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Stock return volatility in emerging equity markets: The relative effects of country and global factors

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STOCK RETURN VOLATILITY IN EMERGING EQUITY MARKETS:

THE RELATIVE EFFECTS OF COUNTRY AND GLOBAL FACTORS

A Dissertation

By

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ABSTRACT

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The rapid growth of capital markets in developing countries has come as a major event in recent financial history. According to the International Finance Corporation (IFC), portfolio flows to emerging countries has kept rising since the early 1980s and the trend has continued even after a number of financial crises (IFC, 2000). Probably one of the most commonly known characteristics of these markets is their high volatility compared to the more developed markets. But results of studies on volatilities in these markets are often based on estimates of the variance of market indexes or asset returns over relatively long periods with little attention given to the fundamentals driving the estimates. This dissertation investigates whether key macroeconomic indicators like exchange rates, interest rates, industrial production and money supply in each country are related to stock return volatility. The MSCI world index and the U.S. 3-month T-Bill are also included to proxy the effects of global variables and to better understand the determinants or causes of stock return volatility.

It has been suggested in the finance literature that stock markets in emerging and developed countries are sensitive to macroeconomic news, and financial market participants tend to follow closely governments' release of economic data and

announcements of policy changes. However, there exists a large gap in the empirical identification of the macroeconomic variables affecting volatility and the few studies that document such relationships have typically focused on developed markets.

Using exponential GARCH and vector autoregressive (VAR) models, this dissertation investigates the relationship and contributes to the literature in three different ways. First it investigates whether the mean effects and volatility shocks of macroeconomic variables are transmitted to emerging stock markets. Second, it investigates whether the relative effects of country and global macroeconomic factors are different in explaining volatility of expected returns in these countries. Lastly, the dissertation investigates whether macroeconomic shocks have any significant asymmetric effects on the return volatility.

The empirical results show that the shocks from both the country and global factors are transmitted to the markets at varying magnitudes. There are differences across countries in terms of the significance of domestic macroeconomic variables as determinants of mean stock returns and volatility. The differences in the response of the different markets are consistent with the underlying economic environment in each country as well as the trade and financial links with the rest of the world. The empirical results also show that the stock markets in these countries react asymmetrically to volatility shocks from macroeconomic variables, and thus suggest evidence of the "leverage effect" found in other studies. These findings may have important implications for decision-making by investors and national policymakers.

Unlike previous studies that attribute market volatility to irrational behavior of investors, this dissertation finds that macroeconomic variables are very important in

explaining market volatility. International investors can therefore improve their portfolio performance by considering the stability in economic fundamentals as determinants of stock market volatility. Policymakers can concentrate their efforts to attain stability in economic fundamentals in order to reduce volatility and minimize investor uncertainty. Both domestic and external factors are important and should be given attention by investors and policymakers. Also, investors and policy makers should be sensitive to the asymmetric ripple effects of volatility in these markets.

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The successful completion of this dissertation is a proud accomplishment for a great family. My father, Abugri Banaba and mother, Mariama Mumuni are greatly honored for all the support they have given me as their son. And I wish to acknowledge with love and gratitude the unflinching support my wife Irene Abugri has given me over the years. The birth of our beautiful daughter, Mariam has brought joy and encouragement for the attainment of this goal.

Lastly, I feel that my understanding of finance theory and practice as well as emerging stock markets has been broadened and deepened as a result of this great accomplishment.

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CHAPTER 1

INTRODUCTION

The rapid growth of capital markets in emerging countries has come as a major event in recent financial history. According to the International Finance Corporation (IFC), portfolio flows to emerging countries has kept rising since the early 1980s and the trend has continued even after a number of financial crises (IFC, 2000). The stock markets in these countries have also grown considerably in size. The aggregate market capitalization of the countries classified by the IFC as emerging markets rose from US$488 billion in 1988 to US$3073 billion in 1999. Trading on these markets also rose in similar magnitude, growing from US$411 billion to US$2873 billion in that period (IFC, 2000).

The revival of these emerging financial markets, after the debt crisis of the early 1980s, the Mexican peso and Asian financial crisis of the 1990s, present new challenges to practitioners, policy makers and researchers in the finance discipline. These markets are characterized as having very high levels of volatility in their returns as compared to those in the more developed markets (Aggarwal *et al.*, 1999). But results of studies on volatilities in these markets are often based on estimates of the variance of market index returns over relatively long periods, with little attention given to the fundamentals driving the estimates. Such estimates of volatilities are of little use to investors, because they do not question its determinants. This dissertation investigate whether some evidence can be

drawn from key macroeconomic indicators like exchange rates, interest rates, industrial production and money supply in each country to better understand the determinants or causes of stock return volatility. The U.S. 3-month T-bill and Morgan Stanley capital International (MSCI) world index are included to capture the relative effects of global variables.

According to finance theory, asset prices should be formed in the long run in a way that reflects economically justifiable rates of return. Therefore, investigating how macroeconomic variables affect stock prices is important to avoid disruptions in financial markets. While emerging stock markets tend to be relatively marginal in the whole process of financial intermediation, the devastating effects of a market crash on an economy can be serious given their increasingly important role for attracting foreign capital. Similar to the developed markets, it has been suggested in the finance literature that emerging stock markets are sensitive to macroeconomic news. Also, financial market participants tend to follow closely governments' release of economic data and announcements of policy changes. Such market behavior is consistent with standard finance theories that suggest that the rate of return on an asset is determined by systematic economic news and that no extra reward can be earned for diversifiable risk. However, there exist a large gap in the empirical identification of the macroeconomic variables determining stock market volatility and the few studies that document any relationship have typically focused on developed markets.

