-year holding period model. It has to be remembered that we have not pre-set the values of the correlation, in our model. Therefore, if the fitted values and the forecasts made using the model result in correlation values within the known accepted range of -1 to +1, we can consider the model robust.

We diagrammatically present the correlations and the fitted values for all the markets, with the MSCI Index in Figures 5.1 to 5.9 . The results for the US, UK and Japan are in Appendix C. We find that the fitted values closely track the actual values of the correlation. We also have run a regression of the forecast values and the fitted values for 5 year correlations, to test the closeness of the two values. The results are in Table 5.7. We find the fit to be very close, as evidenced by the values of the coefficient and the intercept. The intercept is not statistically significantly different from zero, in all cases except for the correlation of India with US. In this case alone, we have to reject the hypothesis that the intercept is statistically significantly different from zero. We have also seen earlier, that local variables are very significant in the predictors, and that the intercepts were significant in many of the regression equations.

The co-efficient is also statistically significant in all the cases, and is close to 1. The t-stats are significant in all the cases, including India, where the t-stats are much

lower. The p-value of the t-stat is zero, signifying that the fit is very close and is significant even at 1% level of significance.

The robustness of the model is evident from the fact that none of the fitted values, including the out-of sample forecasts, fall outside the range of -1 to +1. We can therefore say that our model for predictability of emerging market correlations explains correlations closely and is robust.

Table 5.7

Actuals and Forecast Correlation : Test of the Closeness of Fit

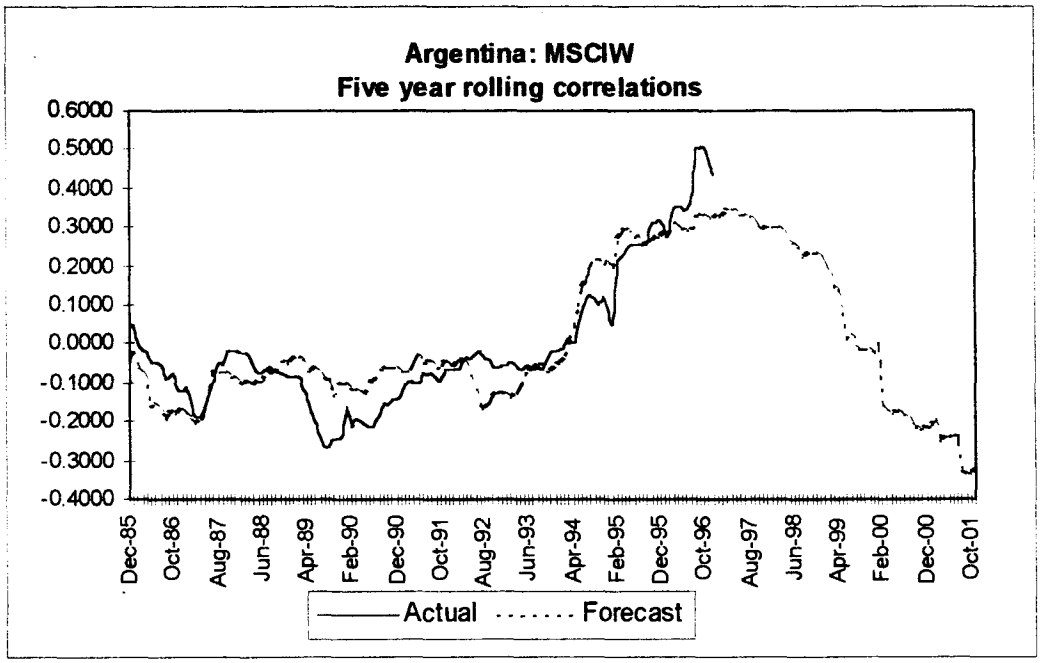
	Adjusted R^2	Intercept	t-stat	p-value	Coefficient	t-stat	p-value
Arg : MSCIW	0.8046	0.0000	0.0004	0.9996	1.0000	23.3343	0.0000
Arg : Japan	0.6033	0.0000	0.0000	1.0000	1.0000	14.2024	0.0000
Arg : UK	0.9094	0.0000	-0.0088	0.9930	1.0000	36.4144	0.0000
Arg : US	0.9130	0.0000	0.0001	0.9999	1.0000	37.2267	0.0000
Braz : MSCIW	0.8305	0.0001	0.0158	0.9874	1.0000	25.4481	0.0000
Braz: Japan	0.7905	0.0000	0.0008	0.9993	1.0000	22.3426	0.0000
Braz: US	0.5032	0.0000	0.0001	0.9999	0.9999	11.6069	0.0000
Braz: UK	0.3709	0.0000	0.0006	0.9995	1.0000	8.8775	0.0000
Chile :MSCIW	0.7595	-0.0001	-0.0075	0.9940	1.0000	20.4442	0.0000
Chile : Japan	0.6665	0.0000	0.0037	0.9971	1.0000	16.2723	0.0000
Chile : US	0.8278	0.0000	-0.0021	0.9983	1.0000	25.2083	0.0000
Chile : UK	0.6674	-0.0001	-0.0034	0.9973	1.0000	16.3062	0.0000
Gre : MSCIW	0.4888	0.0000	-0.0016	0.9987	1.0001	11.2788	0.0000
Gre : Japan	0.6944	0.0000	0.0002	0.9999	1.0000	17.3461	0.0000
Gre : US	0.5788	0.0000	-0.0001	0.9999	1.0000	13.5045	0.0000
Gre : UK	0.4907	0.0000	0.0026	0.9979	1.0000	11.3224	0.0000
India : MSCIW	0.3418	-0.0010	-0.0728	0.9421	0.9861	8.3391	0.0000
India: Jap	0.5764	0.0014	0.0811	0.9355	1.0046	13.4391	0.0000
India : US	0.4102	0.0668	5.1344	0.0000	0.8061	9.6333	0.0000
India : UK	0.7799	0.0021	0.5112	0.6100	1.0155	21.6471	0.0000
Kor : MSCIW	0.8144	0.0000	0.0000	1.0000	1.0000	24.0854	0.0000
Kor : US	0.8054	0.0000	0.0003	0.9998	1.0000	23.3940	0.0000
Kor : UK	0.7248	0.0000	-0.0025	0.9980	1.0000	18.6728	0.0000
Kor : Japan	0.8393	0.0000	0.0000	1.0000	1.0000	26.2719	0.0000

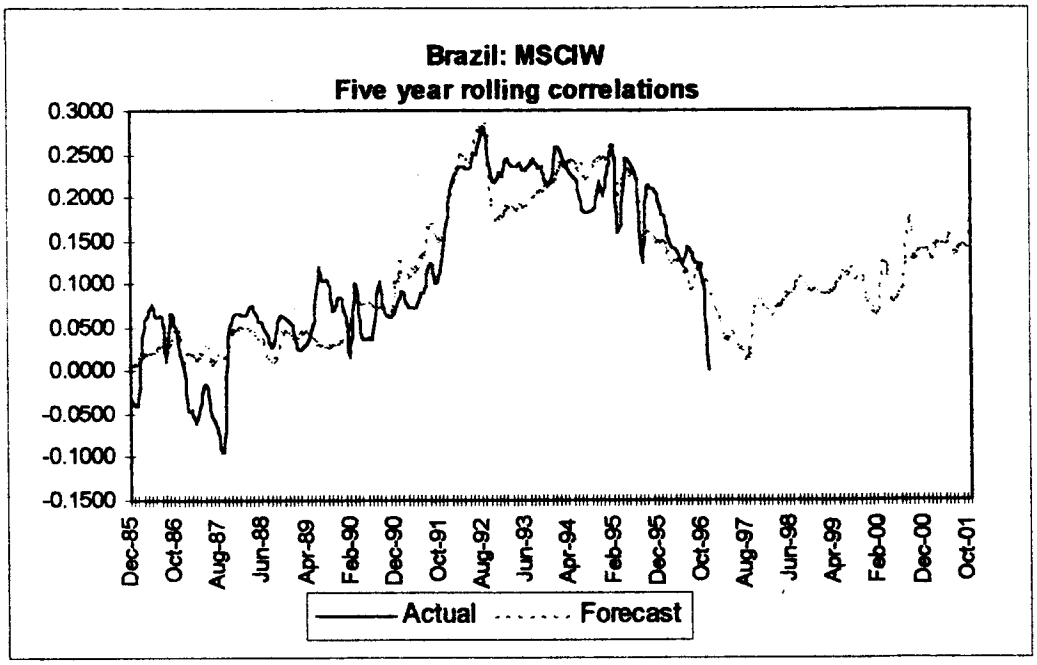
Table 5.7 cont'd

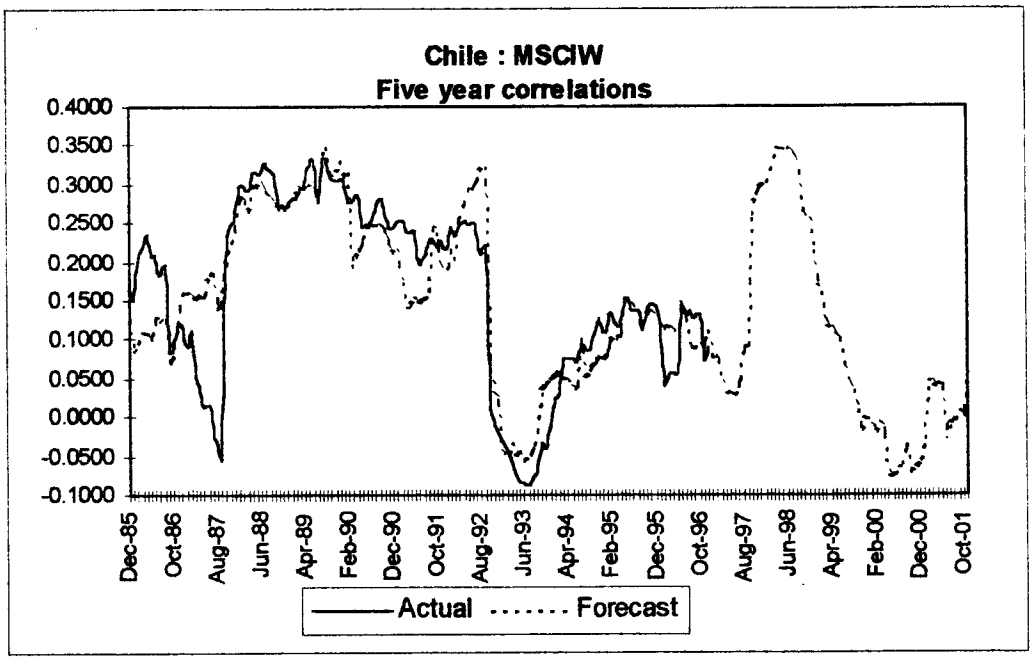
	Adjusted R^2	Intercept	t-stat	p-value	Coefficient	t-stat	p-value
Mex : MSCIW	0.6253	0.0000	0.0011	0.9991	1.0000	14.8753	0.0000
Mex :Japan	0.7660	0.0000	0.0003	0.9998	1.0000	20.8138	0.0000
Mex : US	0.8867	0.0000	-0.0029	0.9977	1.0000	32.1572	0.0000
Mex : UK	0.5486	0.0000	0.0006	0.9995	1.0000	12.7049	0.0000
Thai : MSCIW	0.7366	0.0000	-0.0001	0.9999	1.0000	19.2400	0.0000
Thai :Japan	0.7799	0.0000	-0.0033	0.9974	1.0000	21.6491	0.0000
Thai : US	0.8584	0.0000	-0.0028	0.9978	1.0000	28.3072	0.0000
Thai : UK	0.6859	0.0000	0.0006	0.9995	1.0000	17.0067	0.0000
Zim : MSCIW	0.9270	0.0000	0.0102	0.9918	1.0000	40.9482	0.0000
Zim : Japan	0.8144	0.0000	0.0069	0.9945	1.0000	24.0848	0.0000
Zim: US	0.8790	0.0000	-0.0092	0.9927	1.0000	30.9834	0.0000
Zim: UK	0.8684	0.0000	0.0082	0.9935	1.0000	29.5266	0.0000

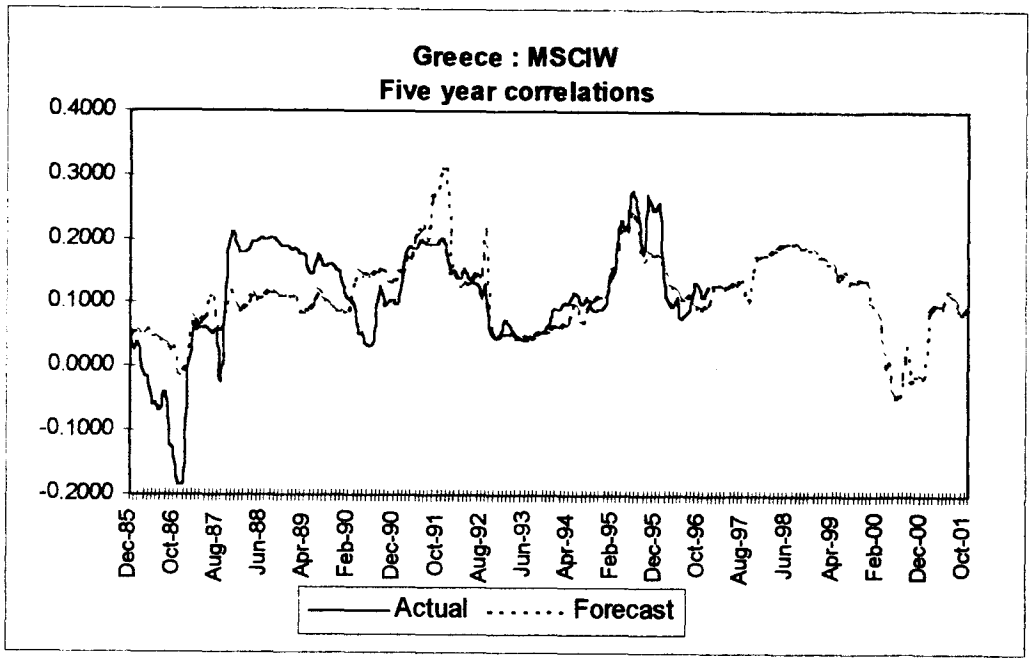
Figure 5.1

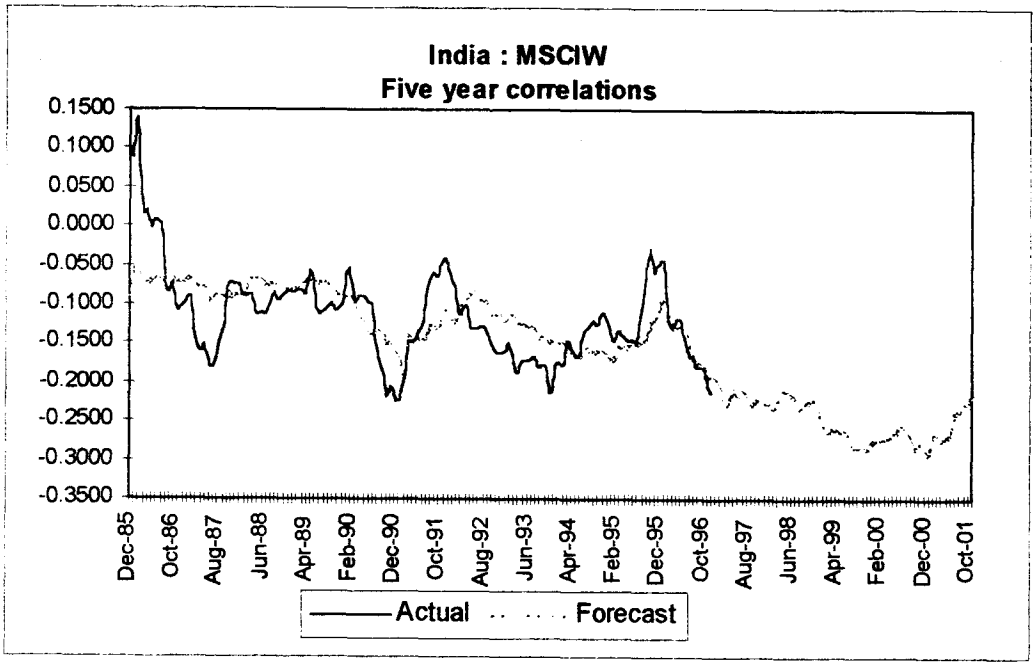
Fitted and Forecast Correlations of Emerging Markets with MSCI World Index

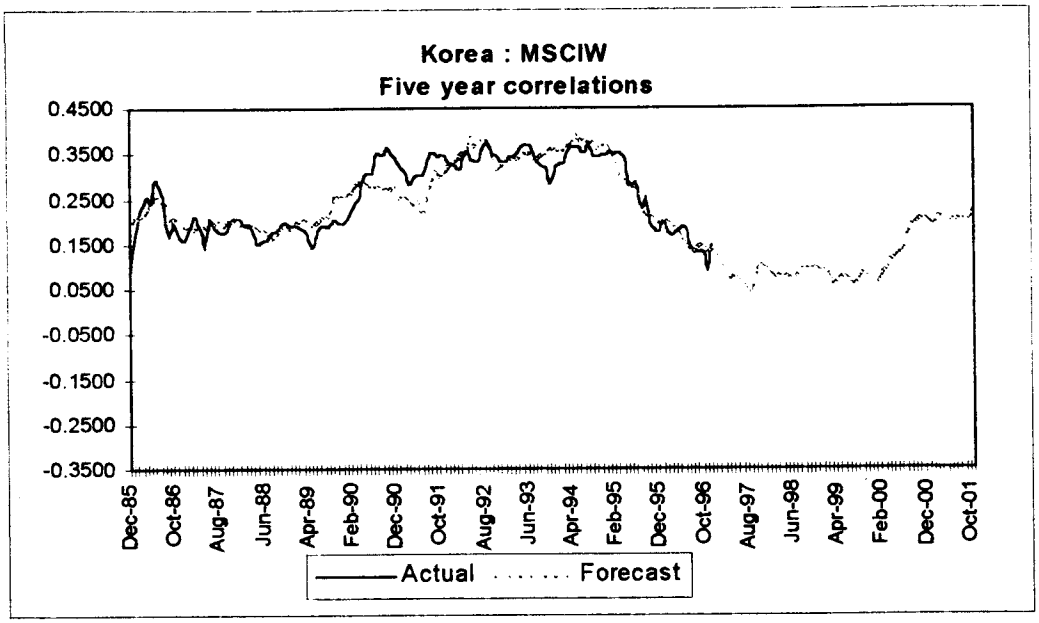


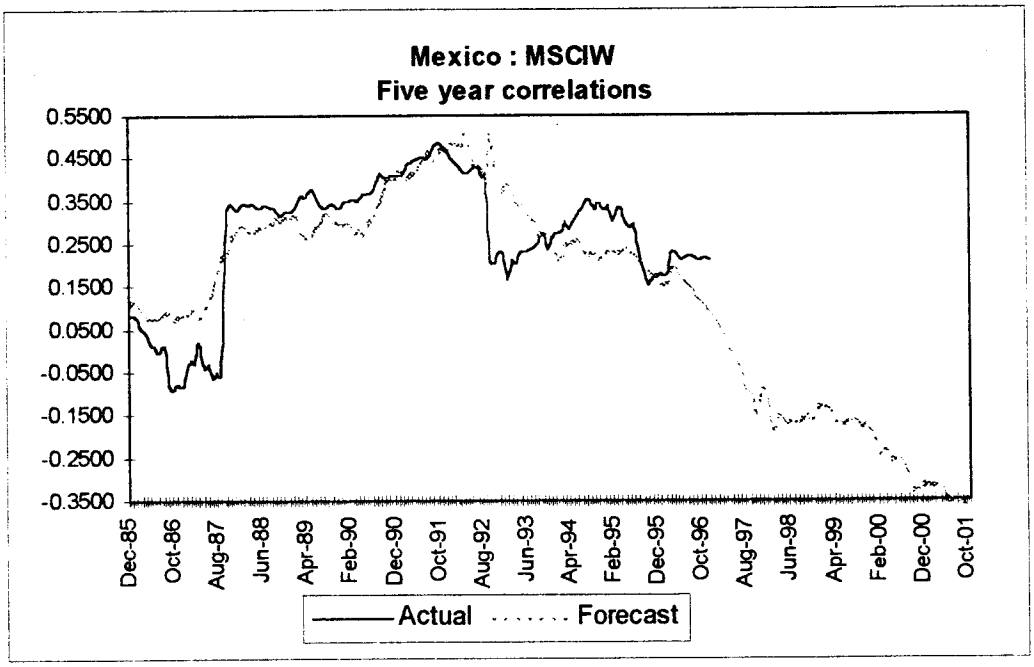

Brazil: MSCIW
Five year rolling correlations
0.3000
0.2500
0.2000
0.1500
0.1000
0.0500
0.0000
-0.0500
-0.1000
-0.1500
Dec-85
Oct-86
Aug-87
Jun-88
Apr-89
Feb-90
Dec-90
Oct-91
Aug-92
Jun-93
Apr-94
Feb-95
Dec-95
Oct-96
Aug-97
Jun-98
Apr-99
Feb-00
Dec-00
Oct-01
Actual
Forecast