The empirical results are mixed in the stock markets' responsiveness to macroeconomic news releases. For the U.S., Cutler, Poterba and Summers (1989) found that in most cases the information cited by the press as causing market movements were

in fact quite unimportant. Their findings reinforced by those of earlier studies that conclude that there is little evidence to suggest that the stock market responds to macroeconomic news other than monetary information (Schwert, 1981; Pearce and Roley, 1983; and Hardouvelis, 1987). Also, Poon and Taylor (1991) provide empirical evidence that various macroeconomic factors do not influence stock market pricing in the U.K. However, other studies in the U.K. distinguishing the relative importance of macroeconomic announcements have invariably established retail price index (RPI) releases to be important (Joyce and Read, 1999). Goodhart and Smith (1985) and Gwilym *et. al.* (1998) found the FTSE100 to be sensitive to the retail price index (RPI) and production price index (PPI) data. Of the U.S. news, Becker *et al.* (1995) stated that PPI, merchandise trade, non-farm payrolls and the CPI were influential.

Aitken (1996) suggests that investors, lacking local knowledge about each individual country's fundamentals may treat these markets as if they belong to a unique class, thus failing to take advantage of existing arbitrage opportunities. So empirically establishing the effects of macroeconomic shocks on the stock markets can provide some insights into the current debate as well as provide investors with vital information for risk management and asset pricing. Moreover, some researchers argue that macroeconomic variables may be used to find securities that are systematically undervalued (Lakonishok et al., 1994; Haugen and Barker, 1996), while others argue that the measures are proxies for exposure to underlying economic risk factors (Fama and French, 1993). It is not possible to distinguish between these views without explicitly modeling the relation between such attributes and risk factors (Ferson and Harvey, 1998). In addition, the predictability of volatility is important in designing optimal asset allocation decisions as

well as dynamic hedging strategies for options and futures (Baillie and Myers, 1991). Therefore understanding the fundamentals underlying volatility is also important for the valuation of stocks and their corresponding derivative products in these markets.

Specifically, the study investigates the following questions regarding the relationship between macroeconomic factors and stock returns in emerging equity markets. First, are the mean effects and volatility shocks of macroeconomic variables transmitted to stock markets in emerging markets, and if so, are the shocks persistent. The presence of persistence in volatility clustering may signify inefficiency of the market, and provide the possibility of arbitrage. Second, how different are the relative effects of country and global macroeconomic factors in explaining volatility of expected returns in these markets. The third question investigates whether macroeconomic shocks have any significant asymmetric effects on the returns volatility of these markets? Ross (1989) points out that volatility is directly linked to the rate of information flow. Hence, positive and negative macroeconomic shocks may be transmitted differently.

These questions are important for both domestic and foreign investors in terms of risk management and portfolio diversification strategies for many reasons. First, the accurate measurement of the volatility of financial data is important because economic agents make decisions based on the perceptions that high levels of volatility tend to cause the general erosion of investors' confidence and a flow of capital away from the stock markets (Schwert, 1989a, b; Ballie and DeGennaro, 1990). Second, answers to these questions may be important for decision-making by national policy makers as well as our understanding of how such decisions affect the stock markets in their respective countries. Analyzing specific macroeconomic fundamentals can also help us understand

the extent to which differences in the performance of the stock markets are justified by economic fundamentals.

Emerging Latin American stock markets are distinct from the developed markets and so have to be examined separately. In most Latin American markets, trading occurs in only a few stocks that account for a considerable part of the total market capitalization. Beyond these actively-traded shares, there are serious informational and disclosure deficiencies and supervision by regulatory authorities is often far from perfect. And despite the implementation of various structural adjustment programs in the past two decades, the countries still exhibit varying forms of macroeconomic instability thus making them ideal for investigating the effects of macroeconomic variables. Furthermore, the phenomenal growth of equity portfolio flows to these countries over the last few decades warrants an investigation on the dynamics of stock markets in the region.

Most previous studies have examined emerging markets by focusing exclusively on the impact of foreign macroeconomic shocks (Johnson and Jensen, 1993; Soydemir, 2000b) or focusing on developed markets alone (Ferson and Harvey, 1998). Other studies examining the returns volatility in emerging countries have focused on the transmission of shocks from one index to the other and made no empirical examination of macroeconomic variables (Aggarwal *et al.* 1999).

This study contributes to the existing literature by directly modeling the effects of specific macroeconomic variables on stock market returns. Bilson *et al.* (2001), is one of the few studies that has examined the effects of both domestic and foreign macroeconomic variables on emerging stock returns. But unlike their study which concentrates on analyzing realized returns, this study looks at expected returns.

According to the authors the independent variables are expressed in the "raw" form and so the variables contain both expected and unexpected components. This makes the measurement of the surprise component (innovations) difficult and may limit our understanding of how news surprises affect the stock market. This study addresses that problem by including the standardized residuals of the independent variables to capture the effects of the unexpected component (innovations), and approach that is consistent with previous studies (Fama, 1990). The measurement of the surprise component and its effects are important for investors in their prediction of future stock returns and management of portfolio risk. Moreover, the current study also investigates the asymmetric effects of macroeconomic shocks and their persistence, questions not examined by Bilson *et al.* (2001). Previous studies have implicitly assumed that the effects of positive and negative macroeconomic shocks are symmetric. This dissertation questions the validity of that assumption and seeks to empirically investigate the issue further.

Other studies that have examined the relationship between local macroeconomic variables and stock returns in emerging equity markets have done so by looking at individual markets (e.g. Phillipines-Bailey and Chung, 1996; Zimbabwe-Oyama, 1997). But despite their examination of macroeconomic variables, none of these studies has simultaneously modeled the effects of country and global factors. The dissertation addresses these shortcomings in the literature by investigating the research questions highlighted above.

CHAPTER 2

LITERATURE REVIEW

A fundamental relationship documented and often used in the finance literature is the negative association between stock prices and volatility of returns. A simple mean-variance intuition tells us that the rational investor would be willing to pay a lower price to a claim that is uncertain against a sure claim. While this is an intuitively appealing explanation for the well known inverse relation between volatility and stock prices, at the macro or aggregate level it is difficult to explain this inverse relation without a clear understanding of the effects of macroeconomic factors on the volatility of returns. The use of such factors can be motivated by the international version of the Ross (1976) Arbitrage Pricing Model (e.g. Ross and Walsh, 1973) or the Merton (1973) intertemporal asset-pricing model.