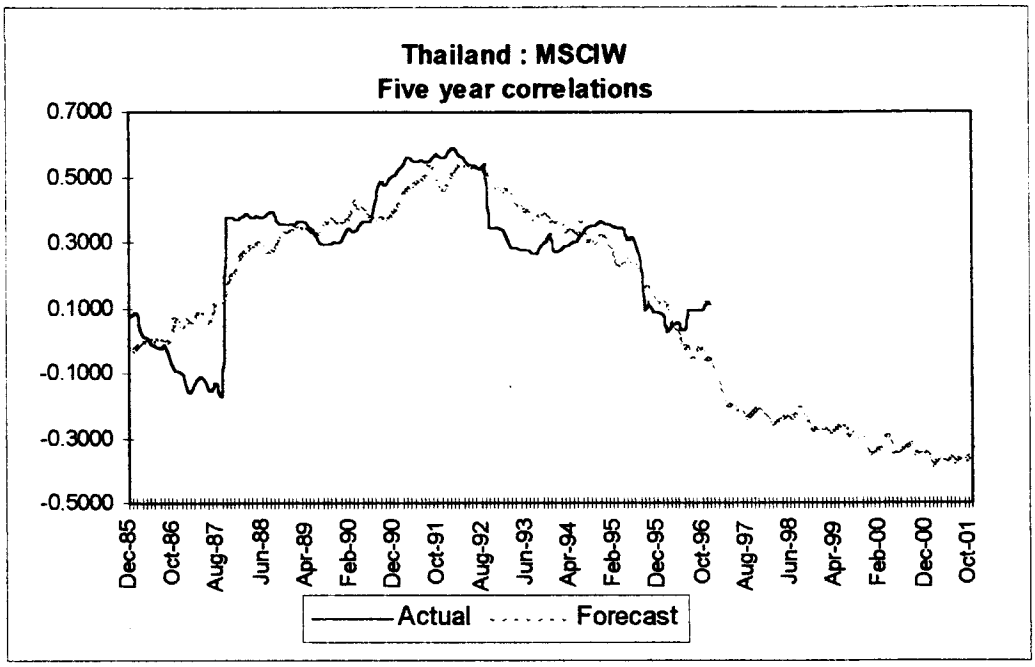

Chile : MSCIW
Five year correlations
0.4000
0.3500
0.3000
0.2500
0.2000
0.1500
0.1000
0.0500
0.0000
-0.0500
-0.1000
Dec-85
Oct-86
Aug-87
Jun-88
Apr-89
Feb-90
Dec-90
Oct-91
Aug-92
Jun-93
Apr-94
Feb-95
Dec-95
Oct-96
Aug-97
Jun-98
Apr-99
Feb-00
Dec-00
Oct-01
Actual
Forecast

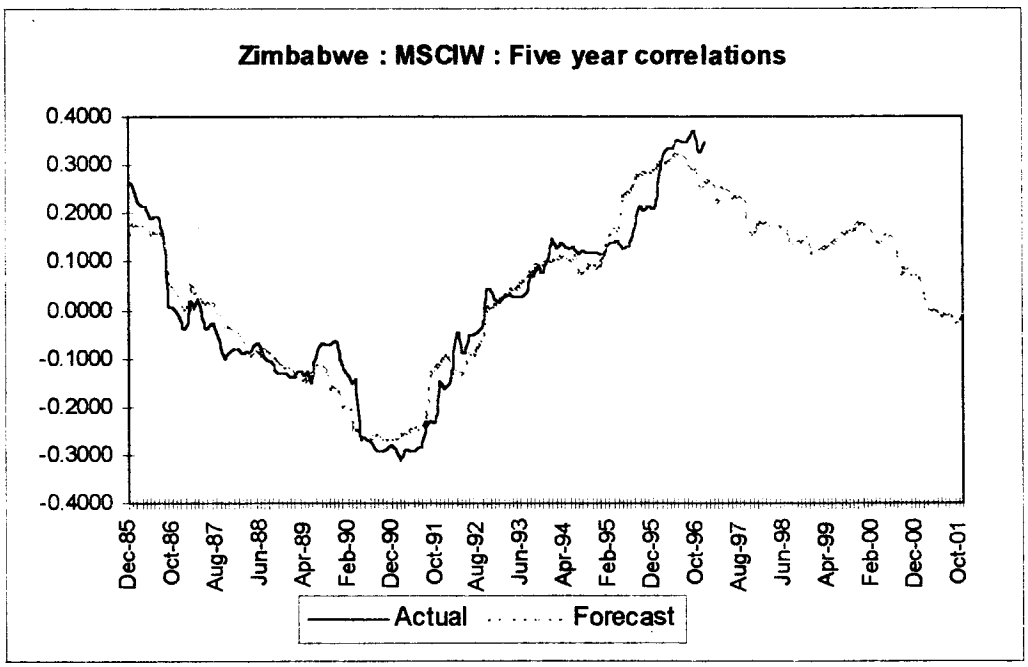

Greece : MSCIW
Five year correlations
0.4000
0.3000
0.2000
0.1000
0.0000
-0.1000
-0.2000
Dec-85
Oct-86
Aug-87
Jun-88
Apr-89
Feb-90
Dec-90
Oct-91
Aug-92
Jun-93
Apr-94
Feb-95
Dec-95
Oct-96
Aug-97
Jun-98
Apr-99
Feb-00
Dec-00
Oct-01
Actual
Forecast


India : MSCIW
Five year correlations
0.1500
0.1000
0.0500
0.0000
-0.0500
-0.1000
-0.1500
-0.2000
-0.2500
-0.3000
-0.3500
Dec-85
Oct-86
Aug-87
Jun-88
Apr-89
Feb-90
Dec-90
Oct-91
Aug-92
Jun-93
Apr-94
Feb-95
Dec-95
Oct-96
Aug-97
Jun-98
Apr-99
Feb-00
Dec-00
Oct-01
Actual
Forecast


Korea : MSCIW
Five year correlations
0.4500
0.3500
0.2500
0.1500
0.0500
-0.0500
-0.1500
-0.2500
-0.3500
Dec-85
Oct-86
Aug-87
Jun-88
Apr-89
Feb-90
Dec-90
Oct-91
Aug-92
Jun-93
Apr-94
Feb-95
Dec-95
Oct-96
Aug-97
Jun-98
Apr-99
Feb-00
Dec-00
Oct-01
Actual
Forecast


Mexico : MSCIW
Five year correlations
0.5500
0.4500
0.3500
0.2500
0.1500
0.0500
-0.0500
-0.1500
-0.2500
-0.3500
Dec-85
Oct-86
Aug-87
Jun-88
Apr-89
Feb-90
Dec-90
Oct-91
Aug-92
Jun-93
Apr-94
Feb-95
Dec-95
Oct-96
Aug-97
Jun-98
Apr-99
Feb-00
Dec-00
Oct-01
Actual
Forecast


Thailand : MSCIW
Five year correlations
0.7000
0.5000
0.3000
0.1000
-0.1000
-0.3000
-0.5000
Dec-85
Oct-86
Aug-87
Jun-88
Apr-89
Feb-90
Dec-90
Oct-91
Aug-92
Jun-93
Apr-94
Feb-95
Dec-95
Oct-96
Aug-97
Jun-98
Apr-99
Feb-00
Dec-00
Oct-01
Actual
Forecast


Zimbabwe : MSCIW : Five year correlations
0.4000
0.3000
0.2000
0.1000
0.0000
-0.1000
-0.2000
-0.3000
-0.4000
Dec-85
Oct-86
Aug-87
Jun-88
Apr-89
Feb-90
Dec-90
Oct-91
Aug-92
Jun-93
Apr-94
Feb-95
Dec-95
Oct-96
Aug-97
Jun-98
Apr-99
Feb-00
Dec-00
Oct-01
Actual
Forecast

5.4 Chapter Summary

Further empirical evidence on the behaviour of emerging market correlation is presented in this chapter. We use the method of instrumental variables to model the behaviour of correlations. Using both global and domestic factors, we are able to model the correlations of emerging markets. The model is tested for 9 emerging markets with a 21 year data set, with respect to 4 developed markets. We repeat the tests for 1, 3 and 5 year holding periods. The predictability of emerging market correlations is evident from the results of the model.

Using the 5 year model for predicting correlations, we test the fitted values of the correlations with the actual values and are able to obtain a very significant fit. This leads us to believe that our model for prediction of correlations is robust. We also attempt a forecast of correlations with the model, upto December 2001, using the values of the instrumental variables upto December 1996. The values fall within the accepted range of -1 to +1, even without explicit fitting of the correlations. These results have been presented in the context of emerging markets for the first time, and are therefore significant.

6. Factors Influencing Returns in Emerging Markets : The Indian Case

6.1 Impact of Segmentation and Integration on International Diversification

The question of integration or segmentation of markets is at the core of international portfolio choice. Much of the case for international investing centers around the lack of interdependence between markets, and hence the tendency for markets to exhibit lower correlations, translating into better risk-return trade-off. We have demonstrated how this benefit of diversification behaves in the context of emerging markets in the preceding chapters.

Interdependence across markets or the lack of it, as evidenced by correlation between markets, should however not be considered synonymous with market segmentation or integration. Integration or segmentation of markets is actually a function of the factors underlying the returns, which translate into low correlations if the presence of common global factors is low. If asset returns across markets are driven primarily by local factors, low correlations across markets results. This argument essentially means that markets may integrate in an economic sense, but continue to exhibit lower correlations as long as local factors dominate the asset returns. Integration, or international asset pricing models assume that assets are priced in terms of a set of global factors, uniform across countries. This would be possible only if local factors do not dominate returns. Therefore, at the root of the lack of correlation between markets, the remarkable constancy of correlations, and

the apparent predictability of market correlations, is the dominance of local factors in pricing assets. Our understanding is that this dominance explains the constancy in correlation even in the case of developed markets. These markets have a history of economic co-operation and integration lasting over longer time periods, than is known in the context of emerging markets.

Therefore, the persistence of diversification benefits is subject to the following conditions being fulfilled:

a. The structure of returns should be such that the co-variances between assets are higher within the market, than across markets.
b. The pricing of assets should be dominated by national rather than international factors.

If factors influencing asset returns are uniform across markets (as in the classic case of integration) then global investing would really be a special case of domestic investing. Each asset, irrespective of the market where it is available, would factor in a proportion of those factors that influence returns, in a global sense. But if local factors dominate returns, benefits from international diversification would be accentuated by better risk-return trade off.

If markets are fully integrated, we would expect that international factors dominate asset pricing, and therefore we would see the benefits from diversification restricted to further reduction of undiversifiable risk from a poorly diversified portfolio. These benefits can be wiped out through appropriate arbitrage across national markets. If markets are fully segmented, then we would find the assets being influenced

predominantly by domestic factors, leading to the possibility of a reduction in diversifiable risk in an international portfolio. The benefits from diversification into segmented markets will persist until international factors impact asset pricing significantly.

In this chapter we choose to examine the returns in the Indian markets to understand whether national or international factors dominate asset returns. The objective is to find out the composition of returns in terms of factors influencing returns, and demonstrate the persistence of diversification benefits in segmented markets like India.

6.2 International Factors in Asset Returns : Theories and Evidence

In one of the earliest studies of international factors in security returns, Lessard (1973) examined whether securities are priced in terms of their domestic rather than international risk. He used a multivariate analysis of returns to compare the performance of portfolios created from 110 stocks of 4 Latin American markets over a 10 year period. He found that domestic market factors which dominated returns for the 4 countries were independent. Solnik (1976) did a factor analysis for European stocks and concluded that though some international influences existed on stock returns, the domestic effects are much stronger. International industry effects were also found to be much weaker compared to domestic market effects.

Solnik and De fritas (1988) studied the returns of 16 developed markets and the relative importance of 4 identified factors using a regression analysis. They tested for World, industry, domestic and currency factors, as well as the combined effect of all these four factors and concluded that domestic factors dominate the returns. Interestingly, they found the influence of currency movements on returns to be insignificant. Though country-by-country results on the impact of international factors vary, the overall picture seems to point to higher impact of domestic factors.

Grinold, Rudd and Stefek (1989) used a hierarchical decomposition of returns to model the factors to which returns from developed market can be attributed. The model attributes return of asset into the contributing components, each one of them arising out of a certain factor. They capture the impact of these factors on asset returns, and explain asset return as a sum of the exposure to these contributing factors. Examining a sample of 2000 companies across 24 developed markets over a 6 year period, they found strong commonalties among markets. However, they found that country factors dominated industry factors on an average. In the case of few industries, they recorded dominance across countries. Their results show that a set of common factors do influence returns across the markets studied, even if they are not the dominant factors determining returns.

Wadhwani (1991) found that there was little common price movement among stocks of the same industrial sector for European stocks. Drummen and Zimmerman (1992) analysed daily returns for 105 European stocks and despite well known economic co-operation in the region, found that country factors dominated industry factors in explaining returns. They also found currency factors to be relatively

minor. Heston and Rouwenhorst (1994) studied returns on 844 European stocks and found that country effect dominates industry effect, and that industrial structures fail to explain cross-sectional differences in returns and volatility for European stocks.

In the context of emerging markets, Divecha, Drach and Stefak (1992) repeated the study of Grinold et al (1989) for 23 markets, over the period 1986 to 1991. They found the dominance of country factors in returns, and high levels of homogeneity in emerging market stocks. They attribute this to the high level of market concentration in emerging markets, with few stocks dominating market capitalization and trading activity. They conclude that though industry factors may dominate in developed markets, domestic factors are more important in emerging markets. There is therefore strong evidence that domestic rather than global factors dominate the structure of returns.

6.3 India in the Global Context

Indian stock markets are the oldest in the Asian region. But the institutional structure for term lending and the directed funding of industry through developmental financial institutions, had limited the use of equity by corporates. The first spurt in stock market activity came in the late 1970s, when the enactment of Foreign Exchange Regulation Act, mandated the reduction in the foreign promoter's equity in multinational companies to 40%. There were a spate of equity offerings by blue chip multinational companies, creating what can be termed as the beginning of the equity cult.

The first set of economic reforms introduced in 1985, facilitated expansion and modernization of companies with equity financing, leading to a spurt in equity issues and higher levels of activity in stock exchanges. More stock exchanges across the country were set up, and listing grew substantially in the 1980s. But the stock exchanges were completely insulated from the world, as was evident during the World market crash of 1987. Indian markets actually recorded a modest gain, when the markets world over were crashing.

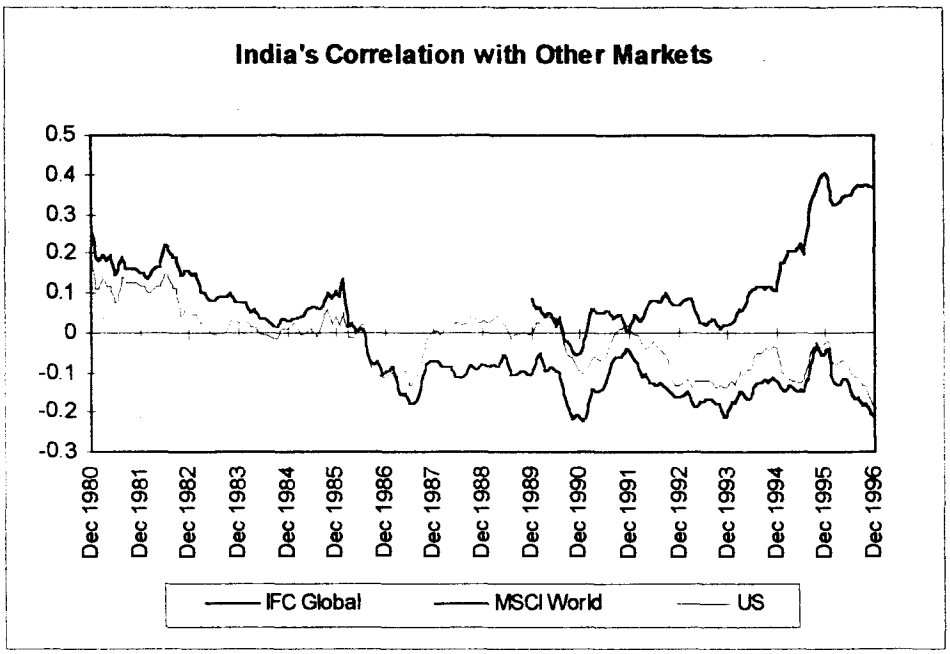
The globalisation of the Indian stock markets was actually set off in the second phase of liberalisation in 1991. The Government encouraged foreign holdings in many of the industrial sectors, having done away with licensing and restrictive procedures. The Foreign Investments Promotion Board was set up to speedily clear proposals for foreign direct investments in Indian corporates. Most importantly, foreign institutional investors were permitted to directly invest in Indian companies through the secondary markets, in 1992. Prior registration with SEBI is mandatory, and some restrictions on investments apply.

Foreign portfolio investment in Indian markets is in three forms: Direct investment after registration as foreign institutional investors; subscription to GDRs, and Euro-currency bonds issued in overseas markets by Indian companies; and investments in Indian companies through offshore funds set up in centres like Mauritius, with whom India has signed a Double Taxation Avoidance Treaty. Foreign portfolio investments in India are nearly $ 10 billion, through the direct route upto March 31, 1998[1].

[1] Securities and Exchange Board of India, Press Release of April 2, 1998.

Indian markets exhibit very low and in some cases negative correlations with other markets. In our earlier chapters we have examined India along with the other emerging markets. Indian markets have negative correlations with most developed markets (Table 3.8) the average correlation being 0.01, which is no correlation at all. As with other emerging markets, the correlation of India is very low, the average being 0.05 (Table 3.7). We have depicted the behaviour of India's correlation with US, MSCI World and the IFC Global Emerging Market Index in Figure 6.1 below.

Figure 6.1



Correlations are 5 year rolling values for the period ending on years shown on the X axis.

What is interesting however, is that India's correlation with the IFC Global Emerging Markets Index has been increasing in the 1990s. In all the holding periods of 2 years

and above, the correlations of India with IFC has changed significantly (Tables 4.9, 4.11, 4,13 and 4.15). However, India's correlation with all the developed markets has been intertemporally stable.

In our model for predictability, we find that for all holding periods, local instrumental variables enter the forecast equations significantly, while global variables are not significant (Tables 5.4, 5.5 and 5.6). The closeness of the fitted forecasts are not too close in the Indian case, particularly with the MSCI World Index (Figure 5.1). In case of other markets, Indian predicted values alone do not show a good fit (Appendix C). We therefore believe that the instrumental variables which worked so well for the other emerging markets do not explain Indian correlations due to the presence of other factors, which have not been factored into the forecasting equation.

Indian markets are attractive to a global investors due to the superior diversification benefit available as evidenced by the lack of correlation with many developed markets. We therefore analyse company return data to verify the factors dominantly priced in the Indian markets, so that we are able to say whether these low correlations would persist.

6.4 Factor Analysis of Indian Equity Returns

We choose a sample of 84 companies listed and traded on the Bombay Stock Exchange to test the factors underlying asset returns. The sample represents

stocks listed on the A group, where stocks with large market capitalisation and high trading volume are included. The 5-year period chosen is January 1992 to December 1996. There are 100 stocks listed in the A Group, and excluding mutual funds and listings that were done after January 1992, we arrive at a sample of 84 stocks. We use log monthly returns of the stocks for our analysis.

6.4.1 Principal Component Analysis

In order to understand the impact of market and industry factors on the returns of stocks, we first use a principal component analysis to test for the dominance of few factors. The objective is to investigate the multivariate structure of returns without imposing any a priori restriction on the number and nature of the underlying common factors. We assume that a model

$$y_{it} = a_i + b_{i1}F_{i1} + b_{i2}F_{i2} + \ldots b_{in}F_{in}$$

explains the return structure, where n variables are required to fully reproduce the correlation amongst the n variables. We use a set of variables such as returns on the market index(the BSE Sensitive Index is used) (X_1), Returns on the CMIE Industry Index (X_2), Returns on the IFC Global Index (X_3) Returns on the MSCI World Index (X_4) and returns on the FT Actuaries Industries Index (X_5). The objective is to be able to construct out of the chosen k variables ($X_1, X_2 \ldots X_k$) a set of new variables (P_i) called principal components, which are linear combinations of the variables. The first principal component P_1, explains most of the correlation amongst the variables chosen. Each successive principal component explains most

of the remaining correlation. The advantage in using the principal component analysis is to be able to explain a large percentage of variance with a few components. To test for the presence of a strong market factor, the principal component analysis is a valuable tool.

The eigen roots and vector solution of the correlation matrix of returns, provides an indication of the importance of each variable in explaining the correlation in the returns matrix. The principal component analysis of the ex-post correlation matrix of monthly returns from 84 stocks and 5 variables, showed that the first principal component, namely the BSE Sensitive Index explained 62% of the returns. CMIE Industry Index explained 29% of the returns, MSCI World Index explained 5% of the returns, and IFC Global index represented 3% of the returns and FT Actuaries Industry Index represented 2% of the returns. This is consistent with the market model of returns, where we use a single factor model to explain returns from a market.

6.4.2 Decomposition of variance

In order to study the impact of a set of factors on stock returns, we deploy a multi-variate analysis of variance for the chosen sample of 84 stocks. The objective is to analyse the sources of variance in the returns of these stocks and assess their relative importance, stock-wise. The principal component analysis provided us the aggregate results for the sample, and the multivariate analysis would measure the impact of the dominant factors on the returns of the sample stocks.

We apply the exogenous variables approach as in Drummen and Zimmerman (1992), using a pre-selected a set of variables. The variables chosen here are the contribution of world factors, local market factor, and local industry factor, as the principal component analysis showed that these variables explain more than 94% of the returns of the sample stocks. The proxies deployed to measure the impact of these factors are MSCI World Index, the BSE Sensitive Index, and the CMIE Industries Index.

In order to measure the cumulative effect of the different components of market risk, we first orthogonalise the indices that are used. Since the factors used are related, there would be muticollinearity between the factors, which would reduce the reliability of the beta estimates. We therefore regress the domestic industry returns on the domestic market returns and use the residuals of the regression as the orthogonalised industry returns.

The single factor model

$$r_{i(t)} = a + b_i Rf_{1(t)} + e_{it}$$

can be used to capture the behaviour of return for asset i, if the return is attributed to a single factor, explained by Rf_1. The R^2 of this regression is indicative of the fraction of total variance that can be explained by the risk factor Rf_1. If we assume that several factors contribute to the movement in stock returns of asset i then we have to restate the model as follows:

$$R_{i(t)} = a + b_1 Rf_{1(t)} + b_2 Rf_{2(t)} + ... bn Rf_{n(t)} + e_{i(t)}$$

The R^2 obtained from this regression will be indicative of the risk that can be attributed to the common impact of the factors Rf_1 to Rf_n. If we add the factors successively into the equation, then, we can compare the R^2 obtained from a model of n factors with the R^2 for a model of n-1 factors, in order to understand the additional variance contributed by the $n+1^{st}$ factor. Since we use orthogonalised factors, we may be able to obtain the contribution of the various factors to the total variance, using this methodology.

The variance of stock returns therefore can be decomposed as

$$\text{Var}\,(r_{it}) = \beta_1^2\,\text{Var}\,[rf_{1(t)}] + \beta_2^2\,\text{Var}\,[rf_{2(t)}] + \beta_3^2\,\text{Var}\,[rf_{3\,(t)}] + \text{Var}\,\varepsilon_{i\,(t)}.$$

Since the factors are orthogonalised and ordered sequentially, we obtain the effect of a hierarchical decomposition of returns. The results are in Table 6.1

Table 6.1

R - squares of the multifactor hierarchical model

Company	International Market Factor	Local Market Factor	Local Industry Factor	Total	Percentage of local factors
ACC	0.0082	0.812	0.012	0.8322	97.57
ABB	0.0015	0.514	0.009	0.524	98.00
Andhra Paper	0.0031	0.523	0.014	0.540	96.83
Apollo Tyres	0.0021	0.663	0.008	0.673	98.50
Arvind Mills	0.0021	0.822	0.061	0.8851	92.87
Ashok Leyland	0.0061	0.496	0.025	0.527	94.10
Atlas Copco	0.0025	0.334	0.041	0.378	88.48
Asian Paints	0.0067	0.519	0.035	0.561	92.57
Bajaj Auto	0.0026	0.623	0.057	0.6826	91.27
Ballarpur Inds	0.0052	0.105	0.051	0.161	65.14

Table 6.1 Cont'd

Company	International Market Factor	Local Market Factor	Local Industry Factor	Total	Market Factor to Total (%)
Bharat Forge	0.0056	0.416	0.029	0.451	92.33
Bombay Dyeing	0.0092	0.532	0.048	0.589	90.29
Britannia Inds	0.0047	0.525	0.005	0.534	98.18
BSES	0.0018	0.795	0.012	0.8088	98.29
Burroghs Wellcome	0.0054	0.298	0.037	0.340	87.54
Castrol	0.0035	0.645	0.069	0.718	89.90
Ceat Tyres	0.0028	0.617	0.004	0.624	98.91
Century	0.0039	0.466	0.019	0.489	95.32
Colgate	0.0083	0.452	0.016	0.4763	94.90
Crompton Greaves	0.0061	0.431	0.016	0.454	95.13
Dr. Reddy	0.0038	0.234	0.071	0.309	75.78
E. I. Hotels	0.0096	0.796	0.084	0.890	89.48
ESAB	0.0051	0.325	0.034	0.364	89.26
Escorts	0.0027	0.436	0.029	0.468	93.22
Essar Steel	0.0036	0.509	0.046	0.559	91.13
Excel Inds	0.0024	0.316	0.071	0.389	81.15
Exide	0.0015	0.428	0.013	0.442	96.72
Finolex Inds	0.0061	0.455	0.051	0.512	88.86
Garware Paints	0.0015	0.268	0.012	0.282	95.20
Garware Wall	0.0034	0.196	0.042	0.241	81.19
GE Shipping	0.0024	0.568	0.019	0.5894	96.37
German Remds	0.0013	0.485	0.031	0.517	93.76
Glaxo	0.0035	0.455	0.021	0.4795	94.89
GNFC	0.0024	0.590	0.034	0.626	94.19
Grasim Inds	0.0011	0.749	0.038	0.7881	95.04
GSFC	0.0019	0.371	0.061	0.434	85.52
Gujarat Alkali	0.0028	0.435	0.061	0.499	87.21
Gujarat Ambuja	0.0011	0.693	0.061	0.7551	91.78
HDFC	0.0036	0.496	0.022	0.521	95.09
Hero Honda	0.0028	0.258	0.064	0.325	79.43
Hind Lever	0.0025	0.648	0.053	0.7035	92.11
Hind Motors	0.0061	0.673	0.012	0.691	97.38

Table 6.1 Cont'd

Company	International Market Factor	Local Market Factor	Local Industry Factor	Total	Market Factor to Total (%)
Hindalco	0.0016	0.642	0.049	0.6926	92.69
ICICI	0.0016	0.698	0.014	0.7136	97.81
Indian Hotels	0.0028	0.613	0.015	0.6308	97.18
Indian Rayon	0.0039	0.492	0.043	0.539	91.30
Indogulf Fert	0.0037	0.267	0.011	0.282	94.78
ITC	0.0024	0.802	0.035	0.8394	95.54
ITC Bhadra	0.0059	0.403	0.051	0.460	87.63
L & T	0.0015	0.84	0.034	0.8755	95.95
Lakme	0.0085	0.361	0.062	0.432	83.66
Mah & Mah	0.0071	0.695	0.015	0.7171	96.92
MRF	0.0024	0.522	0.016	0.540	96.59
Nagarjuna Fert	0.0027	0.103	0.017	0.123	83.92
Nestle	0.0093	0.641	0.018	0.6683	95.92
P & G	0.0063	0.416	0.035	0.457	90.97
Parke Davis	0.0038	0.367	0.062	0.433	84.80
Pfizer	0.0019	0.456	0.031	0.489	93.28
Ponds	0.0048	0.574	0.041	0.620	92.61
Ranbaxy	0.0022	0.637	0.024	0.6632	96.05
Raymond	0.0042	0.512	0.032	0.549	93.40
Reckitt & Col	0.0029	0.411	0.021	0.435	94.51
Rel. Capital	0.0036	0.600	0.062	0.665	90.14
Reliance Inds	0.0089	0.819	0.094	0.9219	88.84
SBI	0.0013	0.612	0.057	0.6703	91.30
Sesa Goa	0.0034	0.359	0.026	0.388	92.43
Siemens	0.0034	0.551	0.027	0.581	94.77
SKF	0.0027	0.311	0.034	0.347	89.43
Smithklin Beecham	0.0026	0.353	0.041	0.397	89.01
Smithklin Pharma	0.0029	0.377	0.049	0.429	87.90
SPIC	0.0035	0.633	0.036	0.673	94.13
Sterlite Inds	0.0061	0.453	0.035	0.494	91.68
Supreme Inds	0.0029	0.635	0.037	0.675	94.09
Tata Chemicals	0.0054	0.618	0.061	0.6844	90.30

Table 6.1 Cont'd

Company	International Market Factor	Local Market Factor	Local Industry Factor	Total	Market Factor to Total (%)
Tata Hydro	0.0059	0.491	0.052	0.549	89.46
Tata Power	0.0019	0.547	0.034	0.5829	93.84
Tata Steel	0.0026	0.789	0.025	0.8166	96.62
Tata Tea	0.0084	0.491	0.034	0.534	92.06
Telco	0.0037	0.589	0.081	0.6737	87.43
TPL	0.0021	0.531	0.038	0.571	92.98
United Phos	0.0011	0.452	0.015	0.468	96.56
Videocon	0.0061	0.574	0.027	0.607	94.55
Voltas	0.0035	0.604	0.026	0.634	95.35
Wartsila	0.0027	0.300	0.048	0.351	85.55

The results of the multi-factor model clearly shows the dominance of domestic market factor on the returns on stocks in India. In many of the companies in the sample, the market factor accounts for more than 90% of the variance.

The industry factors do not explain a substantial portion of returns, since we have orthogonalised the industry returns, and only used the residuals of the regression on market returns. An interesting result of this analysis is that much of the industry factor in an unorthogonalised regression would actually be the market factor, included in the industry factor. This explains why the principal component analysis indicated that 29% of the returns were explained by the local industry factor. We find that global factors do not enter the model significantly at all.

The results are not completely unexpected. We have seen the low correlations Indian markets had with the other markets, and evidence which we have presented in this study has shown that diversification into Indian markets would provide a superior diversification benefit to international investors. The results of the variance decomposition confirms that low correlations seem to arise out of the dominance of domestic factors in asset returns in India. This provides evidence, though the analysis is for a small sample, that diversification benefits from investing in India can be expected to persist. The dominance of domestic factors, we argue, has resulted in the low correlations India exhibits with other markets.

6.5 Estimation of a Single Factor Model

We also cross check our results by deploying a simple market model of returns on the sample of stocks to test for the robustness of our variance estimates. We would expect the market factor to enter the asset pricing equation significantly.

We therefore test the single factor model

$$r_{it} = \alpha_i + \beta_i r_{mt} + \varepsilon_{it}$$

by regressing the sample stock returns on the returns on the BSE Sensitive Index. We test the significance of the regression with F tests, and the intercept and coefficient are reported along with their t-statistics. The results are in Table 6.2

Table 6.2

Results of the Single Factor Regression with Market Index

	Intercept	t stat	β_i	t stat
ABB	2.586	1.721	1.029	7.759
ACC	-0.008	-0.824	1.322	14.586
Andhra Paper	0.313	0.195	1.118	7.904
Apollo Tyres	-0.656	-0.462	1.328	10.598
Arvind Mills	-0.004	-0.280	1.379	11.866
Ashok Leyland	-0.875	-0.800	0.722	7.486
Asian Paints	1.562	1.451	0.508	5.349
Atlas Copco	1.114	0.808	0.956	7.848
Bajaj Auto	0.027	2.142	1.032	8.894
Ballarpur Inds	0.557	0.348	0.188*	1.326
Bharat Forge	-1.426	-0.974	0.824	6.376
Bombay Dyeing	-2.609	-2.351	0.789	8.049
Britannia Inds	-0.463	-0.331	0.979	7.931
BSES	0.011	0.809	1.698	13.132
Burroughs Wellcome	2.321	1.063	0.199*	0.515
Castrol	1.624	1.379	1.059	10.184
Ceat Tyres	-1.486	-1.266	0.995	9.591
Century	-2.463	-2.271	0.676	7.052
Colgate	0.003	0.274	0.637	6.318
Crompton Greaves	0.055	0.026	1.217	6.577
E I Hotels	0.213	0.178	0.368*	1.564
ESAB	-0.111	-0.071	0.721	5.238
Escorts	-0.273	-0.161	0.261*	1.745
Essar Steels	-2.936	-1.539	1.296	7.692
Excel Inds	2.273	1.501	0.198*	1.481
Exide	-0.518	-0.338	0.883	6.529
Finolex Inds	0.212	0.136	0.946	6.902
Garware Paints	3.901	2.018	0.047*	0.277
GE Shipping	-0.006	-0.433	0.976	8.056
German Remedies	0.088	0.050	1.135	7.329

Table 6.2 Cont'd

	Intercept	t stat	β_i	t stat
Glaxo	0.015	1.213	0.770	6.574
GNFC	-2.290	-1.403	1.304	9.049
Grasim	0.000	0.030	0.973	12.434
GSFC	-2.231	-1.641	0.697	5.803
Gujarat Ambuja	0.008	0.744	1.051	10.928
Gujarat Alkali	-1.308	-0.944	0.811	6.626
Garware Wall	2.803	1.529	-0.039*	-0.241
HDFC	3.012	1.555	1.281	7.488
Hero Honda	3.762	1.752	0.245*	1.294
Hind Lever	0.018	2.007	0.810	9.729
Hind Motors	-0.412	-0.297	1.322	10.819
Hindalco	0.014	1.538	0.812	9.487
ICICI	-0.001	-0.035	1.970	10.359
Indian Rayon	2.212	1.755	0.152*	0.322
Indian Hotels	0.037	2.790	1.126	9.069
Indogulf Fertiliser	2.111	0.969	0.163*	0.846
ITC	0.007	0.691	1.288	14.402
ITC Bhadra	2.953	1.121	0.472	2.030
L & T	0.004	0.394	1.422	14.352
Lakme	1.420	1.173	0.398*	1.539
Mah & Mah	0.032	2.897	1.122	10.986
MRF	2.661	1.230	1.507	7.887
Nagarjuna Fert	2.454	1.022	0.542	2.556
Nestle	0.003	0.409	0.700	8.907
P & G	2.971	1.367	0.311*	1.055
Parke Davis	2.142	1.131	0.282*	1.683
Pfizer	0.426	0.246	1.056	6.917
Ponds	0.947	0.923	0.794	8.769
Ranbaxy	0.021	1.820	1.028	9.645
Raymond	0.889	0.465	0.745	4.684
Reckitt & Colmn	0.126	0.109	0.645	6.313
Dr. Reddy	7.142	2.776	0.034*	0.152

Table 6.2 Cont'd

	Intercept	t stat	β_i	t stat
Reliance.Cap	1.657	0.528	2.558	9.239
Reliance Inds	0.003	0.306	1.555	14.908
SBI	0.007	0.287	2.029	9.117
Sesa Goa	-0.566	-0.312	0.904	5.648
Siemens	0.726	0.817	0.656	8.358
SKF Bearings	-0.113	-0.086	0.589	5.068
Smithklin Beecham	1.134	0.958	0.583	5.578
Smithklin Pharma	0.913	0.587	0.806	5.873
SPIC	-1.200	-0.669	1.570	9.922
Sterlite Inds	0.331	0.182	1.104	6.871
Supreme Inds	-0.370	-0.276	1.178	9.962
Tata Chemicals	0.016	0.772	1.865	9.459
Tata Power	-0.001	-0.051	0.972	7.827
Tata Steel	-0.008	-0.825	1.167	13.720
Tata Hydro	0.007	0.005	0.998	7.421
Tata Tea	0.007	0.005	0.998	7.421
Telco	0.008	0.705	0.919	8.271
TPL	-2.025	-1.556	0.923	8.029
United Phos	0.716	0.268	1.615	6.850
Videocon	-2.433	-1.917	0.982	8.760
Voltas	-2.563	-1.958	1.078	9.329
Wartsila	1.491	0.802	0.812	4.944

* we find the beta -co-efficients are not statistically significant. We cannot reject the null that $\beta_i = 0$ in all these cases.

We find that the β_i values in most of the cases are statistically significant, at 5% level, and enter the pricing equation for the sample stocks. In the case of 14 companies, we find the intercept to be statistically significantly different from zero, and also find that the estimated beta coefficients are not significant. These are the

same companies for which also found the R^2 values to be lower. In these cases, the dominance of unsystematic or idiosyncratic factor in asset pricing is significant.

However, the results for the remaining companies confirm the dominance of market factors in asset returns. We therefore conclude that returns from Indian markets are driven primarily by domestic factors, making this market a segmented, but attractive market for international investments.

6.6 Chapter Summary

In this chapter, we examine the factors underlying returns with the view to understanding which of the factors dominantly enter the asset pricing process. The premise is that dominance of domestic factors would lead to segmentation of markets and hence lower correlation of such markets with other markets. Dominance of global factors on the other hand would suggest integrated markets.

We first undertake a principal component analysis of 84 Indian stock returns for the influence of a set of factors on the returns. We find that domestic market factors explain 62% of the returns, domestic industry factors explain 29% of the returns and that global factors are not significant.

We then undertake an hierarchical multi factor analysis, using a set of domestic and global factors. We orthogonalise the variables to avoid problems of multicollinearity. We find that domestic factors dominate the returns, and that global factors do not explain a significant portion of the return variance.

We finally cross check our result of the dominance of the domestic factors, by testing the market model on the sample companies. In 70 out of 84 cases, the beta co-efficient with respect to the market index is significant. We therefore conclude that Indian markets exhibit a low correlation with the other markets due to the dominance of domestic rather than global factors in asset returns. We expect diversification benefits from investing in markets like India to persist, as long as global factors do not enter the pricing equation significantly.

7. Summary of Findings and Scope for Further Research

7.1 Introduction

7.1.1 The 1990s have seen a remarkable increase in international investments, as more and more institutional investors have increased their allocations to foreign assets. Portfolio investments by investors in the US has grown from less than 3% of domestic GDP in 1985 to 12% in 1995. During the same period, investors in Japan have increased their global portfolio investments from 9% to 18% of GDP; in Germany from 4% to 7.3%; in United Kingdom from 27% to 47% and in Canada from 3.6% to 12%[1]. International investment is attracting tremendous policy and research attention in the recent years.

7.1.2 One of the characteristic features of the growth in international investments in the 1990s, is the growing importance of emerging markets as an asset class. According to estimates by the World Bank, the scale of capital inflows into emerging markets in the 1990s is much higher in magnitude than the oil surplus recycling in the 1970s, and is the most important cross border flow to date[2].

[1] OECD, Financial Market Trends, Vol 68, November 1997.
[2] IMF, International Capital Markets, November, 1997.

7.1.3 Emerging markets are markets in the developing economies, with the potential to grow and develop. These markets have set in motion deregulation, opening up to foreign investment, and large scale privatisations, which has made them attractive destinations for foreign portfolio investors. The inclusion of international assets in a portfolio provides the benefit of diversification into asset classes with varying risk-return trade-off. This benefit gets further accentuated if emerging markets are included in a global portfolio.

7.1.4 This study is an empirical examination of diversification benefits from portfolio investments in emerging markets. Most research on international investing focuses on developed markets, and little is known about the diversification benefits from investing in emerging markets. This study is an important, and one of the early contributions in this area. The findings are useful not only to international fund managers, but also market players and policy makers in emerging markets like India, who can use the results to understand the forces that impact foreign investments in their markets.

7.1.5 This study is focused in that it examines only diversification benefits, and is exhaustive in that it studies all the major aspects of diversification benefits in depth, utilising research methods and data of international standards in this type of research. This study empirically examines diversification benefits for 20 emerging markets over the period 1976 to 1996. Since international investors are primarily in developed countries, data on 18 developed markets are used to analyse the diversification benefits.

7.2 Chapter 1 : Emerging Markets and International Investment

7.2.1 Chapter 1 describes emerging markets for their features and characteristics. An attempt is made to describe the factors influencing the flow of portfolio investments into emerging markets. Among the pull factors are the higher growth rates in emerging markets, creating the potential for better investment returns; deregulation of markets which has increased the opportunity set for international investors; creation of new markets in many emerging market economies; large scale privatisations in many economies, which has lead to an increase in the stocks available for investors; wider choice of investment vehicles such as depository receipts and country funds for investing in emerging markets; a progressive decrease in direct barriers such as entry restrictions and withholding taxes, and indirect barriers such as non-availability of information, lack of international standards in market practices.

7.2.2 The push factors that underlie the flow of portfolio investments into emerging markets are : growing size of institutional investors in developed markets, and the need for prudential management of funds; the demographic structures in developing countries that have created the need for seeking higher returns on pension assets to support the aging populations; and the regulatory regimes that have facilitated the creation of international portfolios for prudent management of institutional funds.

7.2.3 We describe the essential features of emerging markets and provide data on the size, growth, and trading volumes in emerging markets. We also discuss qualitative indicators like liquidity, market concentration, and average size of listed companies. The objective is to provide a sketch of the essential features of emerging markets, and document the growth that they have registered in the past few years.

7.3 Chapter 2 : Benefits from Diversification into Emerging Markets : Theories and Evidence

7.3.1 Chapter 2 is devoted to the review of research and the mapping of research issues. We first discuss the case of international investing and discuss research that has built diversification benefit as the core case for international investment. We discuss the case of emerging markets separately in detail. We then review research on measurement of diversification benefits through asset-pricing and non-asset pricing approaches. We also discuss in detail research problems in studying international correlations and market linkages. We then list 12 important research issues that we propose to examine and discuss the data set. The data set comprises of monthly return data for 20 emerging markets and 18 developed markets over the period 1976 - 1996.

7.4 Chapter 3 : Emerging Markets - Risk, Return and Diversification

7.4.1 This chapter presents the first set of results of our study. In this chapter, we examine the risk, return and diversification features of emerging markets

and contrast them with developed markets. A series of statistical analysis is performed on the return series for all the developed and emerging markets. We present the case for diversification into emerging markets and analyse the extent of integration of these markets with developed markets by computing correlations, and using a single factor regression model.

7.4.2 We are able to identify certain peculiarities in the behaviour of risk and return, which are totally in contrast with what is known in the context of developed markets. This leads us to believe that models widely accepted and applied in the context of developed countries may not be applicable without necessary modifications in the emerging markets. Apart from return and volatility being much higher in emerging markets, as compared to developed markets, they are also inter-temporally instable. We find that returns in emerging markets are time varying. We also find that contrary to popular belief, volatility in emerging markets have not increased after liberalization.

7.4.3 We have tested whether emerging markets exhibit the simplest and most well known form of predictability: serial correlation. We compute coefficients of the Markov first order auto-regressive process (AR(1) process) with various lags and estimate the auto-correlation function (ACF). There is a strong evidence of serial correlation in emerging market returns, with 15 out of the 20 markets exhibiting statistically significant serial correlation at lag 1. Except for Malaysia, Mexico and Jordan all emerging market returns exhibit the likelihood of having predictable components.

7.4.4 Emerging market returns are not completely explained by means and variances, but exhibit high levels of skewness and kurtosis. The skewness and kurtosis in emerging market returns, lead us to believe that the returns may not be amenable to prediction by the normal distribution. Most emerging markets exhibit skewness and kurtosis values higher than the benchmark levels, though some developed markets too are not different. We therefore use standard tests to examine whether emerging market returns are normally distributed. We first conduct the Jarque-Bera(JB) test of normality. We also conduct the Kolmogorov - Smirnov (KS) distribution test, a standard goodness of fit test to judge how close the return distribution is to the normal distribution. At 5% level of significance we reject the hypothesis that emerging market returns are normally distributed in 19 out of 20 markets using the JB tests and in 15 out of 20 markets using the KS test.

7.4.5 Benefits from diversification depend on the correlation exhibited by assets in the portfolio. Diversifying into emerging markets will provide the scope to accentuate this benefit further, if the correlation of emerging markets with developed markets is lower than what is known in the context of developed markets alone.

7.4.6 We first examine correlation of emerging markets with one another. Except for some of the South East Asian markets which exhibit relatively higher correlations with one another (Philippines with Malaysia is 0.53; Malaysia with Indonesia is 0.62; and Indonesia with Thailand is 0.51), the overall correlation between emerging markets is very low. The average correlation

for all emerging markets is 0.208, much smaller than what is known in the developed market context. We also find some markets like India and Korea exhibiting very low, as well as negative correlation with other emerging markets. The lack of correlation amongst emerging markets is one of first evidences of the lack of integration of these markets with one another, and their distinctiveness as an asset class.

7.4.7 Correlations between developed and emerging markets are very low and suggest lack of integration. It was seen that markets like Venezuela (-0.07), India (0.01)and Columbia (0.02) have very negligible correlation with developed markets. The average correlation of emerging markets with developed markets is 0.194. The prevalence of very low correlation provides the basis for the case of emerging markets in an international portfolio. Even assuming differences in the risk and return attributes, inclusion of emerging markets in international portfolios is bound to enhance the diversification benefit, due to the near lack of correlation with developed markets.