This chapter reviews the literature regarding the relationship between macroeconomic factors and the returns and volatility of stock markets. The chapter is divided into three sections. The first section presents the literature on empirical studies involving the relative effects of country and global factors. The second part details the general lack of empirical research on whether there exist asymmetric effects of macroeconomic variables. The third part of the chapter presents literature on the growing

interest in the link between portfolio capital flows and the dynamics of asset price volatilities in emerging stock markets.

Relative Effects of Country and Global Factors

Integrated Markets Approach

Studies on the link between macroeconomic variables and stock returns can be broadly grouped into three strands based on the level of market integration. The first strand promotes the view that markets are generally integrated and so global factors are more important in explaining returns volatility than country factors. Most of the studies that emphasize the role of global factors have modeled returns as a linear function of global risk factors (Ferson and Harvey, 1994a; Dumas and Solnik, 1995; Harvey, 1995a). A list of the most popular factors examined in the integrated market approach includes industrial production, unexpected inflation, change in expected inflation, real interest rates, term structure risk and price of crude oil. Ferson and Harvey (1993a, 1993b) examined all these variables, measured as global aggregates, as potential risk factors for global asset pricing models. Based on a cross section of average returns for developed countries, Ferson and Harvey (1994a) found that only the world stock market index and exchange risk factors had statistically significant unconditional risk premiums. And based on conditional returns, Ferson and Harvey (1993) found that most of the predictability in the returns over time is related to the world index.

Ferson and Harvey (1994a)

Purpose of study

Ferson and Harvey (1994a) investigate the source of risk and average returns in eighteen national equity markets. The risk factors are chosen to measure global economic

risk. The monthly risk measures used in the study include the returns on a world equity market portfolio, a measure of exchange risk, a Eurodollar – U.S. Treasury bill yield spread, and measures of global inflation, real interest rates, and industrial production growth.

Methodology

The study estimates factor model regressions for the equity market index for eighteen countries. Most of the empirical models are estimated using Hansen's (1982) generalized method of moments (GMM), which is valid under mild statistical assumptions. In order to apply a beta pricing model in a global setting, the national equity markets are assumed to perfectly integrated in a global economy, with no barriers to extranational equity investments, no taxes, no transactions or information cost.

Findings

The study finds significant premiums associated with the world equity index and a measure of exchange rate fluctuations, but no significant average premium associated with the other variables.

Critique

The study assumes that the national equity markets examined are perfectly integrated in a global economy, with no barriers to extranational equity investments, no taxes, no transaction or information cost (Ferson and Harvey, 1994a). Such extreme assumptions are unlikely to provide a good approximation to the actual complexity of international investments. The authors suggest that further refinement of the models, to incorporate additional considerations should produce even better explanatory power, and remain an important topic for future research.

Dumas and Solnik (1995)

Purpose of study

The study investigates whether exchange rate risks are priced in international asset markets using a conditional approach that allows for time variation in the rewards for exchange rate risk.

Methodology

They estimate two asset-pricing models (APM). First, an "international" APM that contains additional terms to reward exchange-rate risk, and second, a "classic" APM that does not contain such terms and in which there is only one risk premium based on the covariance of the asset return with the market portfolio. The main goal of the study is to discriminate empirically between the two models and to test the null hypothesis that exchange-rate risk receives a zero price, against the international APM.

Findings

The results for equities and currencies of four developed countries support the existence of foreign exchange risk premia in international financial markets, and that the international APM dominates the classic APM.

Critique

The major shortcoming of the APM model is that it does not provide any guidance as to the choice of instrumental variables. APMs are partial-equilibrium models reflecting equilibrium in the financial market only. The link with the underlying physical and monetary variables is left unspecified. General-equilibrium models would make that link explicit and would in this respect be preferable.

Harvey (1995a)

Purpose of study

This is probably one of the few studies that test the relationship between returns in emerging stock markets and a set of global variables.

Methodology

The study examines a conditional asset-pricing model where the expected returns from emerging stock markets are a function of global variables. The global variables used by Harvey include world inflation, world GDP, world oil prices and trade-weighted world exchange rate.

Findings

Results of the study suggest that standard global asset pricing models, which assume complete integration of capital markets, fails to explain the cross section of average returns in emerging markets. A consequence of the segmented nature of these markets is that local information has increased importance (Harvey, 1995b), and this feature potentially allows an international investor to enhance the mean-variance efficiency of their portfolio (Errunza, 1977). However, the diversification benefits will be greatest when the factors driving return variation are uncorrelated across markets. Furthermore, his findings on predictability of the returns reveals that emerging market returns are more likely than developed countries to be affected by local information.

Critique

But the weakness of this conclusion is that local macroeconomic variables were not explicitly examined.

Some of the studies that have examined the role of global risk factors on the stock returns of emerging markets have implicitly or explicitly emphasized the relevance of market integration and/or linkages in their analysis.

Pagan and Soydemir (2001)

Purpose of study

They investigate whether the stock markets of Brazil, Argentina and Chile react differently to positive as opposed to negative shocks in the returns of the Mexican equity market.

Methodology

Unlike previous studies that adopt a univariate approach, their study uses a bivariate vector autoregressive (VAR) model to investigate the possibilities of response anomalies in equity market dynamics for Argentina, Brazil, Chile and Mexico. They argue that one advantage of the VAR model is that it does not impose a priori restrictions on the system of equations and allows for artificial shocks to be introduced in the system. Based on the VAR model estimates, the authors construct impulse response functions to investigate the postulated response of the dependent variable to a one standard deviation shock to another variable in the system.

Findings

The study establishes statistically significant asymmetries in the responses of Argentina, Brazil and Chile to changes in the Mexican equity market – with responses to downturns much outweighing upturns in the equity markets of Mexico. They argued that from a policy perspective, a better understanding of such causal relationships can have important implications at the time of conducting monetary policy to achieve stability in

financial markets or when implementing regulatory reforms. Asymmetric responses might exist as a result of unidentified risk dimensions that are nonetheless priced by investors in these markets (Fama and French, 1992).

Critique

A possible shortcoming of the study is that it only focuses on identifying the presence of asymmetries in the transmission of the Mexican shocks but does not assess the possible sources of these responses.

Soydemir (2000a)

Purpose of study

Examines the interdependence between the stock markets in industrial economies and emerging market economies.

Methodology

The study investigates transmission patterns of stock market movements between developed and emerging market economies by estimating a four-variable vector autoregressive (VAR) model and constructing impulse response functions from the VAR model. According to Runkle (1987), reporting the variance decompositions (VDCs) and impulse response functions (IRFs) without confidence intervals is equivalent to reporting regression coefficients without t-statistics. The study uses Monte Carlo methods to specify confidence bands around impulse response functions and variance decompositions for statistical inference.

Findings

The results of the impulse response functions and variance decompositions show that significant links exist between stock markets of the U.S. and Mexico and weaker

links between the stock markets of the U.S., Argentina and Brazil. The results also indicate that no single emerging market can affect the US stock market, however, the combined effect of emerging markets on the US Stock market is significant. Overall, the findings suggest that the transmission of stock market movements is in accord with underlying economic fundamentals rather than irrational contagion effects.

Critique

The main weakness of this study is that the VAR model and impulse response functions are estimated using stock return indices. The effects of macroeconomic variables are not drawn from the model but from trade links shown on tables.

Soydemir (2000b)

Purpose of study

This analyzes the impact of the movements in the U.S. 3-months Treasury bill yields on Latin American equity market returns prior to Mexican financial crisis.

Methodology

The study estimates a vector autoregressive (VAR) model using weekly stock market indices for Argentina, Brazil, Chile, Colombia, Mexico and Venezuela and the U.S. 3-months Treasury bills yield. The VAR specification is particularly useful when trying to understand empirical regularities embedded in time-series data when correct specification is difficult. The impulse response functions constructed from the VAR model essentially show the response of the dependent variable to a one-standard-deviation shock to another variable in the system and can be thought of as a type of dynamic multiplier.

Findings

The results of the study show a strong and immediate negative effect of T-Bills yield on the U.S. equity market returns but a slow and varying impact on stock markets of Mexico, Argentina, Brazil, Venezuela and Columbia.

Critique

The estimated model focuses on the impact of the U.S. Treasury bill on the Latin American markets, without controlling for domestic macroeconomic shocks in each country.

Market Liberalization and the Integrated Market Approach

Some researchers have used financial market liberalization dates in emerging countries to proxy the effects of global factors (Bekaert, 1995; Bekaert and Harvey, 1997a; DeSantis and Imrohoroglu, 1997). It is argued that more liberalized markets are likely to be impacted more by global factors than local factors.

Bekaert and Harvey (1997a)

Purpose of study

This study uses liberalization dates to examine the behavior of volatility in emerging countries. The time-series and cross-sectional models analyze the reasons that volatility is different across emerging markets, particularly with respect to the timing of capital market reforms.

Methodology

They estimate a world factor model of conditional variances using the generalized autoregressive conditional heteroscedasticity or GARCH(1,1) specification of Glosten, Jagannathan, and Runkle (1993). After studying the time-series properties of volatility,

they use the conditional variance estimates to analyze the cross-section of volatility. They also use the cross-sectional framework to investigate whether capital market liberalization policies affect volatility after controlling for other factors that might affect volatility.

Findings

The study finds that capital market liberalization often increase the correlation between local market returns and the world market but do not drive up local market volatility.

Critique

Liberalization dates may not be good proxies for measuring global shocks because it has been argued that markets can move from segmentation to integration and back (Bekaert and Harvey, 1995). So a market that is assumed to be integrated based on a given liberalization date may have reverted back into a segmented form. It has also been suggested that the effect of market liberalization seems to be gradual and probably results in a smooth adjustment rather than a shock (see Bekaert and Harvey, 1997b). Aggarwal et al. (1999) for example argue that none of the sudden change points in volatility for emerging countries in their study corresponds to the initiation of market liberalization policies.

DeSantis and Imrohoroglu (1997)

Purpose of study

Using liberalization dates in emerging markets, they investigate whether investors can successfully predict future changes in volatility and whether they are rewarded with higher expected returns for being exposed to a higher level of anticipated risk.

Methodology

The study models conditional second moments using variations of the GARCH process originally proposed by Bollerslev (1986). The estimation proceeds in three steps. First, a model assuming full market segmentation while allowing for time-varying volatility is estimated. In this scenario, they test whether investors can successfully predict future changes in volatility and, most important, if they are rewarded with higher expected returns for being exposed to a higher level of anticipated risk. Second, they relax the assumption of full segmentation and analyze a number of models that assume different degrees of market integration. Finally, they evaluate the claim that liberalization is not necessarily beneficial for many developing countries, because it may increase the volatility of their financial markets.

Findings

They find clustering, predictability and persistence in conditional volatility. They also find that exposure to high country-specific risk does not appear to be rewarded with higher expected returns. Their study does not find evidence to support the claim that market liberalization increases price volatility.

Critique

Using liberalization dates to proxy global effects may have some weaknesses. First, the question of what constitutes a liberalization date has not been adequately answered in the literature. Second, the assumption that the process of integration into the world economy is irreversible (DeSantis and Imrohoroglu, 1997) is quite weak. There is evidence that the economies of countries can switch between varying levels of segmentation and integration (see for example, Bekaert and Harvey, 1995).

Segmented Market Approach

The proponents of complete market segmentation highlight the overriding role of domestic macroeconomic variables in their investigation of return volatility. Most of these studies are predominantly focused on developed markets (Chen et al., 1986; Fama; 1990; Jorion, 1991; Ely and Robinson, 1997). It has been argued that in less integrated markets, correlation with the world portfolio is typically weaker, and according to Harvey (1998, 2000), only local market variance explains the cross-section in emerging markets.