7.4.8 In order to demonstrate the impact of including emerging markets in an international portfolio, we construct efficient frontiers using the MSCI World Index as the proxy for a global portfolio of developed markets. The objective is to test whether the inclusion of emerging markets shifts a developed market portfolio to the left, in risk-return space, thus providing the scope to enhance return at lower risk or reduce risk at a given level of return. We test 2000 portfolios thus constructed with gradually stepped up

allocations to emerging markets. We find that portfolios that include emerging markets dominate those that are constructed with developed markets. The results clearly demonstrate that including emerging markets in a global portfolio, will provide the diversification benefit of reducing risk while increasing return, upto a certain point, beyond which higher return can be earned only by bearing higher risk.

7.4.9 We propose a joint test of integration and asset pricing in emerging markets, using the ICAPM framework. A single factor model is estimated for developed and emerging markets, using the MSCI world index as the benchmark portfolio. We repeat the tests for two 5 year sub periods, 1987 - 1991 and 1992 - 1996.

7.4.10 In 13 out of the 20 markets, the observed F is higher than the theoretical level. We therefore can reject the hypothesis that MSCIW is not a significant explanatory variable of returns in these emerging markets. In these cases, the regression is significant. However, the lower levels of sensitivity of emerging market returns to World Index, and hence the lower explanatory power of the regression, is evident from the very low R^2 exhibited for most markets. The highest adjusted R^2 is for Malaysia at 0.449. However in the other 7 emerging markets for the period 1987-1991, we are unable to reject the hypothesis. The results for the significance of the regression in the recent 5 year period 1991 - 1996 are similar. However the power of the regression is weak, as evident from the lower R^2 values in the second period as compared to the first. On the basis of empirical

examination, we are able to conclude that, at 5% level of significance, MSCI World index has a higher explanatory power for the returns of developed markets, and explains weakly a small fraction of emerging market returns.

7.4.11 We then test the significance of the regression estimates. During the first 5 year period (1987 - 1991), we find that the p-values of the t statistics of the intercept term is higher than 0.05 in the case of Greece, India, Jordan, Korea, Malaysia, Philippines, Portugal and Taiwan. In these markets, we may reject the hypothesis that the intercept is significantly different from zero, at 5% level of confidence.

7.4.12 In 7 emerging markets we are able to obtain statistically significant estimates of the beta coefficient. These are Philippines, Taiwan, Thailand, Korea, Mexico, Malaysia and Portugal. In all the other markets we reject the hypothesis that return on the MSCI World Index is a significant explanatory variable of emerging market returns. In countries like Argentina, India, Venezuela, Nigeria and Zimbabwe, the beta co-efficient is actually negative. These were also the countries in which we observed very little or negative correlation with developed markets. A single factor regression model in the International Capital Asset Pricing Model (ICAPM) framework, which applies well in the developed market context, fails to explain returns from emerging markets.

7.4.13 These results lead us to adopt a non-asset pricing approach to examining the diversification benefit from emerging markets. We do not attempt to

explain emerging market returns in terms of an asset pricing model, but instead do a statistical analysis of diversification benefits, which do no necessitate any assumption about the underlying return generating process.

7.5 Chapter 4: Intertemporal Stability of Emerging Market Correlations

7.5.1 In chapter 4 we present the second set of results from an empirical analysis of emerging market correlations. Empirical analysis of emerging market correlations in this chapter addresses four major areas of concern for benefits from international diversification. The first is the proposition that increasing integration between markets would result in an increase in correlations over time. This would mean a progressive decrease in diversification benefits over time.

7.5.2 The second concern is that correlations increase during periods of high volatility in markets, and therefore the happening of events like the October 1987 crash, would alter the secular direction of correlations. If market exhibit contagion during the happening of such events, benefits from international diversification would not be available when they are needed the most. If such events are not sporadic, but persist over time, they would undermine the benefits of international diversification.

7.5.3 The third concern is that correlations are not symmetrically distributed, but behave differently in rising and falling markets. Asymmetry in correlation structure would mean that asset allocations based on correlations in a falling

market, would be significantly different from those based on correlations in a rising market.

7.5.4 The fourth concern is the variation of correlations over time, leading to intertemporal instability. The use of ex-post correlation estimates in ex-ante portfolio decisions would be difficult if correlations are time varying. Evidence on these propositions in the context of developed markets is first presented. We then test all these four propositions empirically, in the context of emerging markets.

7.5.5 It has been argued that removal of regulatory barriers would lead to higher levels of integration of emerging markets with developed markets. This has led to the proposition that emerging market correlations would have increased over time. We examine these proposition empirically, by testing whether emerging market correlations exhibit a time trend. If there was a progressive increase in emerging market correlations over time, there would be a linear time trend in the correlations, which can be modelled to capture any increase in correlations over time. We are unable to reject the hypothesis of lack of time trend at 5% level of significance, in the case of all the emerging markets. None of the emerging markets exhibit a time trend over the periods examined. We therefore conclude that emerging market correlations have not shown any significant shift in direction over the years.

7.5.6 During the October 1987 crash, every major market collapsed and therefore moved in the same direction. It is accepted that an increase in correlation during periods of high volatility in the markets undermines the benefits from

international diversification. However, if the changes in the direction of correlation during such events is temporary, and does not impact the secular direction of correlations, there is limited cause for concern. We therefore examine whether the sharp increase in correlations during the crash significantly altered the correlations between emerging markets and the MSCI World Index. We use the dummy variables approach and test the model for correlation with MSCI World Index. The coefficient of the dummy variable for the 1987 crash is not significant at 5% level, in the case of all emerging markets. Therefore, we can infer that the crash of 1987 did not bring about any secular change in the correlation of emerging markets. We are unable to test the impact of the 1994 Mexican crisis, that had impacted emerging markets, due to the short time series of data after the event.

7.5.7 We test whether correlations alter significantly with changes in the holding period. We conduct this test on the entire correlation matrix comprising of emerging and developed markets, over the period 1976-1996. For each of the emerging market studied , we compute correlations with one another and with the developed markets for holding periods of 1, 2, 3, 4 and 6 years. We do not see any significant change in the value of the correlation over varying holding periods.

7.5.8 In the recent years, particularly after the 1987 market crash, research on international markets has extensively documented the propensity for markets to fall together, in what is now known as the contagion effect.

Research seems to indicate that correlations distribution may not be symmetrical. We empirically test correlations for asymmetry.

7.5.9 We classify retum pairs into three classes : At a given time period t, If retums in both market(i) and market(j) are positive, we classify them as rising markets; if retums in both market(i) and market(j) are falling, we classify them falling markets; if retums in one market (i) is rising when the other market (j) is falling or vice-versa, we classify the them as mixed markets. We would expect the correlations under the first two of the above scenarios to be equal. We compute semicorrelation of each of the 40 markets with every other market, over the period 1970 January -1996 December.

7.5.10 In the case of all developed markets, correlation in falling markets is larger than the correlation computed in rising markets. Developed market semicorrelations with other developed markets, and with emerging markets are unmistakably skewed. Markets exhibit higher correlations when they fall, which actually means that global investors would suffer a reduction in the benefit of international diversification when markets fall, than when markets rise. The results also point to the possibility of altering portfolio construction strategies, using semicorrelation rather than total correlations.

7.5.11 The semicorrelations of emerging markets, with other emerging markets and with developed markets is not symmetrical either, though we are unable to say that semicorrelations in falling markets are higher than in rising markets, in all cases. In the case of markets such as Columbia, Indonesia, Pakistan,

and Zimbabwe, apart from the IFC Composite Index for emerging markets, the correlation with other emerging markets is higher in rising markets than in falling markets. Similarly emerging market semicorrelations with developed markets also present mixed results. In the case of Argentina, Brazil, Columbia, India, Jordan, Korea and Pakistan, correlations in rising markets are higher than in falling markets

7.5.12 We then test the intertemporal stability of the correlation co-efficients. We adopt the methodology used in Shaked (1985) to test the stability of the correlation coefficients. This methodology allows us to tests stability for the complete matrix on a market-by-market basis. This is important in the context of emerging markets, where we have already documented important differences in behaviour among markets. This methodology also provides us the scope to test the correlations with all markets, rather than the MSCI World Index alone, and is therefore more comprehensive in approach.

7.5.13 Correlation coefficients of the monthly returns of 18 emerging markets with other emerging markets, and each of the 17 developed markets are computed, for the period January 1985 to December 1996 (12 years). (Markets whose data set begin later than January 1985 have been excluded). The correlations are computed for varying sub-periods, namely 1 year, 2 years, 3 years, 4 years and 6 years. For each holding period, the returns data is sub-divided into k sub-periods and correlation coefficients are computed for each pair of countries.

7.5.14 The hypothesis that we set out to test is that several sample estimates of the correlation coefficient (r)are estimates of the same population correlation coefficient (ρ). If the correlation coefficients derived using varying holding periods are equal, we can say that they are stable over time. This would also mean that the sample estimates are all estimates of the same population ρ.

7.5.15 We first transform the sample estimate correlation coefficient (r) into a quantity (z), to develop a statistic that is distributed χ^2, We then compute z values to arrive at a test statistic that is distributed χ^2 with (k-1) degrees of freedom. Correlations of each market with every other market in the sample was calculated for every subset, converted into Z values as explained above and the χ^2 statistics were calculated for each of the 612 possible pairs (18 emerging and 17 developed markets).

7.5.16 We are unable to reject the hypothesis that the sample correlations are all estimates of the same population correlation, in all the holding periods, in 86% of the cases, at 5% level of significance. For a one year holding period, 506 out of 612 statistics are lower than the χ^2 value at 5% level of significance, which means that 83% of the values are statistically significant. The percentage of pair-wise statistics that are significant are 85%, 88%, 86% and 87% in the case of 2, 3,4 and 6 year holding periods.

7.5.17 Our results show that emerging market correlations are remarkably stable for all the holding periods examined. In the case of Mexico and Thailand we

can say that stability has increases with the increase in holding periods. This result is of immense practical significance to global investors who can use past estimates to predict future estimates of emerging market correlations.

7.6 Chapter 5 : Predictability of Emerging Market Correlations

7.6.1 The linear relationship between the expected returns and the vector of information variables indicates possible predictable components in return correlations across markets. In this chapter, we use an instrumental variables approach, based on this intuitive understanding, to test for predictability in emerging market correlations and attempt a model for forecasting emerging market correlations.

7.6.2 Based on our understanding of constant correlation in emerging markets, as empirically tested in Chapter 4, we begin with the hypothesis that past correlations can explain future correlations, and use a simple lagged correlation model. We find one year lags to provide statistically significant β_1 values in the case of 6 out of 9 markets. . The adjusted R^2 in all the cases in very small, indicating that lagged correlations explain a very insignificant percentage of the future correlations. We find that using past correlations to predict the future correlations is quite sensitive to the lag used, and the results improve as the period of lag is increased. We are however not satisfied with the power of the predictor, given the low R^2 values, and therefore seek to use more instrumental variables to forecast future correlations.

7.6.3 We use a set of pre-selected instrumental variables which have been chosen to reflect a combination of global and domestic factors. We choose not to maximise the fit for the emerging markets examined, but instead focus on deriving results from using the same set of variables for each of the emerging markets studied. This is to avoid data mining and data snooping problems in using ex-post data in our model. We use the lagged correlations as the first instrumental variable. Based on the findings of Fama and French (1988) on mean reversion in expected returns and serial correlations over long time horizons, we introduce lagged returns of emerging markets and the developed market examined as predictors in the forecasting equation. Harvey (1991) found that using dividend yields as predictors enhanced the forecasting ability of the equation. We therefore use dividend yields as the fourth instrumental variable. All the instrumental variables are lagged according to the holding period that is chosen.

7.6.4 We test the model on a set of 9 emerging markets which have a large enough time series of data for these types of tests. Data for these emerging markets are from January 1976 to December 1996. The test are done against correlations with developed markets which have been the dominant investors in the emerging markets. These markets are US, UK and Japan. We also test the model using the MSCI World Index value to study the predictability of emerging market correlations with respect to the broad developed market index.

7.6.5 We repeat the tests of predictability using instrumental variables for rolling correlations for 1, 3 and 5 year holding periods. We find the R^2 values to have significantly improved with the increase in the number of instrumental variables and find that both global and local variables enter the equation significantly. The significance of the variables has improved in all the cases, as is evident from the higher levels of significance of the t-statistics in the case of all the markets. This pattern is evident across the results of the model with the 4 developed market studied. We therefore conclude that predictability of return correlations is high for emerging markets.

7.6.6 We attempt an application of our model for predicting emerging market correlations to see how well it fits the actual values of correlations obtained ex-post. We also make some out-of-sample forecasts of correlations, using the 5-year holding period model. We find that the fitted values closely track the actual values of the correlation.

7.6.7 We also run a regression of the forecast values and the fitted values for 5 year correlations, to test the closeness of the two values. We find the fit to be very close, as evidenced by the values of the coefficient and the intercept. The intercept is not statistically significantly different from zero, in all cases except for the correlation of India with US. In this case alone, we have to reject the hypothesis that the intercept is statistically significantly different from zero. The co-efficient is also statistically significant in all the cases, and is close to 1. The p-value of the t-stat is zero, signifying that the fit is very close and is significant even at 1% level of significance. The t-

stats are significant in all the cases, including India, where the t-stats are much lower.

7.6.8 The robustness of the model is evident from the fact that none of the fitted values, including the out-of sample forecasts, fall outside the range of -1 to +1. We have not imposed this constraint in the model, though. We can therefore say that our model for predictability of emerging market correlations explains correlations closely and is robust.

7.7 Chapter 6 : Factors Influencing Returns in Emerging Markets : The Indian Case

7.7.1 At the root of the lack of correlation between markets, and the remarkable constancy of correlations, and the apparent predictability of market correlations, is the dominance of local factors in pricing assets. Our understanding is that this dominance explains the lack of increasing correlation even among markets that have a history of economic co-operation.

7.7.2 The persistence of diversification benefits is subject to :a) The structure of returns should be such that the co-variances between assets are higher within the market, than across markets; and b) The pricing of assets should be dominated by national rather than international factors.

7.7.3 In this chapter we choose to examine the returns in the Indian markets to understand whether national or international factors dominate asset returns.

The objective is to find out the composition of returns in terms of factors influencing returns, and demonstrate the persistence of diversification benefits in segmented markets like India.

7.7.4 We apply the principal component analysis to the ex-post correlation matrix of monthly returns and a set of variables. The data set comprises of 84 companies listed and traded on the Bombay Stock Exchange, India. These companies are in the traded in Group A of the Bombay Stock Exchange representing stocks with large market capitalisation and active trading. Group A has a list of 100 stocks, but we exclude mutual funds and stocks which were listed after January 1992. The return data is the monthly series over the period January 1992 - December 1996.

7.7.5 We use a set of variables such as returns on the market index(the BSE Sensitive Index is used) (X_1), Returns on the CMIE Industry Index (X_2), Returns on the IFC Global Index (X_3) Returns on the MSCI World Index (X_4) and returns on the FT Actuaries Industries Index (X_5). The objective is to be able to construct out of the chosen k variables (X_1, X_2...X_k) a set of new variables (P_i) called principal components, which are linear combinations of the variables. The first principal component P1, explains most of the correlation amongst the variables chosen. Each successive principal component explains most of the remaining correlation. We found that the first principal component explained 62% of the returns. This is consistent with the market model of returns, where we use a single factor model to explain returns from a market.

7.7.6 In order to study the impact of a set of factors on stock returns, we deploy a hierarchical multivariate analysis of variance for the chosen sample of 84 stocks. The objective is to analyse the sources of variance in the returns of these stocks and assess their relative importance. The variables chosen here are the contribution of world market factor, local market factor, and local industry factor. The proxies deployed to measure the impact of these factors are the MSCI World Index, BSE Sensitive Index, and the CMIE Industries Index.

7.7.7 The results of the multi-factor model clearly shows the dominance of domestic market factor on the returns of stocks in India. The industry factors do not explain a substantial portion of returns, since we have orthogonalised the industry returns, and only used the residuals of the regression on market returns. An interesting result of this analysis is that much of the industry factor in an unorthogonalised regression would actually be the market factor, included in the industry factor. We find that global factors do not enter the model significantly at all.

7.7.8 The results of the variance decomposition confirms that low correlations seem to arise out of the dominance of domestic factors in asset returns in India. This provides evidence that diversification benefits from investing in India can be expected to persist.

7.7.9 We also cross check our results by deploying a simple market model of returns on the sample of stocks to test for the robustness of our variance

estimates. We would expect the market factor to enter the asset pricing equation significantly.

7.7.10 We find that the β_i values in 70 out of the 84 cases are statistically significant, at 5% level, and enter the pricing equation for the sample stocks. We also find the R^2 values for the sample stocks to be slightly lower than what we estimated from a multi-factor model. We therefore conclude that returns from Indian markets are driven primarily by domestic factors, making this market a segmented, but attractive market fro international investments.

7.8 Scope for Further Research

7.8.1 The behaviour of international correlations during periods of high market volatility is an important research issue. The crashing of markets, triggered by the South East Asian crisis, in October 1997, has triggered concern about market contagion. It should be possible to use volatility clustering models that combine the effect of volatility and correlation to model the behavior of international correlation.

7.8.2 Alternative investment mechanism like the GDRs and offshore funds are increasing in popularity. It would be useful to examine the relative attractiveness of these routes to investing in emerging markets.

7.8.3 Portfolio flows and foreign direct investments have been compared both by research and policy. It is held that portfolio flows are more volatile than

foreign direct investments. There is limited research on the impact of these flows and the macro policy issues with regard to the choice of flows into an emerging market. The issues of policy responses to both portfolio and direct investments, and the factors impacting the choices of policy makers is an important area meriting study.

7.8.4 Management of currency risk is becoming an important issue, with the availability of a variety of currency hedging tools in international markets. It would be useful to study portfolio strategies that deploy currency hedges and the efficacy of these tools in the context of emerging markets.

7.8.5 The institutional structures in many of the emerging markets that have deregulated has changed in the 1990s. There is no research yet on the impact of foreign flows on the market microstructures and the quality of the equity markets into which such investments have been made. The impact of foreign portfolio investments on the institutional structure of markets is an important area of research, not yet addressed.

7.8.6 Foreign investors in emerging markets are concentrated in a few developed countries. The impact of such concentration on return, correlation and volatility can be examined. This would help policy initiatives on attracting foreign investments in an emerging market.

7.8.7 Data on emerging market companies is now available with the IFC EMDB. Studies that analyse cross country factors, cross country market efficiencies

and pricing models would be useful in understanding the distinctive features of emerging markets.

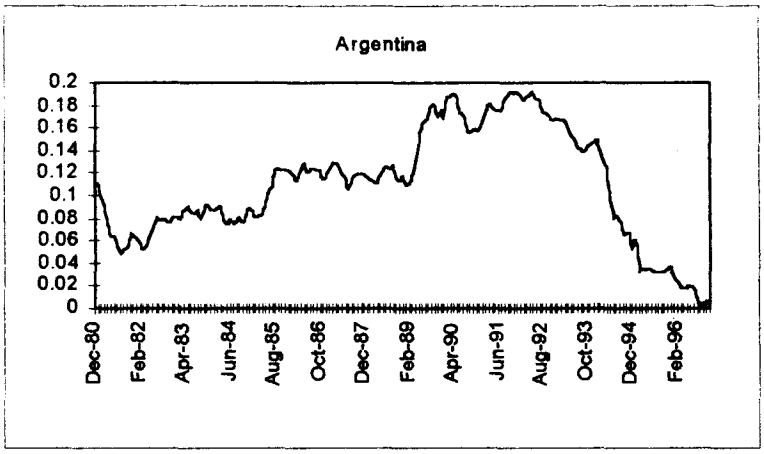
7.8.8 Despite the known attractiveness of emerging markets, actual allocations by international investors is very low. This would mean that there is conscious sub-optimal asset allocation. It is known that costs in international investing is a deterrent. It would be useful to study investment and transactions cost, and their impact on actual return to international investors.

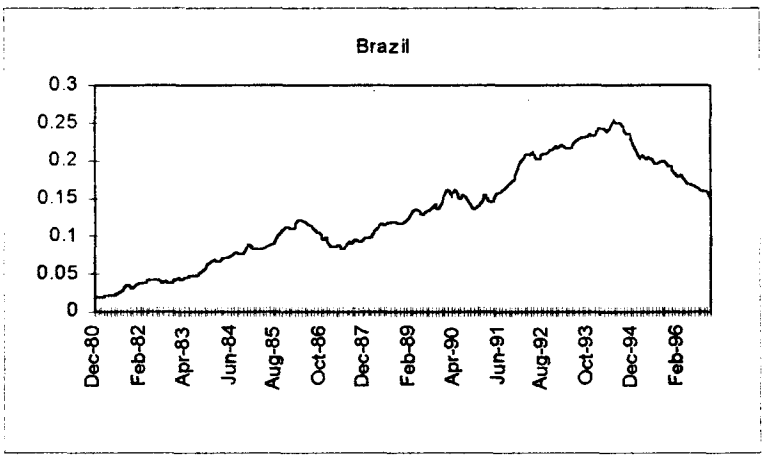
Our study is an attempt at describing the diversification benefits from portfolio investments in emerging markets. We have established that the diversification benefit from emerging markets is superior to those available in developed markets. Our empirical analysis focusses on emerging market correlations, as a measure of this benefit. We adopt this approach due to difficulties in modelling emerging market returns with an asset pricing model, as these markets are highly segmented. We find that emerging market correlations are very low, have not increased in the recent years (contrary to popular belief), stable and predictable. We find that factors underlying emerging market returns are dominated by local rather than global factors, indicating that diversification benefits would persist.