Chen, Roll and Ross (1986)

Purpose of study

Chen, Roll and Ross (1986), examine the question whether innovations in macroeconomic variables are risks that are rewarded in the stock market and model equity returns as functions of macro variables and non equity asset returns.

Methodology

The assets exposure to the economic state variables is estimated by regressing returns on the unanticipated changes in the economic variables; inflation, treasury bill rate, government bonds, per capita consumption, industrial production, low grade bonds, equities. Their study uses monthly series of data of the U.S. from past studies and the survey of current business cycles across different periods between 1953 and 1983.

Findings

The spread between long and short interest rates, expected and unexpected inflation, industrial production and the spread between high and low grade bonds were found to systematically affect stock the market returns. Unlike the focus of my dissertation, emerging markets, this study concentrated on a developed country.

Critique

A major weakness of the study is the implicit assumption that the U.S. economy is insulated from global shocks and so the absence of global factors in the model.

Fama (1990)

Purpose of study

The study determines the extent to which variations in expected cash flows and changes in discount rates can explain the stock return variation in the U.S. market. The paper argues that measuring the total return variation explained by shocks to expected cash flows, time-varying expected returns, and shocks to expected returns is one way to judge the rationality of stock prices.

Methodology

The empirical investigation involves estimation of regression equations to determine the relationship between stock returns and the variables that are proxies for changing expected returns, shocks to expected returns, and changing investors' expectations about future cash flows.

Findings

The study finds that U.S. stock returns and its aggregate real activity are correlated. The test suggest that a large fraction of the variation of stock returns can be explained primarily by time varying expected return and forecasts of real activity.

Critique

One weakness of the study is that the variables used to explain returns are chosen largely on the basis of goodness-of-fit rather than the directives of a well-developed theory. The author recognizes this problem and points out that it seems most unlikely that

a single macro-variable, production, captures all variation in returns due to information about future cash flows.

Ely and Robinson (1997),

Purpose of study

This study explores the international evidence on the relationship between stock prices and goods prices; to test if stocks maintain their value relative to goods prices and whether these response patterns depend on the source of inflation shocks.

Methodology

Using quarterly data for 16 industrial countries the study estimates a vector error correction (VEC) model by including three measures of goods prices (gross domestic product, consumer price index, producer price index) and money supply. They argued that past models were not structured to incorporate any long run relationships that might be present in equities and goods prices, hence, the decision to use a VEC model.

Findings

It concludes that stocks do maintain their value relative to movements in overall price indexes and this conclusion generally does not depend on whether the source of the inflation shock is from the real or monetary sector.

Critique

Contrary to the evidence that developed countries are integrated to some extent, the study assumes that there is no dynamic interaction between the domestic macroeconomic variables, global variables and the stock markets of the 16 developed countries examined.

Jorion (1991),

Purpose of study

Jorion (1991), analyzes the pricing of foreign exchange risk in the stock market by empirically measuring whether currency exposure commands a risk premium in the stock market.

Methodology

The study estimates a two-factor and multifactor arbitrage pricing models using monthly macroeconomic data from the U.S. for variables like industrial production, expected and unexpected inflations, risk premium, term structure and exchange rate. The two-factor model includes the market and exchange rate, and can be interpreted as a test of the CAPM against the alternative that exchange rate factor is not diversifiable. The multifactor model extends the Chen, Roll, and Ross (1986) approach with six factors.

Findings

The study finds that the relation between stock returns and the value of the U.S. dollar systematically differ across industries. No evidence is found to support the view that exchange risk is priced in the stock market.

Critique

The empirical tests, as implemented in the estimation rest on the assumption that the price of exchange risk is constant through time. Whether the conclusions drawn from such an assumption can be related to the pricing of exchange risk in the stock market is an open question, because the evidence in the literature points to a varying price of risk depending on business cycles and other prevailing economic factors.

Partial Integration/Segmentation Approach

So far, none of the studies presented in the literature has found evidence supporting either perfect market integration or perfect market segmentation. Bilson et al. (2001) point out that the difference between the two approaches is driven by the assumptions about the level of integration.

Bilson et al. (2001)

Purpose of study

Bilson et al., investigate the extent to which macroeconomic variables are able to explain the variation in equity returns in emerging stock markets by analyzing whether local macroeconomic variables have explanatory power over stock returns in emerging markets.

Methodology

Their study uses a principal component approach to investigate the impact of local macroeconomic variables and a global factor on emerging market returns. The test in their study involved three steps. First, for each market, a number of variables are identified that are able to explain a 'significant' portion of return variation for that market. Second, a number of factors are extracted by principal component analysis (PCA). Third, the equity returns for each market are then regressed against these factors, and a test is performed to determine which factors the markets have similar sensitivities.

Findings

Some evidence is found to show that the local macroeconomic variables are significant in their association with emerging equity returns above that explained by the

world factor. The results indicate that ESMs show little sensitivity to the return on the world market index, consistent with the findings of Harvey (1995a).

Critique

Asset pricing models such as the APT employ the unexpected component (i.e. innovations) of the explanatory variables when modeling expected returns. However, Bilson et al. (2001) used independent variables expressed in the "raw" form. Thus, the variables contain both an expected and unexpected component. This makes the measurement of the effect of the news component of the variables difficult. They argue that given the large number of countries, it is not feasible to generate expectations for each variable in every market.

Bekaert and Harvey (1995)

Purpose of study

They propose a measure of capital market integration arising from a conditional regime-switching model. Their method allows for the degree of market integration to change through time. Authors argue that the disadvantage of models used in other studies is that they assume that the degree of segmentation is fixed through time.

Methodology

The model allows conditionally expected returns in any country to be affected by their covariance with a world benchmark portfolio and by the variance of the country returns using an ARCH-M model. In a perfectly integrated market, only the covariance counts. In the segmented markets, the variance is the relevant measure of market risk. The model is conditional in the sense that predetermined information is allowed to affect the expected returns, covariances, variances, and integration measure.