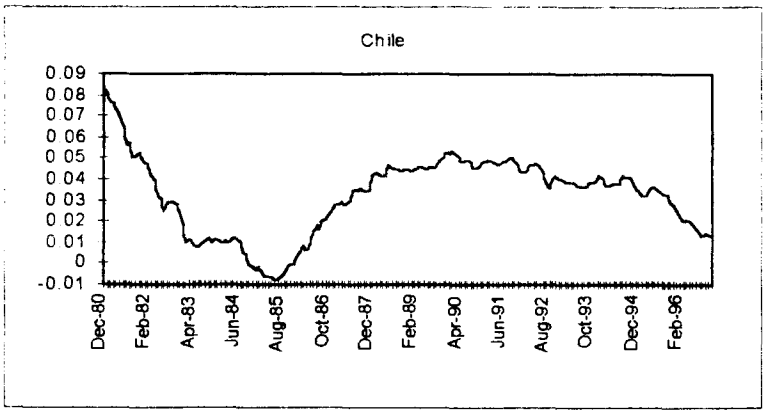
Appendix A

Time varying mean returns from Emerging Markets

(5 year rolling mean returns for periods ending)



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0.02
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0
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Feb-82
Apr-83
Jun-84
Aug-85
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Apr-90
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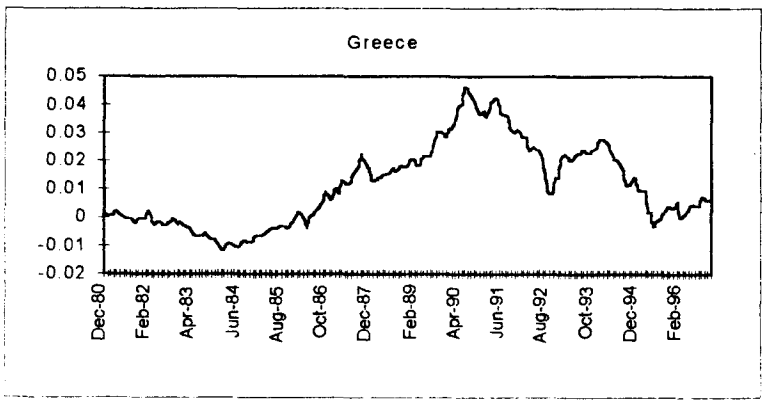
Dec-94
Feb-96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Dec-80
Feb-82
Apr-83
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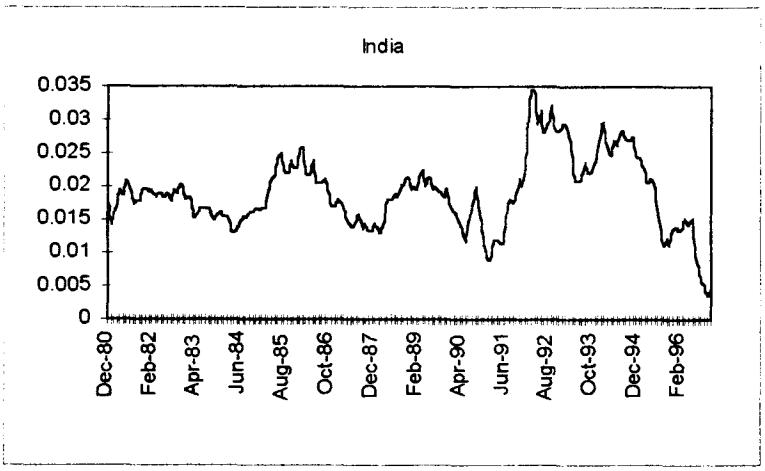
Dec-94
Feb-96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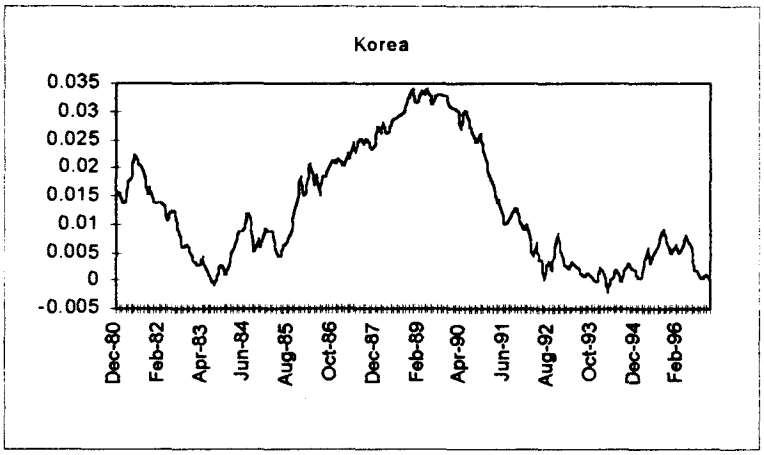
0.005
0
Dec-80
Feb-82
Apr-83
Jun-84
Aug-85
Oct-86
Dec-87
Feb-89
Apr-90
Jun-91
Aug-92
Oct-93
Dec-94
Feb-96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0.025
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0.01
0.005
0
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Dec-80
Feb-82
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Feb-89
Apr-90
Jun-91
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Oct-93
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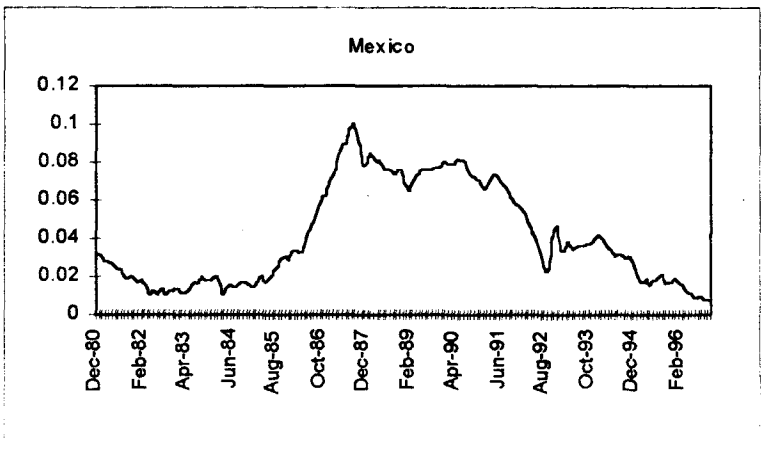
Feb-96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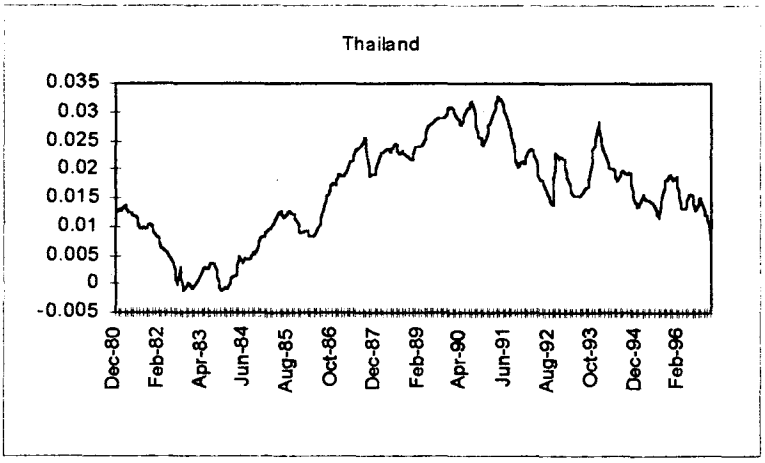
Dec-87
Feb-89
Apr-90
Jun-91
Aug-92
Oct-93
Dec-94
Feb-96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Dec-80
Feb-82
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Jun-84
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Dec-87
Feb-89
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Jun-91
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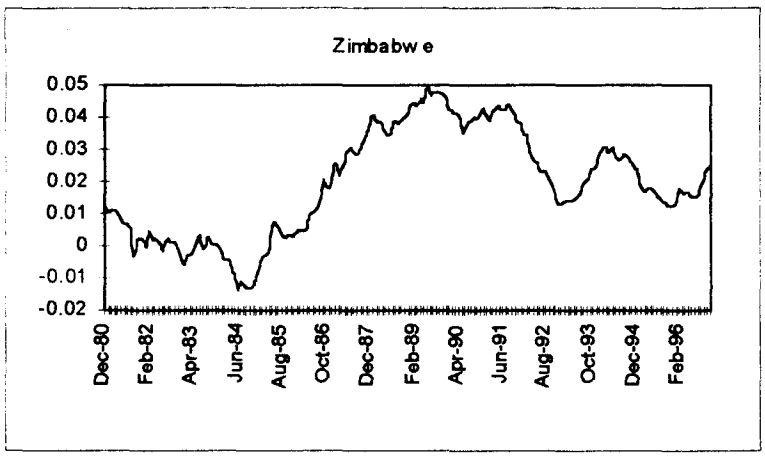
Oct-93
Dec-94
Feb-96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Feb-82
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Jun-91
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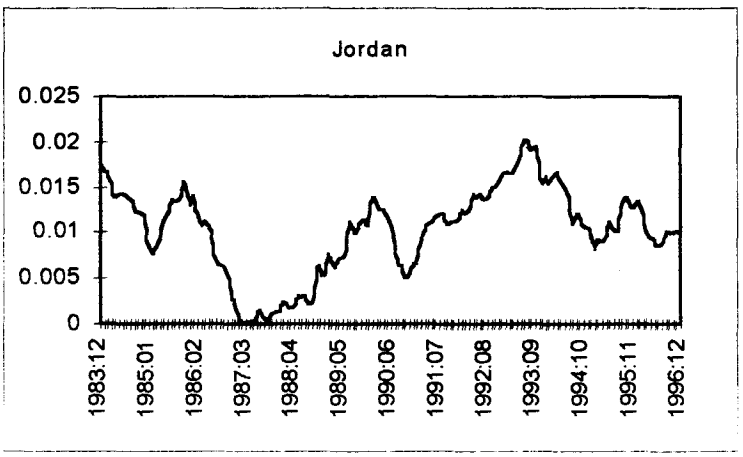
Feb-96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0.01
0.005
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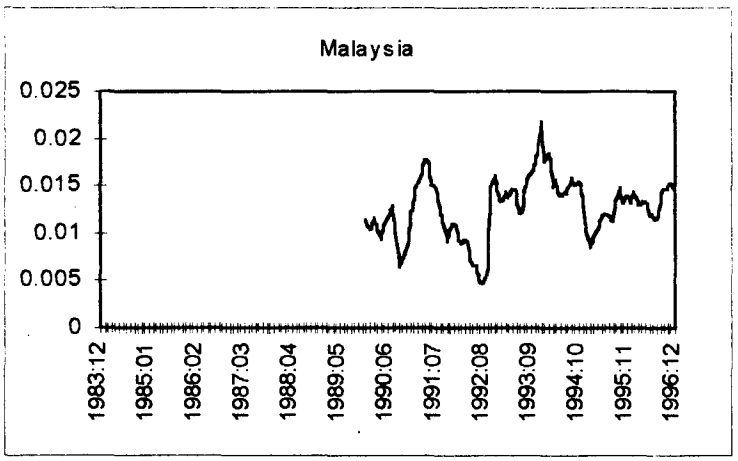
Malaysia
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0.01
0.005
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1983:12
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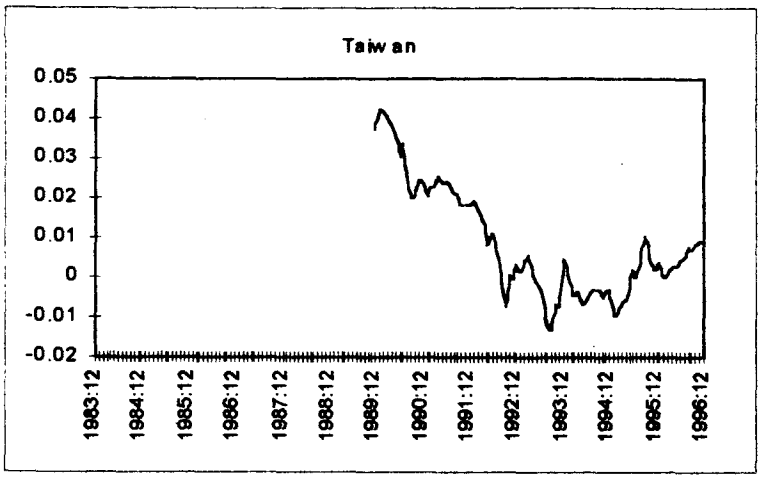
Taiwan
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0.04
0.03
0.02
0.01
0
-0.01
-0.02
1983:12
1984:12
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1988:12
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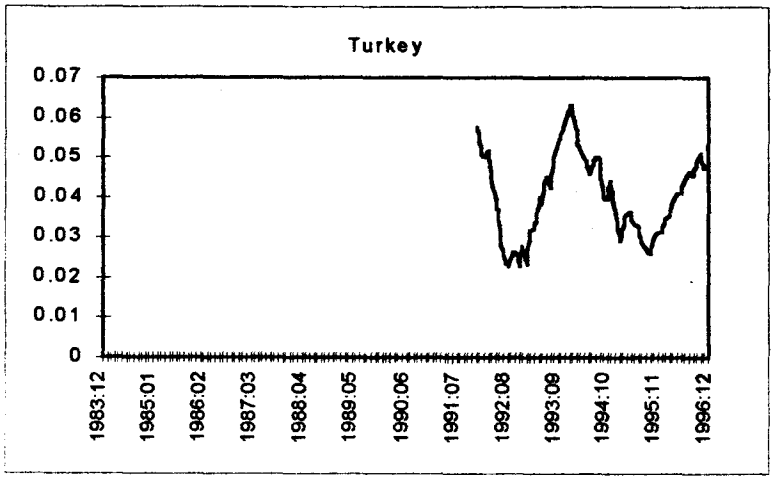
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0.03
0.02
0.01
0
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1987:03
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1990:06
1991:07
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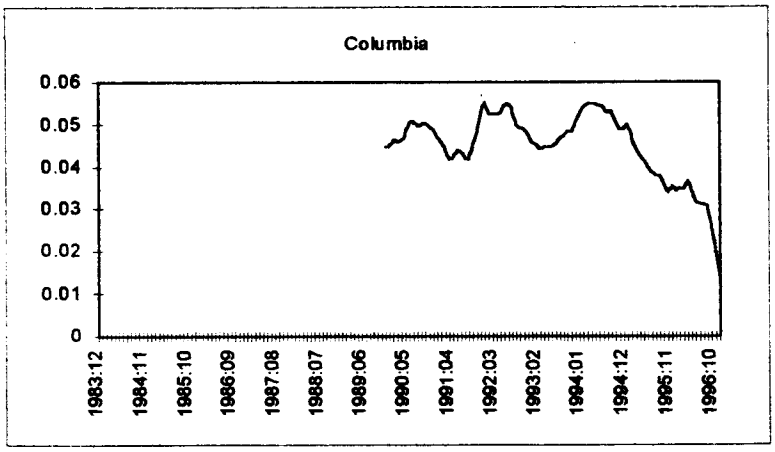
Columbia
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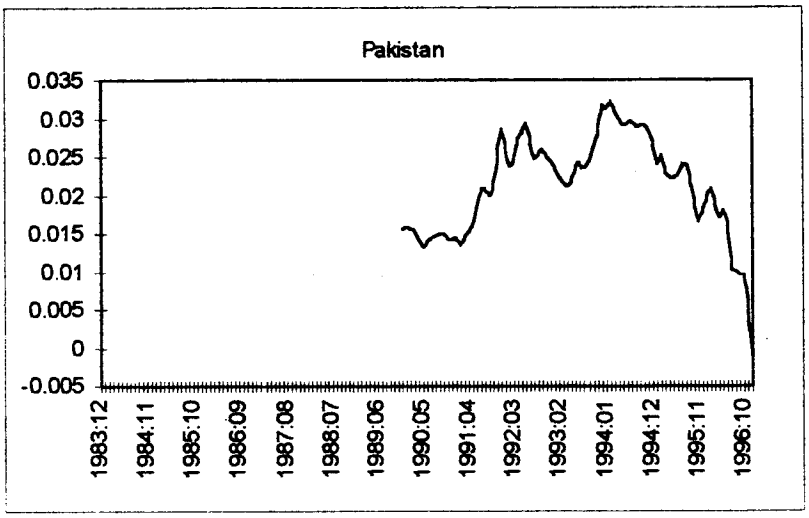
0.05
0.04
0.03
0.02
0.01
0
1983:12
1984:11
1985:10
1986:09
1987:08
1988:07
1989:06
1990:05
1991:04
1992:03
1993:02
1994:01
1994:12
1995:11
1996:10


Pakistan
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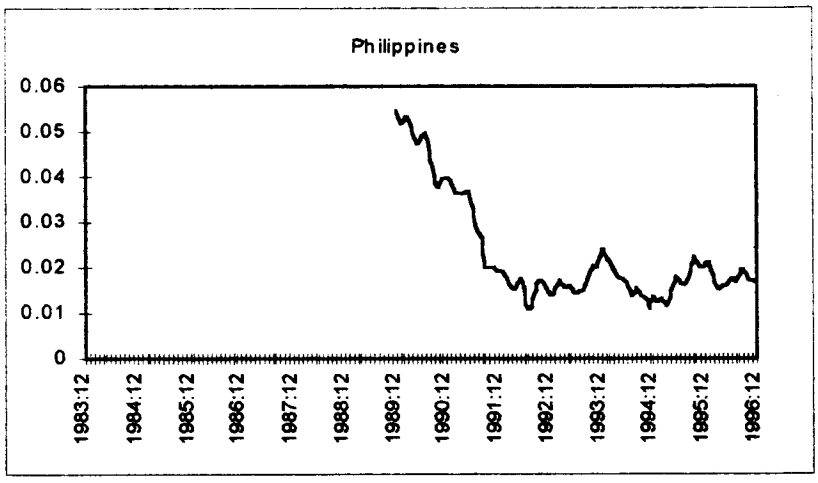
0.03
0.025
0.02
0.015
0.01
0.005
0
-0.005
1983:12
1984:11
1985:10
1986:09
1987:08
1988:07
1989:06
1990:05
1991:04
1992:03
1993:02
1994:01
1994:12
1995:11
1996:10


Philippines
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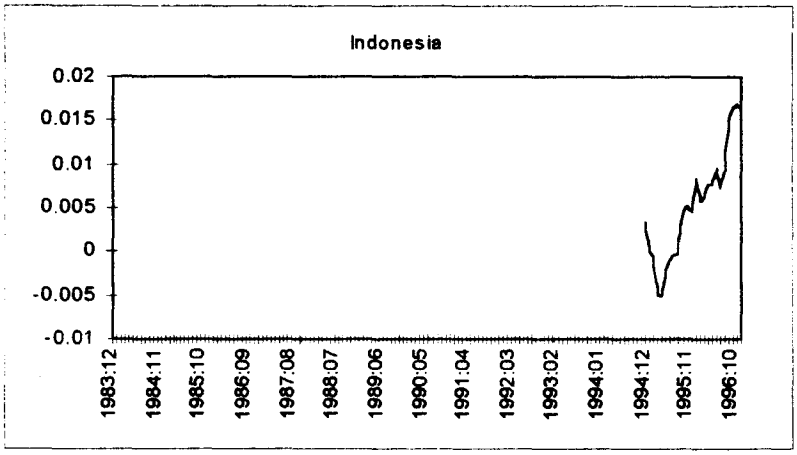
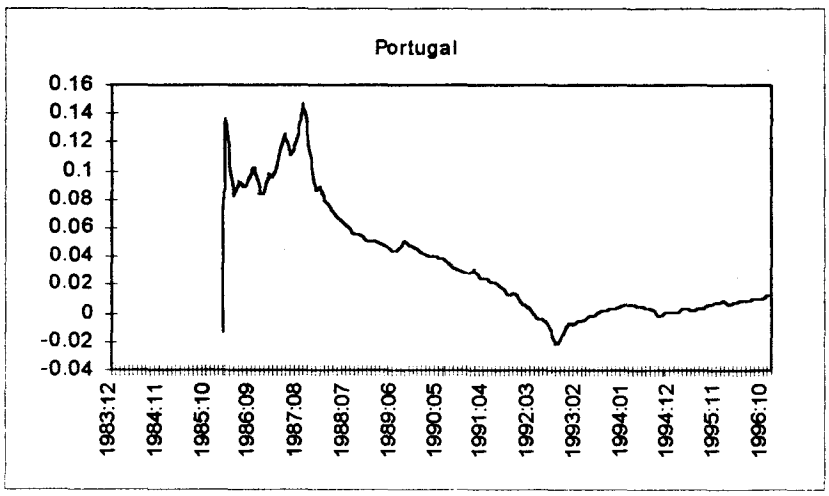
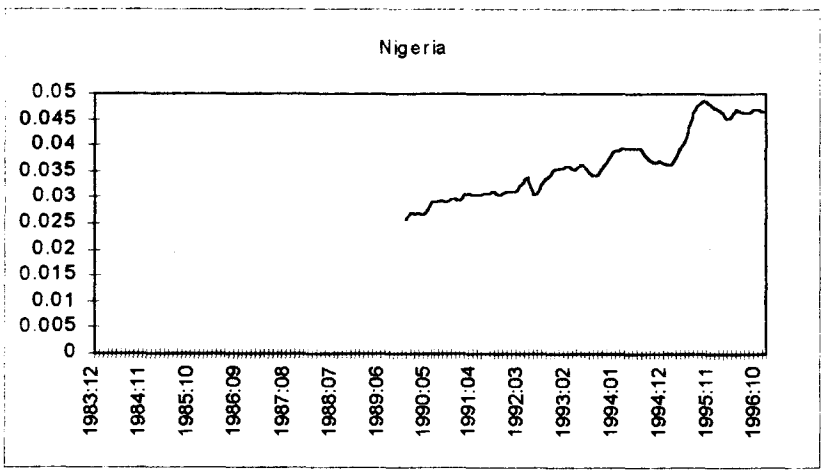
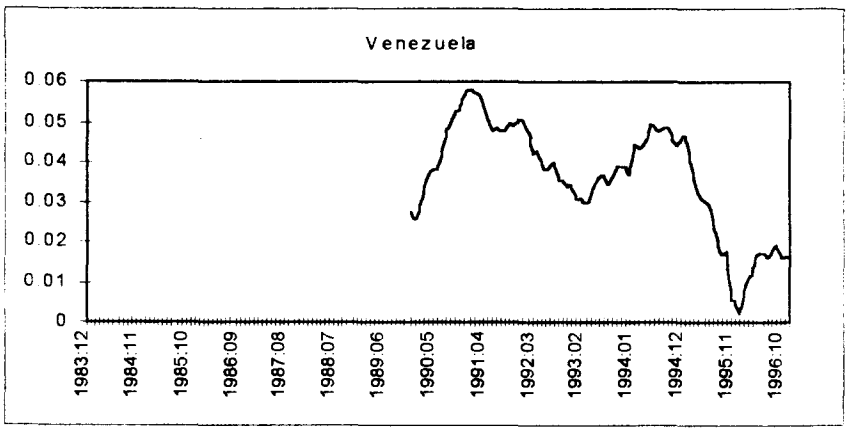
0.05
0.04
0.03
0.02
0.01
0
1983:12
1984:12
1985:12
1986:12
1987:12
1988:12
1989:12
1990:12
1991:12
1992:12
1993:12
1994:12
1995:12
1996:12