Findings

The study finds that a number of emerging markets exhibit time-varying integration. Some markets appear more integrated than one might expect based on prior knowledge of investment restrictions. Other markets appear segmented even though foreigners have relatively free access to their capital markets.

Aggarwal et al. (1999)

Purpose of study

Aggarwal et al., (1999) analyze the kind of events that cause large shifts in the volatility of emerging stock markets. The paper examines whether global or local events are more important in causing major shifts in emerging markets' volatility. The paper also investigates whether these events tend to be social, political, or economic.

Methodology

Using event studies, they determine when large changes in volatility of emerging stock markets returns occur and then examine global and local events during the periods of increased volatility. Their empirical approach uses an iterative cumulative sum of squares (ICSS) algorithm to identify the points of shocks/sudden changes in the variance of returns in each market and how long the shift lasted. Dummies are then introduced into the variance of a GARCH model to account for the sudden changes.

Findings

The paper concludes that the large changes in volatility in emerging countries seem to be related to important country-specific political, social and economic events. These events include the Mexican peso crisis, periods of hyperinflation in Latin America

and the Marcos-Aquino conflict in the Philippines. The 1987 crash is the only global event that causes a significant jump in the volatility of several emerging stock markets.

Critique

Although the study emphasizes the role of country-specific factors in its findings, no specific local macroeconomic variables are empirically examined.

One major shortcoming of conducting research at the two extremes is that capital markets have different levels of integration and evolve with the increasing trend towards globalization. At the one extreme of this evolving path are the more highly segmented frontier capital markets and at the other extreme are the more integrated developed markets. This dissertation argues that in between these two extremes are the emerging markets and so investigating the relative roles of country and global factors in that setting is in fact a joint test for market integration and segmentation.

Asymmetries in Stock Market response to Macroeconomic Shocks

In the case of emerging stock market returns and volatility, the role of economic news has gained importance, especially because of the volatile macroeconomic environment and economic reforms in those markets over the last two decades. However, it has been pointed out that researchers frequently assume that the influence of economic variables is symmetric (Gamkhar and Olson, 2001). Symmetry in the sense that a change in the economic variables will impact asset prices by an equal magnitude and of the same sign whether there is an increase or a decrease in the economic variable. In fact, the possibility of asymmetric adjustment of stock prices to macroeconomic shocks has received little attention. Interestingly, most studies assume that the sign or size of the

unexpected component in the macroeconomic news does not influence the resulting reaction of emerging stock market returns and volatility.

Brennan and Cao (1997)

Purpose of study

The study develops a model of international equity portfolio investment flows to test the implications of information asymmetry hypothesis for flows of portfolio investment between countries. Using data on U.S. equity portfolio flows, the differences in informational endowments between foreign and domestic investors are examined.

Methodology

The study uses a model that abstracts from barriers to investment, currency and political risk, deviations from purchasing power parity, and interest rate differentials in order to focus on the implications of information differences between foreigners and domestic residents. The model is a dynamic generalization of the noisy rational expectations model with the basic assumption that domestic investors are better informed about the payoffs on domestic markets than are foreign investors.

Findings

The findings are that while U.S. investors' purchase of equities in developed foreign markets tend to be positively associated with the foreign market return, foreign purchases of U.S. equities show no such relation to the U.S. market return. The authors argue that the finding is consistent with U.S. investors being less well informed about foreign markets than locals, but with foreigners being as well informed about U.S. markets as U.S. residents.

Critique

The model relies on very strong assumptions that may not be achieved in the real world. In the current global economy, financial institutions and pension funds perform a major portion of international portfolio investment, so the assumption that local investors have superior information may not be the case and it might seem that information asymmetry is much weaker.

Aggarwal and Schirm (1998)

Purpose of study

This is one of the few studies that have investigated the asymmetric impact of macroeconomic variables on stock returns. The study specifically examines the sensitivity of markets in equities, currencies, and debt instruments to information in trade balance announcements.

Methodology

Using regression equations, the study analyzes the impact of U.S. trade balance announcements on asset prices (equities and exchange rates). First, the market reaction to unexpected trade balance announcements is estimated, and second, the change in the asset price or yield is regressed on dummy variables representing positive and negative movements in the trade balance.

Findings

Significant asymmetric impact of information in trade balance on prices of assets is documented. They argue that the asymmetry in market response is consistent with the asymmetric nature of central bank intervention policy commitments.

Critique

The findings are based on the U.S. economy and one macroeconomic variable, so further investigation in other economic settings and controlling fro other factors may provide more insights.

Over the past several decades researchers have documented strong evidence that volatility is asymmetric in equity markets: negative returns are generally associated with upward revisions of the conditional volatility while positive returns are associated with smaller upward or even downward revisions of the conditional volatility (see, for example, Cox and Ross, 1976). The fact that volatility is an asymmetric function of past positive and negative innovations suggests that returns themselves may adjust asymmetrically to macroeconomic information (Koutmos, 1998).

There are a number of reasons why the stock return and volatility impact of news in macroeconomic variables can be expected to be asymmetrical (see for example, Aggarwal and Schirm 1998). First, asset price reaction to news has been documented to be asymmetric because of volatility feedback (Campbell and Hentschel, 1992). Volatility feedback can result in asymmetric asset price reactions even if the underlying shocks to the market have a normal distribution. As any news increases volatility, the positive asset price impact of good news is reduced, and the negative asset price impact any bad news enhanced, by the higher rate of return demanded by the higher expected volatility. Further, as documented in prior studies, asset price volatility is characterized by persistence and typically higher after asset prices fall than it is after they rise (Black, 1986; French et. al., 1987). Thus, the asset price responsiveness of negative news is

enhanced and that of positive news reduced by the negative effects of volatility on asset prices.

Second, asset price reaction to news has been seen to be asymmetric because of behavioral aspects of risk assessment such as framing and prospect theory (Patel et al., 1991). According to the prospect theory, monetary outcomes are viewed not in absolute terms but in terms of changes from a reference level such the status quo (framing), and the value function is steeper for losses than for gains (Kahneman and Tversky, 1986). Third, asset price reaction to news in the macroeconomic variables may be asymmetric because of how economic agents react to this type of news, given the state of the business cycle and anticipated government policy reactions.

CHAPTER 3

BACKGROUND OF MARKETS

This chapter presents the history and main characteristics of the stock markets in Argentina, Brazil, Chile and Mexico. First, the chapter describes the growth and development of stock markets of emerging countries in general and Latin America in particular. Second, the chapter also reviews the development of each of the four stock markets analyzed and their major characteristics.

Emerging Stock Markets

The International Finance Corporation (IFC) defines an "emerging market" as a stock market that is in transition, increasing in size, activity, or level of sophistication (IFC, 2000). In general, the IFC classifies a stock market as "emerging" if it meets at least one of two general criteria: (i) it is located in a low- or middle-income economy as defined by the World Bank, and (ii) its investable market capitalization is low relative to its most recent GNP figures. Stock markets that retain or introduce investment restrictions such as foreign limits, capital controls, extensive government involvement with listed companies, and other legislated restraints on activity, particularly on foreign investors, are generally considered emerging. According to the IFC, pervasive investment restrictions on foreign portfolio investment should not exist in developed stock markets, and their presence is a sign that the market is not yet "developed".

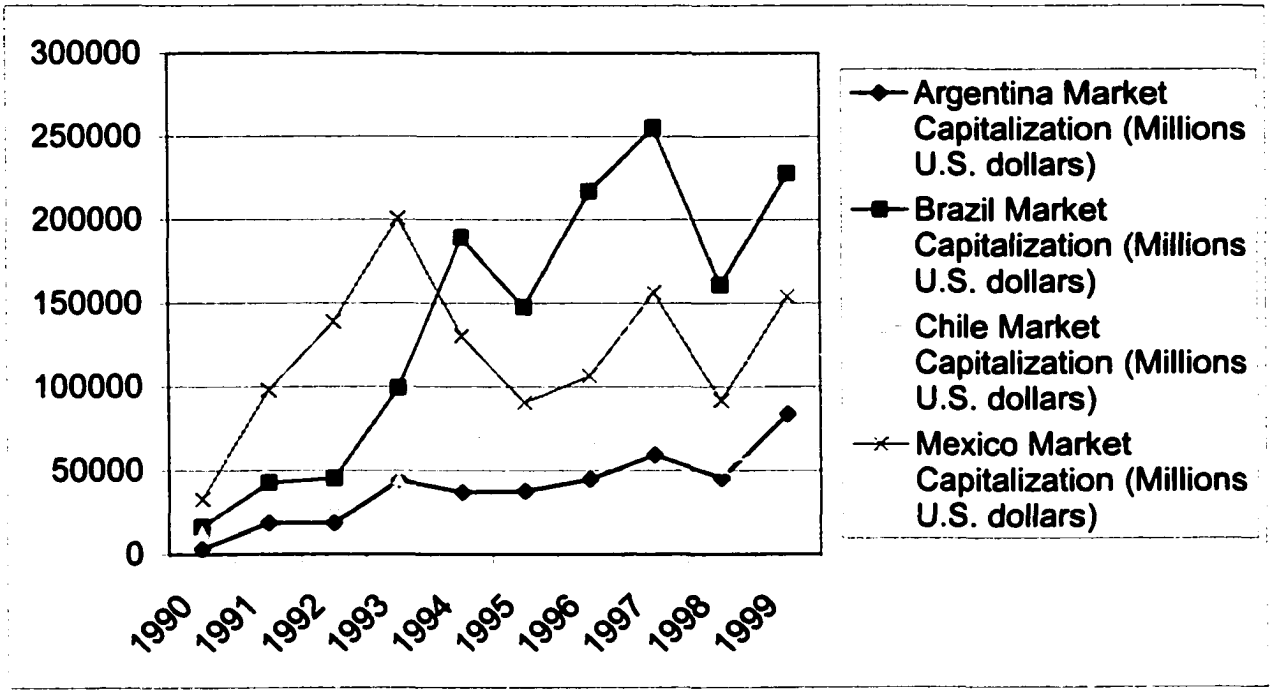
One of the most significant changes in the world financial markets over the past two decades has been the growth of emerging markets around the world. In 1990 for example, emerging stock markets surveyed by IFC had a combined market capitalization of US$ 604 billion. That figure increased to $3 trillion by the end of 1999 (IFC, 2000). Emerging stock markets also posted strong positive returns in 1999, ending the Asian market crisis that affected most developing equity markets in 1997 and 1998. The S&P/IFCI regional index for Asia gained 70.5% in 1999, while its Latin American and Middle East/Africa counterparts rose 56.9% and 49.1% respectively.

Latin American Emerging Stock Markets

In particular, Latin American stock markets have achieved a phenomenal growth in the last two decades or so. For example in 1998, Latin American emerging stock markets such as Brazil, Mexico, Chile and Argentina were placed among the top 40 developed and emerging markets in the world. In fact, these four markets ranked 18th, 25th, 30th and 31st respectively (IFC, 1999). Figure 3.1 shows that in terms of regional ranking according to market capitalization, Brazil, Mexico, Argentina and Chile were placed 1st, 2nd, 3rd and 4th respectively among the Latin American stock markets in 1999. Tables 3.1 – 3.4 reports an important characteristic of these markets, that is, the high concentration of market capitalization. Because of the large size of some recently privatized companies, the top ten Brazilian, Chilean, Mexican and Argentinean companies for example constituted about 31%, 46%, 51% and 74%, of each respective total national market capitalization. The high concentration of market capitalization in these countries may also provide some explanation to the high volatility of the markets. Because these markets are dominated by a few large firms swings in the fortunes of those

Figure 3.1

Market Capitalization Levels of the four Latin American Countries (1990-99)



Source: Created by author from IFC 2000 Statistics.