Indonesia
0.02
0.015
0.01
0.005
0
-0.005
-0.01
1983:12
1984:11
1985:10
1986:09
1987:08
1988:07
1989:06
1990:05
1991:04
1992:03
1993:02
1994:01
1994:12
1995:11
1996:10


Portugal
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
1983:12
1984:11
1985:10
1986:09
1987:08
1988:07
1989:06
1990:05
1991:04
1992:03
1993:02
1994:01
1994:12
1995:11
1996:10

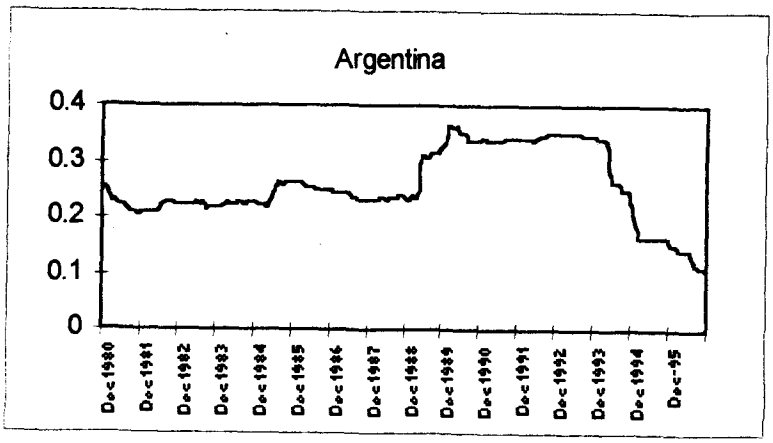

Nigeria
0.05
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
1983:12
1984:11
1985:10
1986:09
1987:08
1988:07
1989:06
1990:05
1991:04
1992:03
1993:02
1994:01
1994:12
1995:11
1996:10

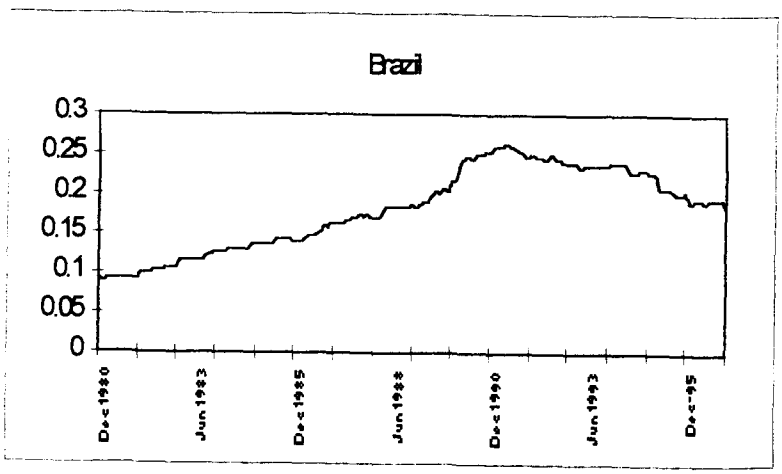

Venezuela
0.06
0.05
0.04
0.03
0.02
0.01
0
1983:12
1984:11
1985:10
1986:09
1987:08
1988:07
1989:06
1990:05
1991:04
1992:03
1993:02
1994:01
1994:12
1995:11
1996:10

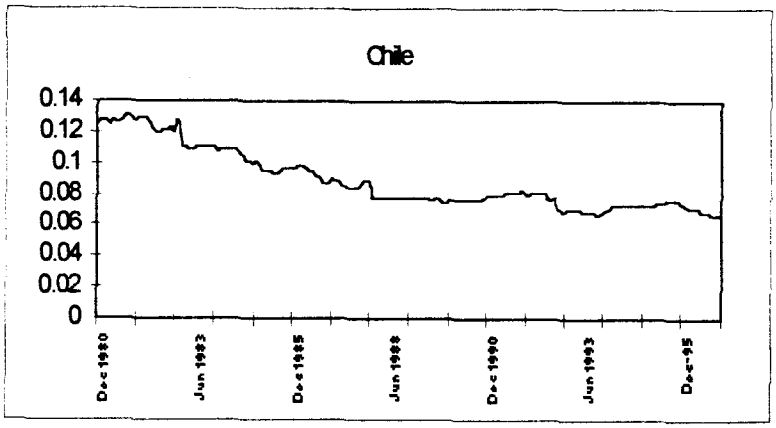
Appendix B

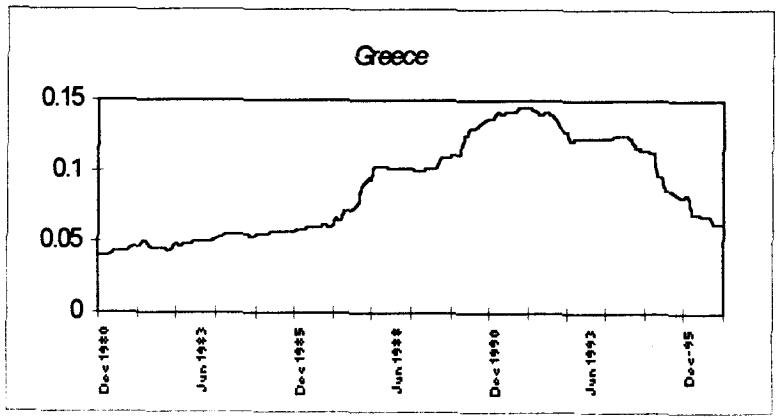
Time varying risk in Emerging Markets

(5 year rolling standard deviation for periods ending)






Chile
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Dec 1980
Jun 1983
Dec 1985
Jun 1988
Dec 1990
Jun 1993
Dec-95


Greece
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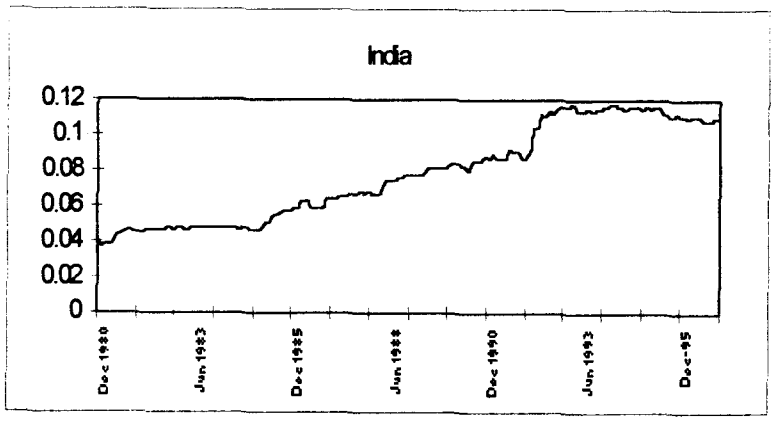
0.1
0.05
0
Dec 1980
Jun 1983
Dec 1985
Jun 1988
Dec 1990
Jun 1993
Dec-95


India
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0.1
0.08
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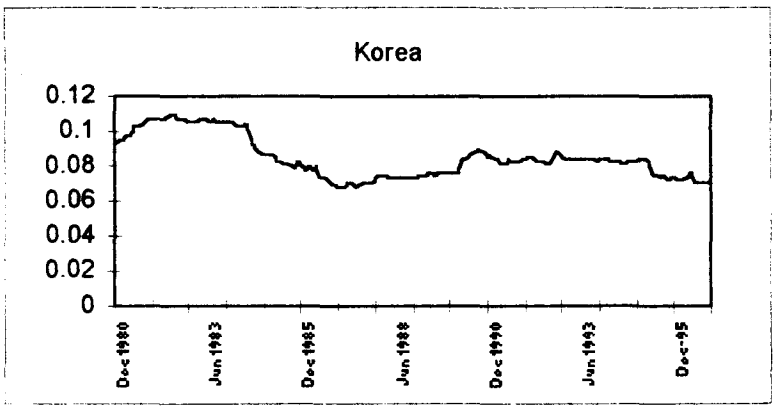
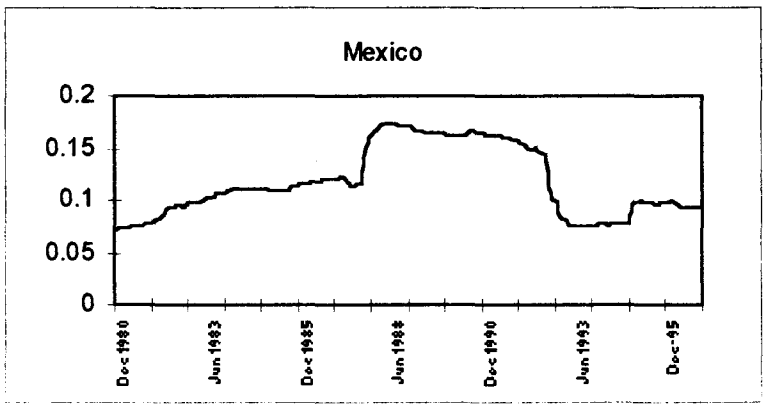
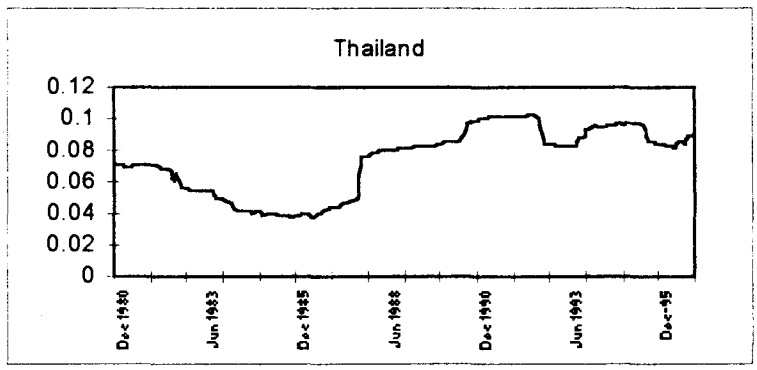
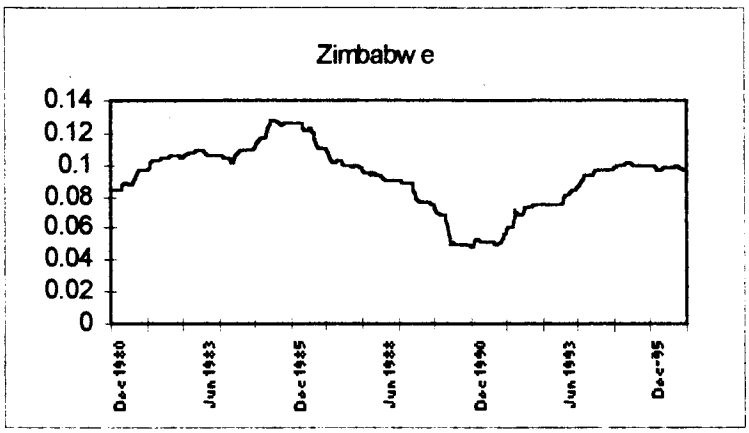
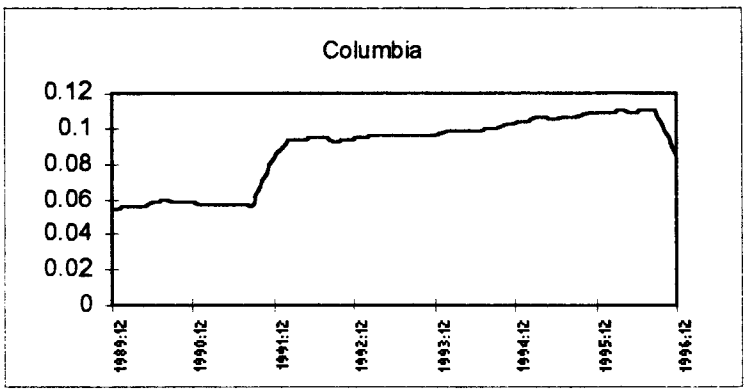
0.04
0.02
0
Dec 1980
Jun 1983
Dec 1985
Jun 1988
Dec 1990
Jun 1993
Dec-95


Korea
0.12
0.1
0.08
0.06
0.04
0.02
0
Dec 1980
Jun 1983
Dec 1985
Jun 1988
Dec 1990
Jun 1993
Dec-95


Mexico
0.2
0.15
0.1
0.05
0
Dec 1980
Jun 1983
Dec 1985
Jun 1988
Dec 1990
Jun 1993
Dec-95


Thailand
0.12
0.1
0.08
0.06
0.04
0.02
0
Dec 1980
Jun 1983
Dec 1985
Jun 1988
Dec 1990
Jun 1993
Dec-95


Zimbabwe
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Dec 1980
Jun 1983
Dec 1985
Jun 1988
Dec 1990
Jun 1993
Dec-95


Columbia
0.12
0.1
0.08
0.06
0.04
0.02
0
1989:12
1990:12
1991:12
1992:12
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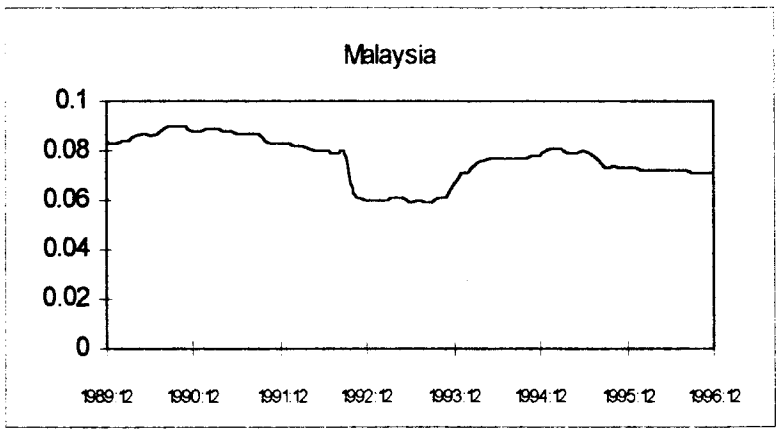
1994:12
1995:12
1996:12


Malaysia
0.1
0.08
0.06
0.04
0.02
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1989:12
1990:12
1991:12
1992:12
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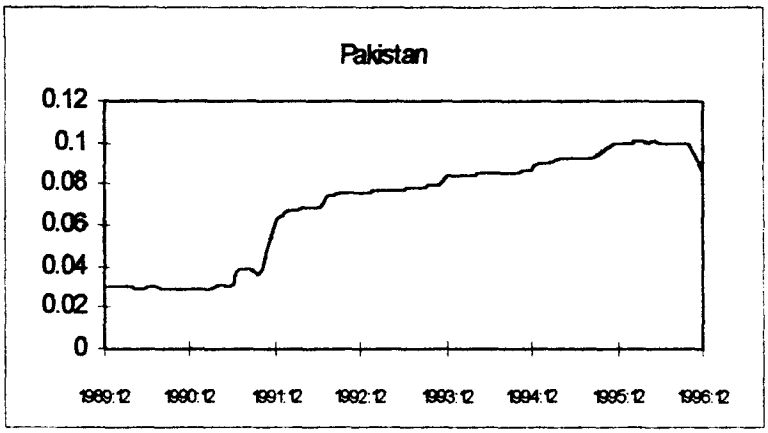
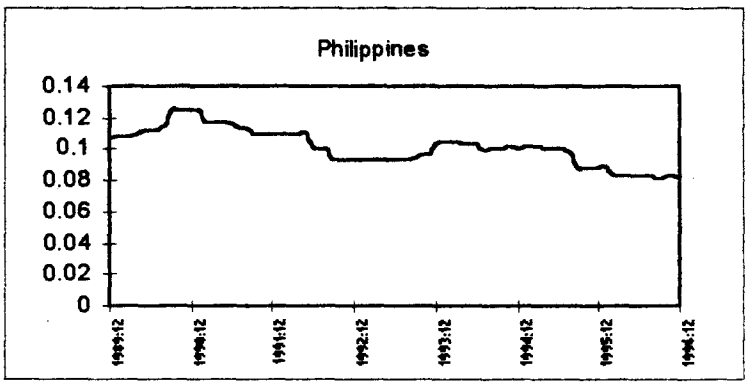
1994:12
1995:12
1996:12


Pakistan
0.12
0.1
0.08
0.06
0.04
0.02
0
1989:12
1990:12
1991:12
1992:12
1993:12
1994:12
1995:12
1996:12


Philippines
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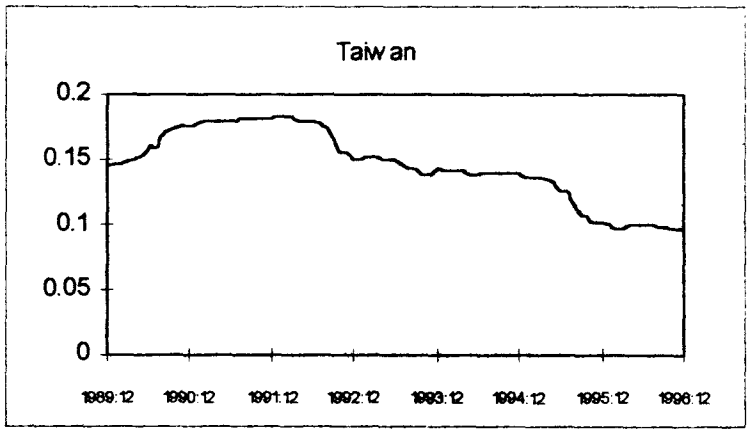
0.08
0.06
0.04
0.02
0


Taiwan
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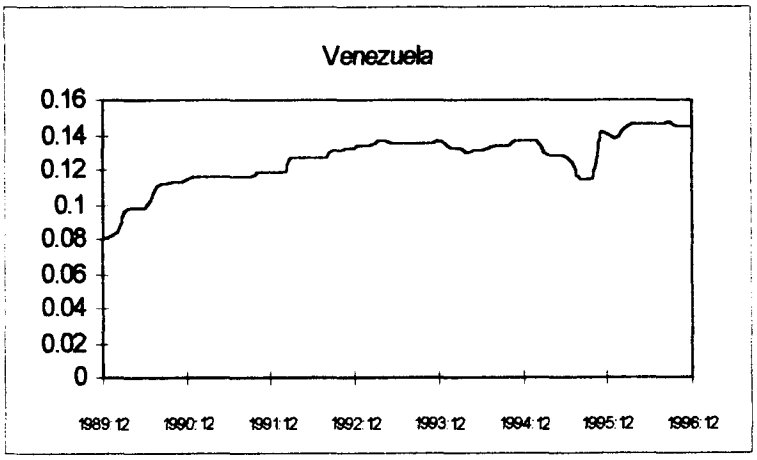
1989:12
1990:12
1991:12
1992:12
1993:12
1994:12
1995:12
1996:12


Venezuela
0.16
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0.12
0.1
0.08
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1990:12
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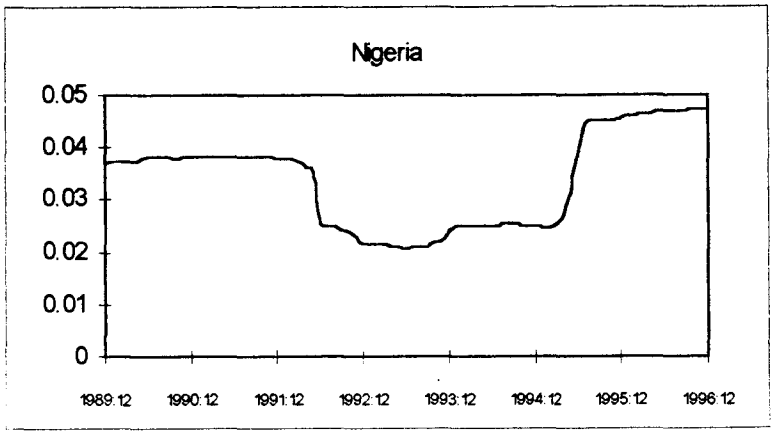
1995:12
1996:12


Nigeria
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0.01
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1989:12
1990:12
1991:12
1992:12
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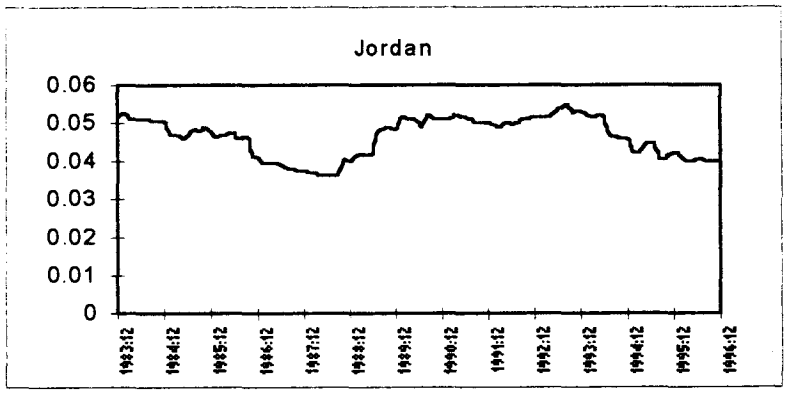
1994:12
1995:12
1996:12


Jordan
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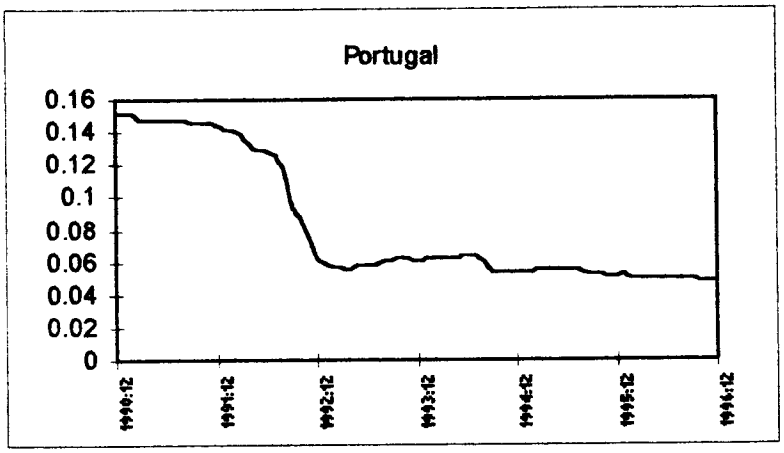
0.04
0.03
0.02
0.01
0


Portugal
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
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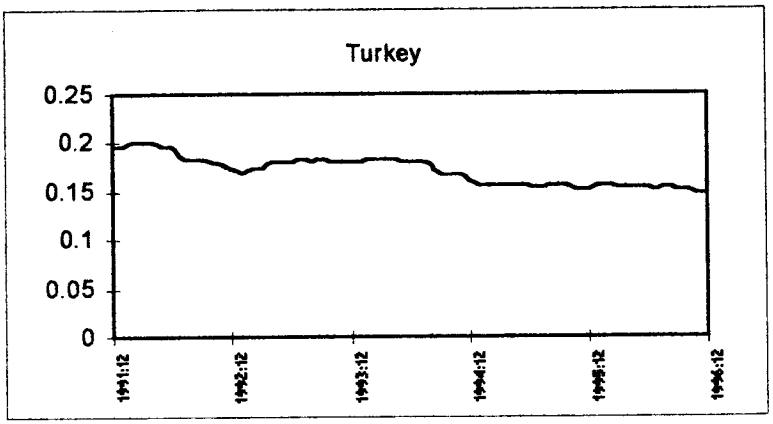
1990:12
1991:12
1992:12
1993:12
1994:12
1995:12
1996:12


Turkey
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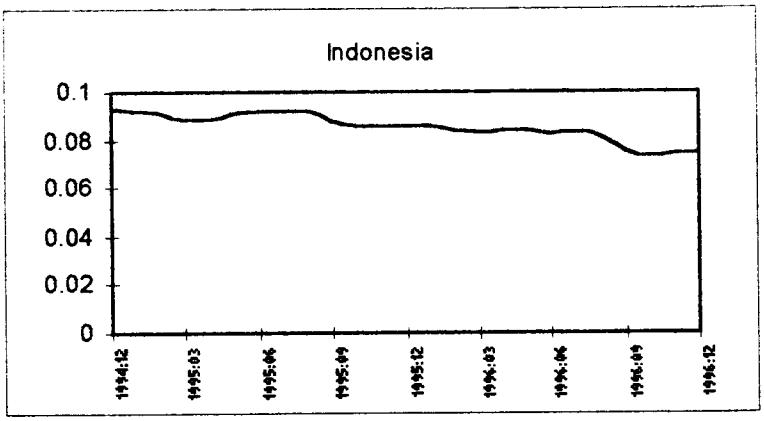
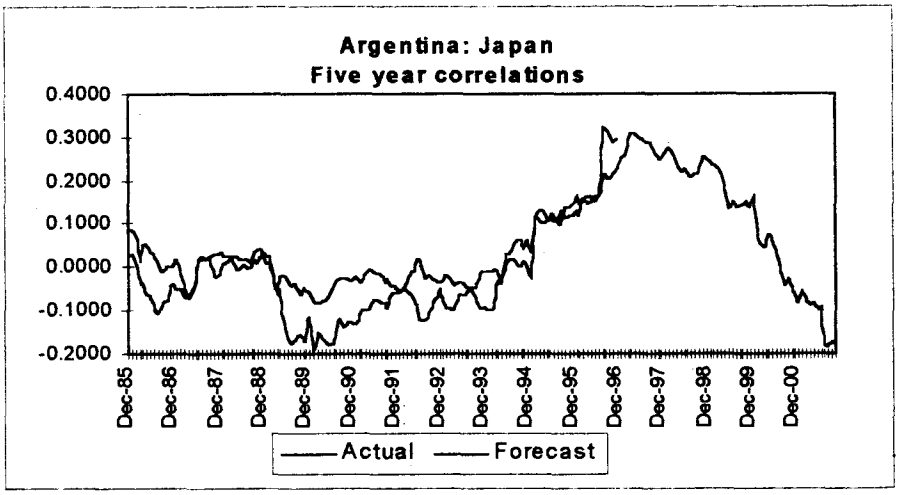
0.1
0.05
0
1991:12
1992:12
1993:12
1994:12
1995:12
1996:12

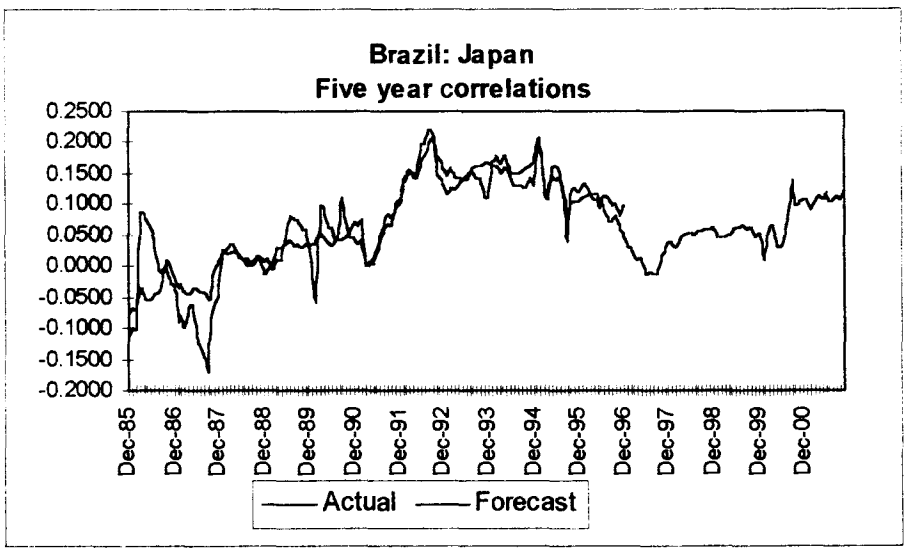

Indonesia
0.1
0.08
0.06
0.04
0.02
0
1994:12
1995:03
1995:06
1995:09
1995:12
1996:03
1996:06
1996:09
1996:12

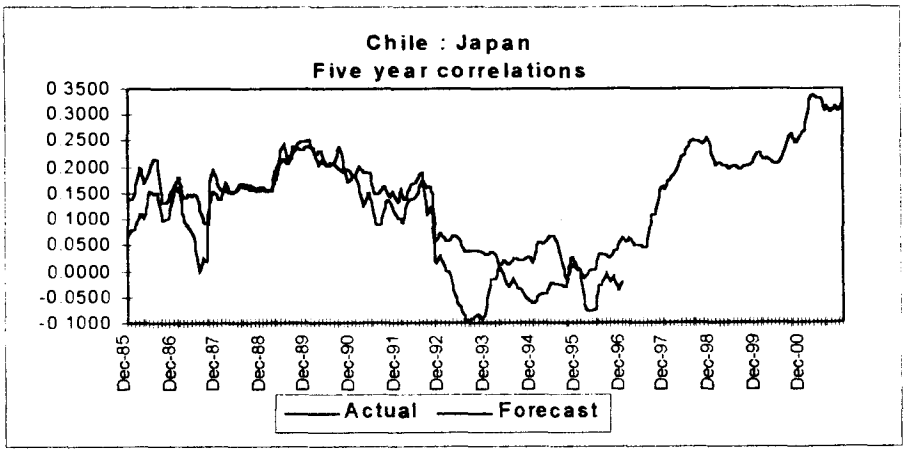
Appendix C
Predictability of Emerging Market Correlations

Fitted and Forecast Values

Fitted values and forecast correlations with Japan






Chile : Japan
Five year correlations
0.3500
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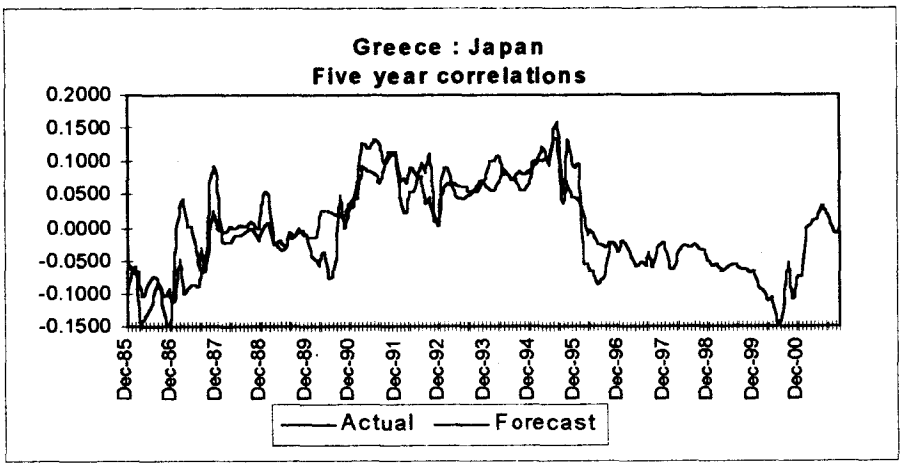
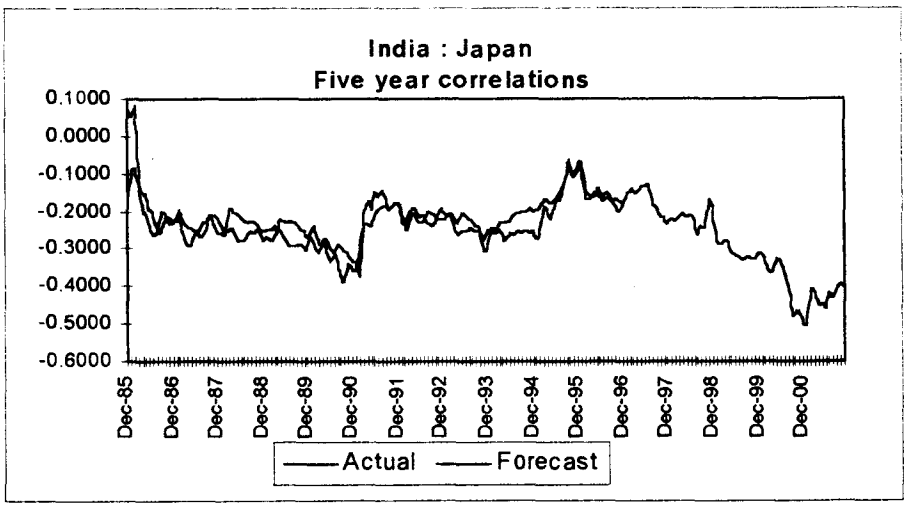
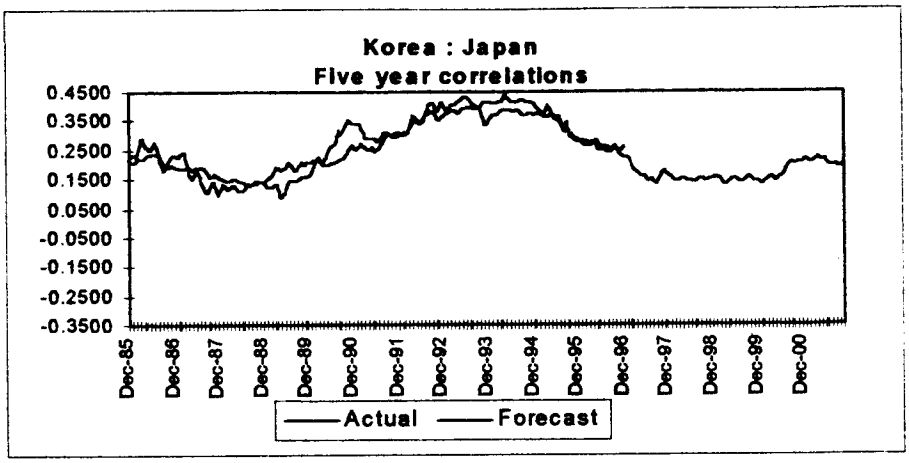
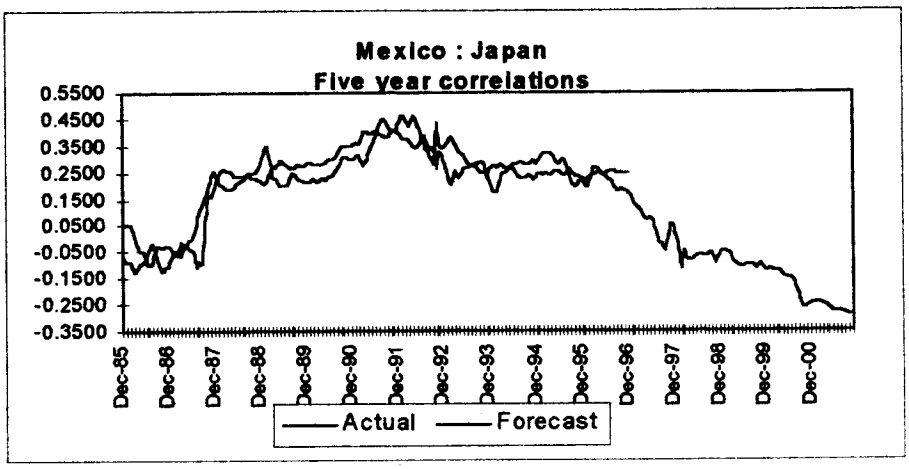
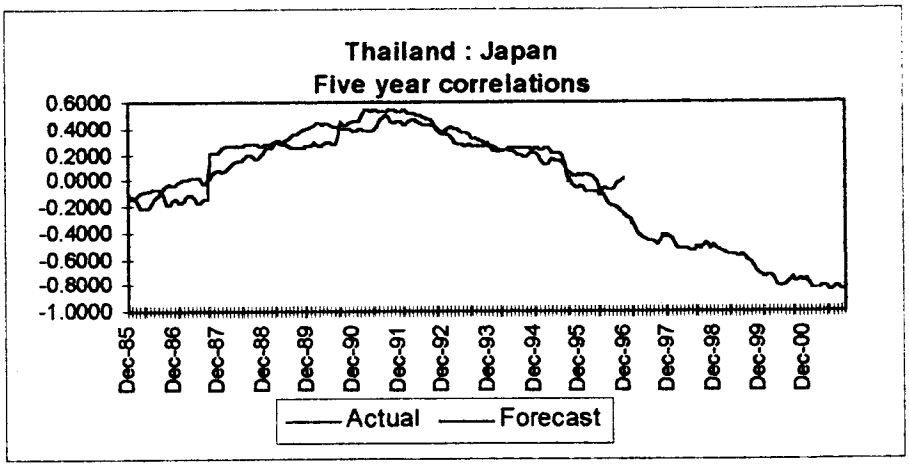
0.2500
0.2000
0.1500
0.1000
0.0500
0.0000
-0.0500
-0.1000
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast

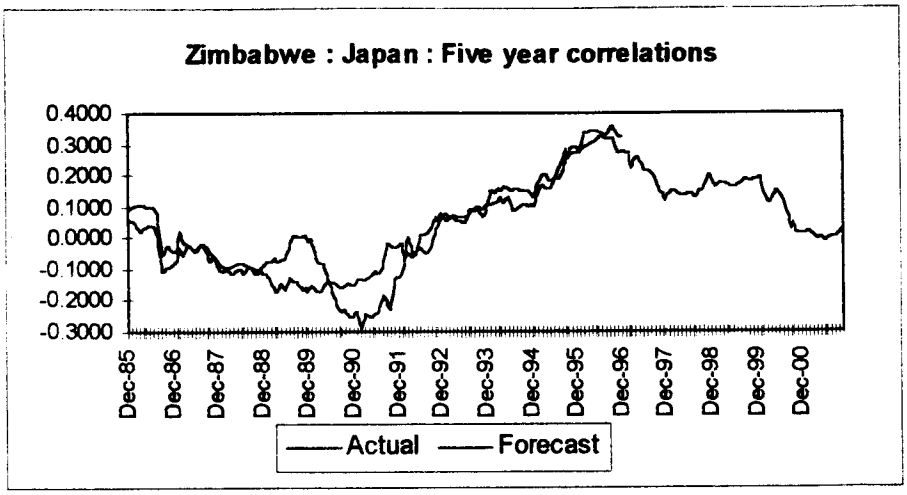

Greece : Japan
Five year correlations
0.2000
0.1500
0.1000
0.0500
0.0000
-0.0500
-0.1000
-0.1500
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast


India : Japan
Five year correlations
0.1000
0.0000
-0.1000
-0.2000
-0.3000
-0.4000
-0.5000
-0.6000
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast

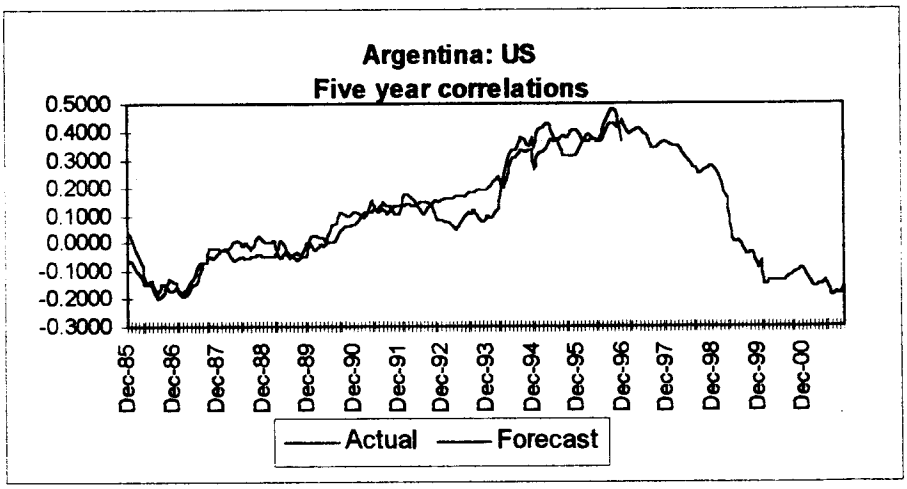

Korea : Japan
Five year correlations
0.4500
0.3500
0.2500
0.1500
0.0500
-0.0500
-0.1500
-0.2500
-0.3500
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast

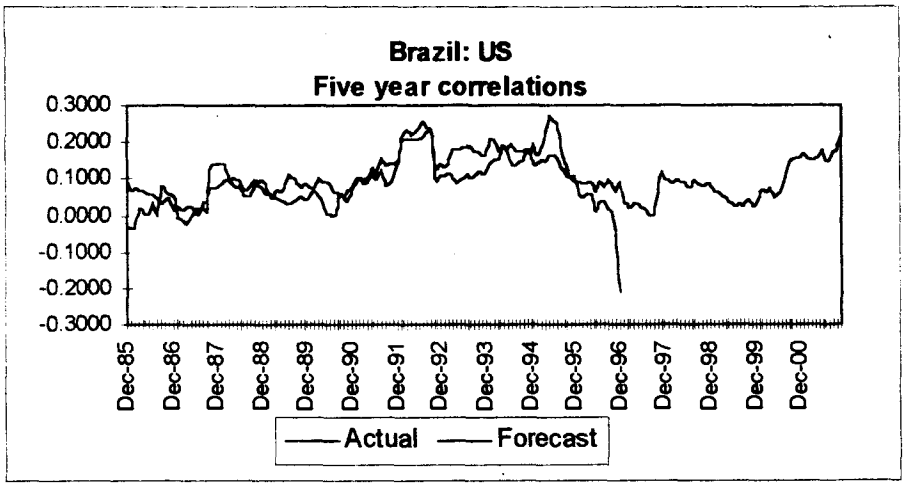

Mexico : Japan
Five year correlations
0.5500
0.4500
0.3500
0.2500
0.1500
0.0500
-0.0500
-0.1500
-0.2500
-0.3500
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast

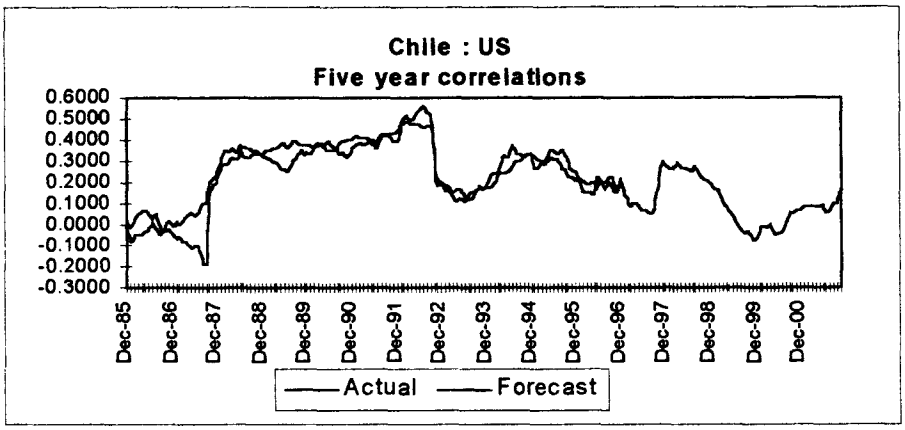

Thailand : Japan
Five year correlations
0.6000
0.4000
0.2000
0.0000
-0.2000
-0.4000
-0.6000
-0.8000
-1.0000
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast

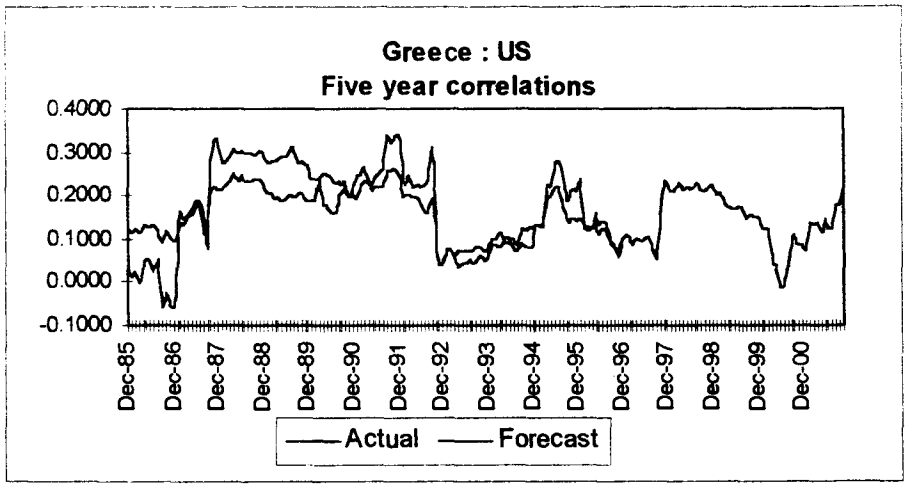


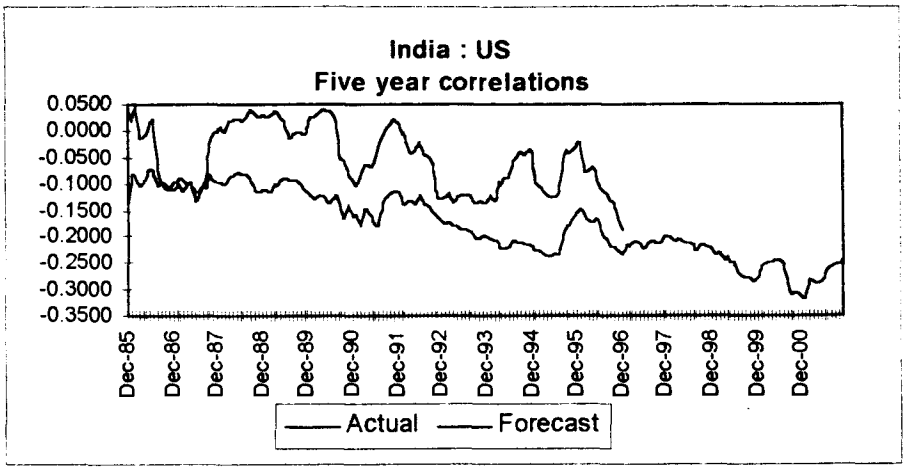
Fitted values and forecast correlations with US

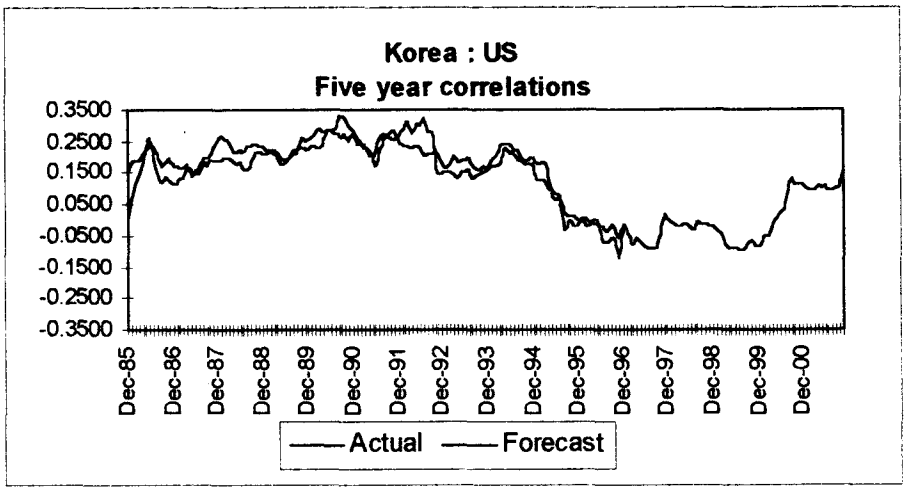


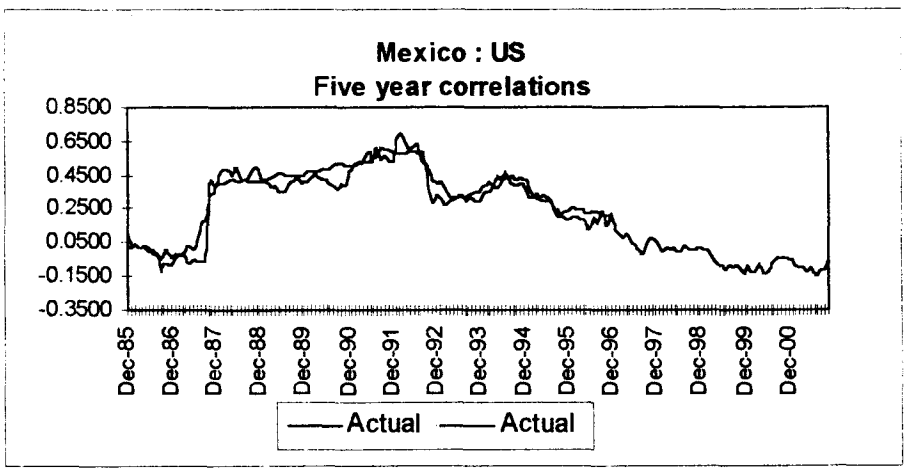

Brazil: US
Five year correlations
0.3000
0.2000
0.1000
0.0000
-0.1000
-0.2000
-0.3000
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast

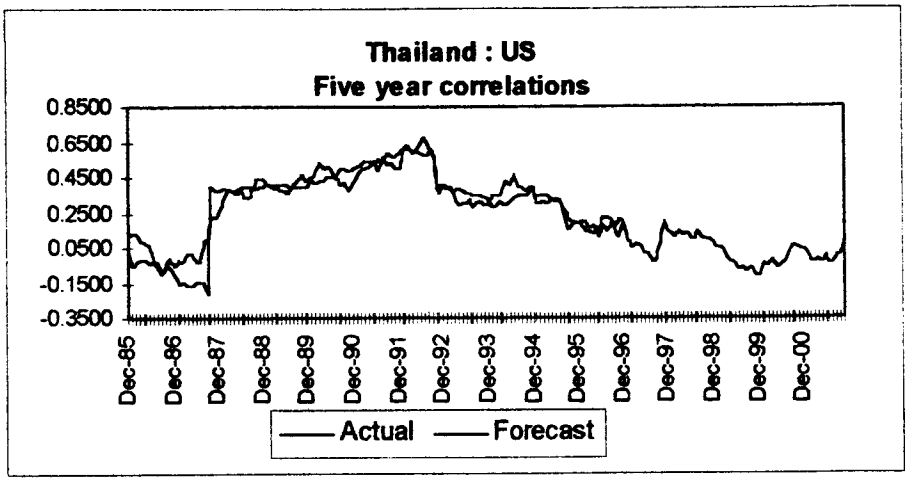

Chile : US
Five year correlations
0.6000
0.5000
0.4000
0.3000
0.2000
0.1000
0.0000
-0.1000
-0.2000
-0.3000
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast

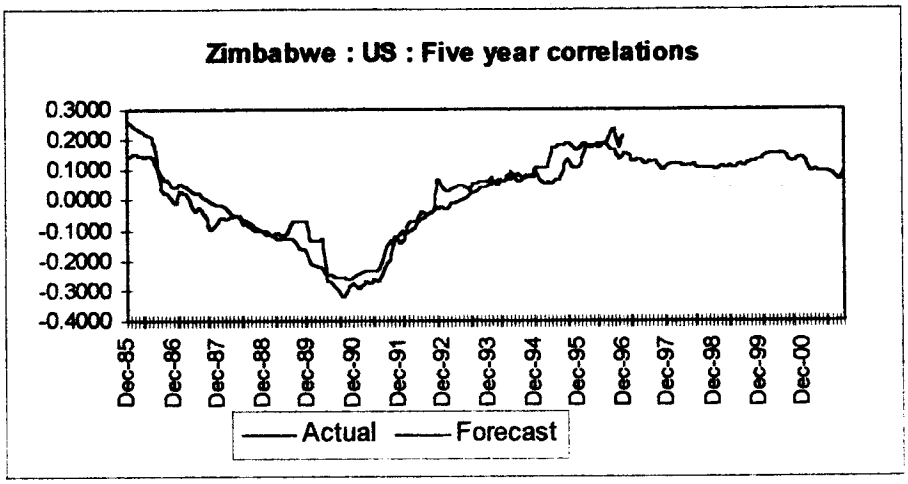

Greece : US
Five year correlations
0.4000
0.3000
0.2000
0.1000
0.0000
-0.1000
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast


India : US
Five year correlations
0.0500
0.0000
-0.0500
-0.1000
-0.1500
-0.2000
-0.2500
-0.3000
-0.3500
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast

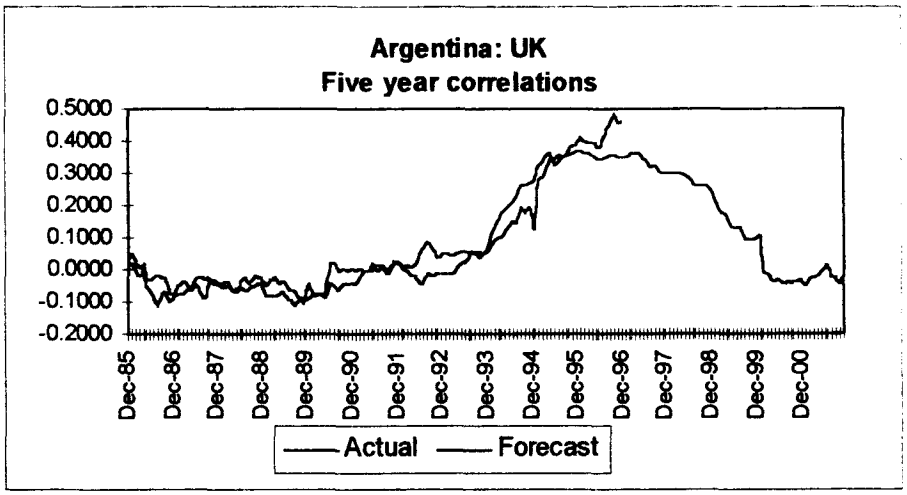

Korea : US
Five year correlations
0.3500
0.2500
0.1500
0.0500
-0.0500
-0.1500
-0.2500
-0.3500
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast

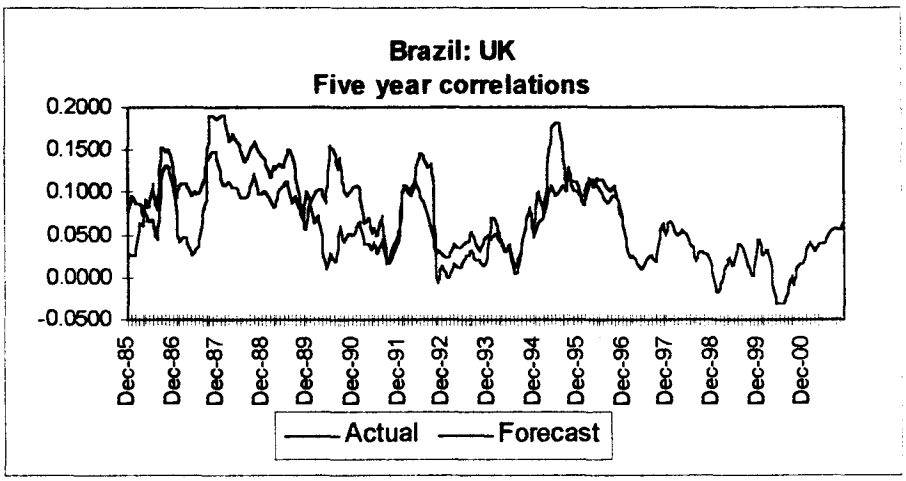

Mexico : US
Five year correlations
0.8500
0.6500
0.4500
0.2500
0.0500
-0.1500
-0.3500
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Actual

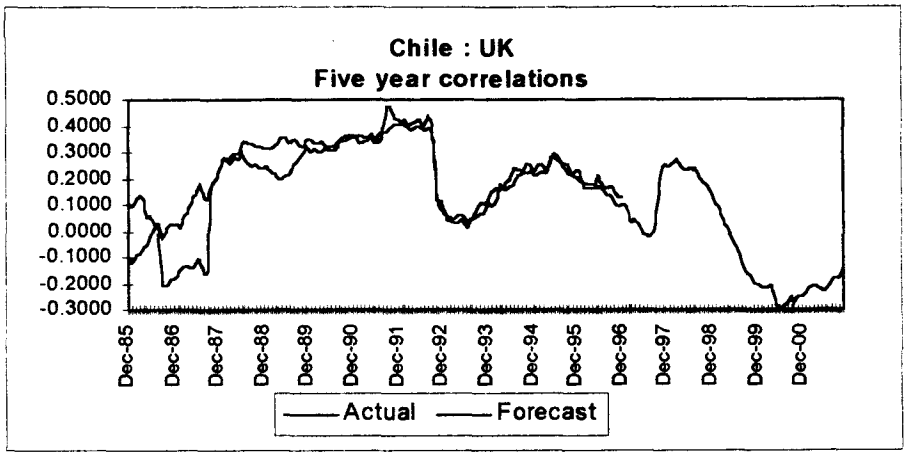

Thailand : US
Five year correlations
0.8500
0.6500
0.4500
0.2500
0.0500
-0.1500
-0.3500
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast

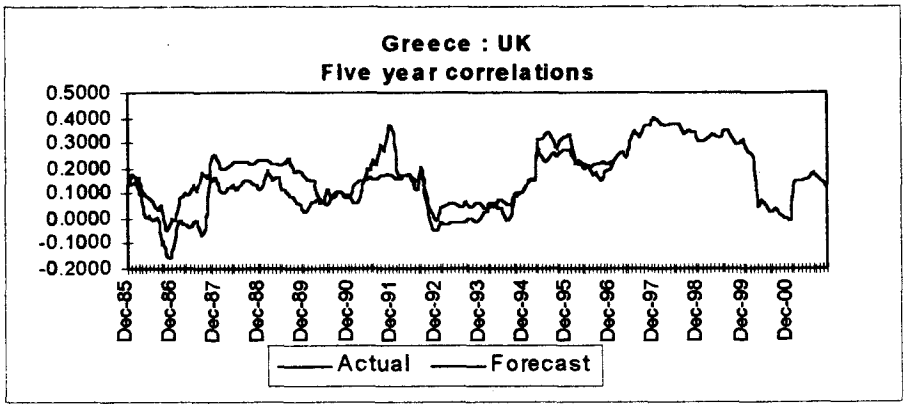

Zimbabwe : US : Five year correlations
0.3000
0.2000
0.1000
0.0000
-0.1000
-0.2000
-0.3000
-0.4000
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast

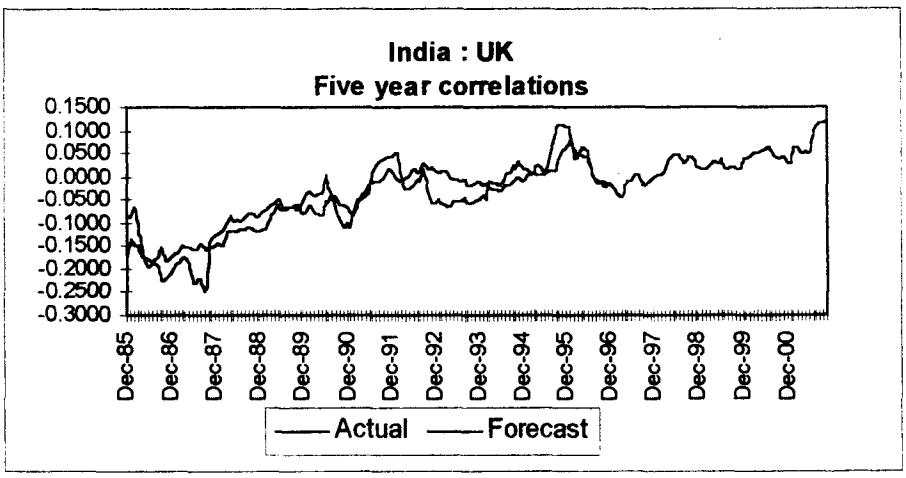
Fitted values and forecast correlations with UK

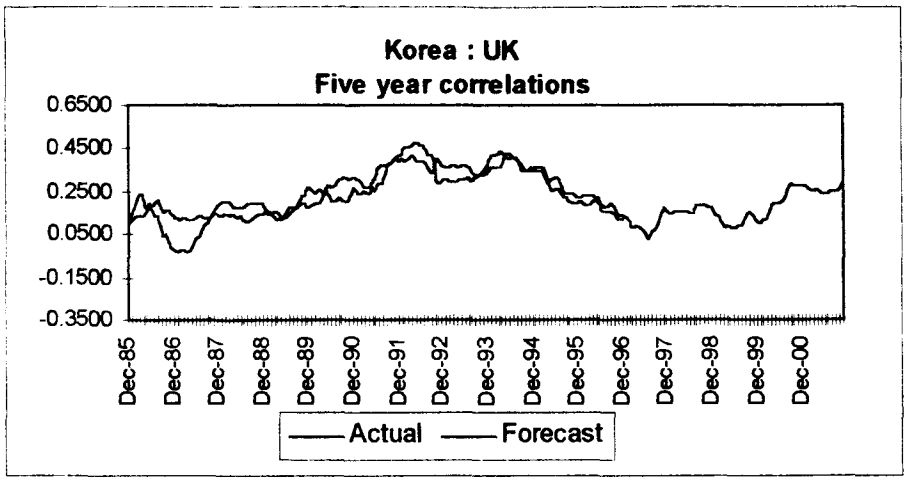


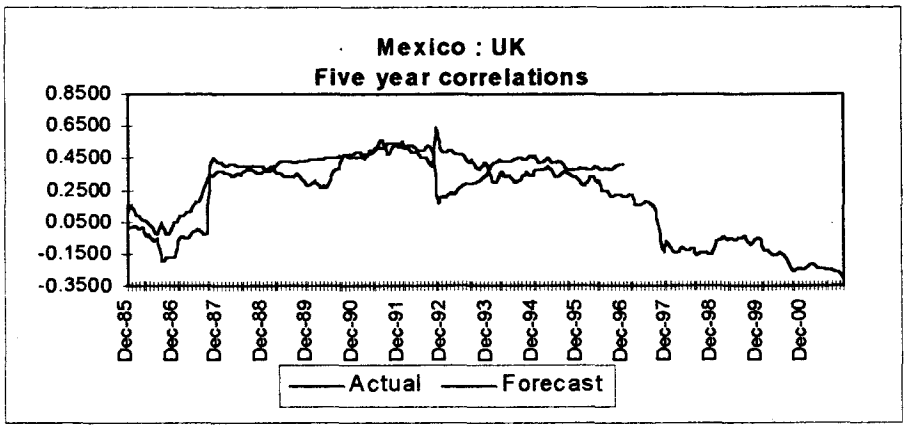


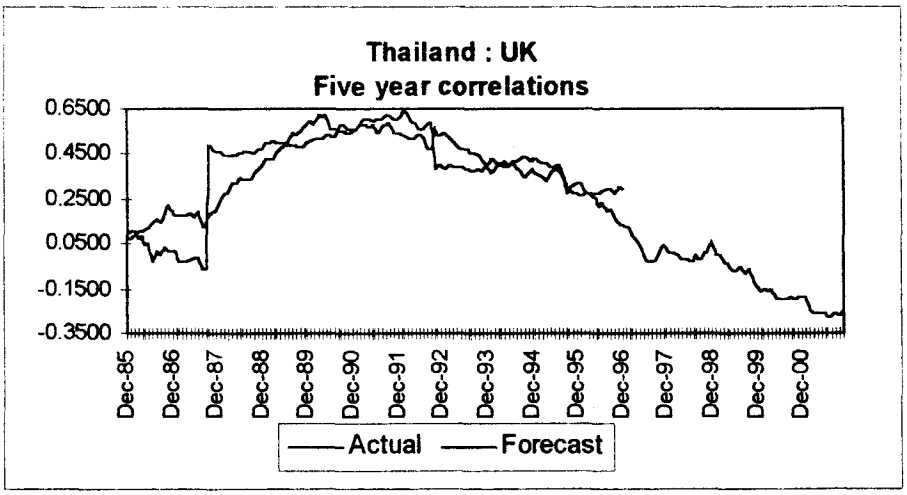

Chile : UK
Five year correlations
0.5000
0.4000
0.3000
0.2000
0.1000
0.0000
-0.1000
-0.2000
-0.3000
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast

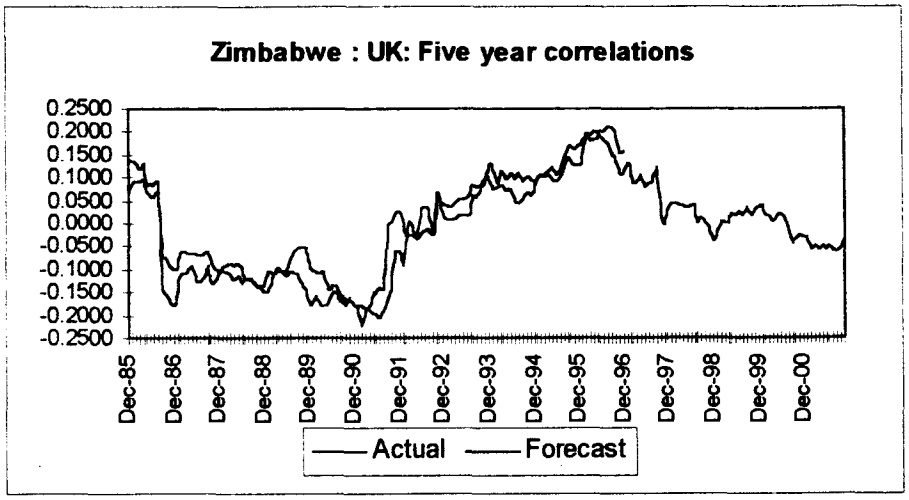

Greece : UK
Five year correlations
0.5000
0.4000
0.3000
0.2000
0.1000
0.0000
-0.1000
-0.2000
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast


India : UK
Five year correlations
0.1500
0.1000
0.0500
0.0000
-0.0500
-0.1000
-0.1500
-0.2000
-0.2500
-0.3000
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast


Korea : UK
Five year correlations
0.6500
0.4500
0.2500
0.0500
-0.1500
-0.3500
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast


Mexico : UK
Five year correlations
0.8500
0.6500
0.4500
0.2500
0.0500
-0.1500
-0.3500
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast


Thailand : UK
Five year correlations
0.6500
0.4500
0.2500
0.0500
-0.1500
-0.3500
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast


Zimbabwe : UK: Five year correlations
0.2500
0.2000
0.1500
0.1000
0.0500
0.0000
-0.0500
-0.1000
-0.1500
-0.2000
-0.2500
Dec-85
Dec-86
Dec-87
Dec-88
Dec-89
Dec-90
Dec-91
Dec-92
Dec-93
Dec-94
Dec-95
Dec-96
Dec-97
Dec-98
Dec-99
Dec-00
Actual
Forecast

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