Table 3.1

Top Ten Securities in the Argentinean Stock Market (1998)

	Market Capitalization (U.S.$ Million)	Percent of Total
Argentina	**43,500**	
YPF D	10,276	23.6
Telefonica Argentina B	6,243	14.4
Telecom Argentina B	5,306	12.2
Perez Companc B	3,427	7.9
Transportadora Gas Sur B	1,566	3.6
Banco Rio de la Plata B	1,435	3.3
Banco Galicia y BS AS B	1,275	2.9
Banco Frances	1,027	2.4
Siderca A	581	2.0
Astra Argentina Petroleo	743	1.7
Top ten	**32,202**	**74.0**

Source: Source: Solnik (2000), *MSCI Perspectives, Emerging Markets*, February 1999

firms may have frequents destabilizing effects on the markets. Domestic financial markets can play a key role in the adjustment to shocks, fulfilling the dual purpose of facilitating both risk diversification among agents in the capital markets and channeling of resources towards sound firms and sectors hurt by shocks. In most Latin American countries, however, weak links with world financial markets and shallow domestic financial markets greatly contribute to amplifying shocks rather than absorbing them (Caballero, 2000).

The development of stock markets in the region prior to the early 1980s was limited for a number of reasons. First, most firms in the region used relatively short-term sources of funds to finance their projects, hence, the use of securities was limited. Second, Many of the countries in the region had high inflationary pressures and high interest rates that further undermined the development of security markets. The economic reform programs and financial liberalization in some of the countries provided the necessary environment for economic growth in the region and its capital markets. Chile, for example implemented a labor market reform that substantially increased savings and contributed to the development of its capital markets. Among others, policies focused on the relaxation of barriers to entry, encouragement of security markets and institutional investors, deregulation of interest rates and harmonization of reserve requirement for commercial banks strongly enhance the growth of the capital markets (Edwards, 1995).

Table 3.2

Top Ten Securities in Brazilian Stock Market (1998)

	Market Capitalization (U.S.$ Million)	Percent of Total
Brazil	**123,100**	
Electrobras ON	6,006	4.9
Telesp PN	5,605	4.5
Vale do Rio Doce PNA	4,974	4.0
Banco Itau PN	4,207	3.4
Petrobras PN	3,578	2.9
Telesp Participacoes PN	3,509	2.9
Banco Brasil PN	2,963	2.4
Embratel Part. PN	2,690	2.3
Petrobras ON	2,555	2.1
Banco Itau ON (PN Price)	2,402	2.0
Top ten	**38,689**	**31.4**

Source: Source: Solnik (2000), *MSCI Perspectives, Emerging Markets*, February 1999

Table 3.3

Top Ten Securities in the Chilean Stock Market

	Market Capitalization (U.S.$ Million)	Percent of Total
Chile	**60,600**	
CTC Telecom, Chile (CIA)A	4,762	9.4
Endesa (Chile)	3,431	6.8
Enersis	3,319	6.6
Copec Compania Petroleos	2,745	5.4
Chilectra	1,760	3.5
Banco Santiago	1,715	3.4
Andina (Embotel.) Pref A	1,621	3.2
Banco Santander Chile	1,561	3.1
CMPC (Empresa)	1,267	2.5
Gener	1,226	2.4
Top Ten	**23,429**	**46.3**

Source: Source: Solnik (2000), *MSCI Perspectives, Emerging Markets*, February 1999

Table 3.4

Top Ten Securities in the Mexican Stock Market

	Market Capitalization (U.S.$ Million)	Percent of Total
Mexico	**111,400**	
Telefonos Mexico L	16,876	15.1
Grupo Modelo C	7,270	6.5
Telefonos Mexico	8,947	6.2
Cifra V	5,207	4.7
Kimberly-Clark Mexico	4,292	3.9
Grupo Televisa CPO	4,267	3.8
Grupo Carso	3,060	2.7
Femsa Unit	2,884	2.6
Grupo Industrial Bimbo	2,739	2.5
Empresas La Moderna	2,719	2.4
Top ten	**56,241**	**50.5**

Source: Source: Solnik (2000), *MSCI Perspectives, Emerging Markets*, February 1999

Argentinean Stock Market

The Mercado de Valores de Buenos Aires S.A. (Merval), a self-regulating incorporated business organization, was established in 1929. The primary functions of the Merval are concerned with the execution, settlement, surveillance and guarantee of exchange trades. This institution is also empowered to take disciplinary actions against individual brokers or brokerage firms who violate statutory rules, and/or the rules and regulations governing the Argentine stock exchange system under Public Offering Act 17.811. Furthermore, Merval regulates, coordinates and implements each and every aspect connected with stock exchange trading, types of securities and trading mechanisms, terms and conditions of payment, and the like.

The capital stock of the market is divided into stocks, the holders of which (individuals or legal persons) must meet certain requisites to be authorized as individual brokers or brokerage firms. It is in that capacity that they may execute securities purchase and sale transactions for their own account or on behalf of third parties. The Mercado de Valores has a trading system called a concurrent market, where trades are executed in an automated order-matching system or the traditional open outcry mode on the floor of the Bolsa. Trades in government and corporate bonds may also be executed through bilateral telephone execution, called the continuous trading system.

Table 3.5 reports some important characteristics of the Argentina stock market between 1990 and 1999. Market capitalization has grown from 3.2 billion US$ in 1990 to about 83.8 billion US$ in 1999. In the same period, the number of companies listed declined from 179 to 129. The table also shows that trading value has increase over the years despite a high level of variability.

Table 3.5

Characteristics of Argentinean Stock Market (1990-99)

Year	No. of Listed Companies	Market Capitalization (US$ Millions)	Trading Value (US$ Millions)
1990	179	3268	852
1991	174	18509	4824
1992	175	18633	15679
1993	180	43967	10339
1994	156	36864	11372
1995	149	37783	4594
1996	147	44679	4382
1997	136	59252	25702
1998	130	45332	15811
1999	129	83887	7781

Source: IFC, Emerging Stock Market Factbook 2000

Brazilian Stock Market

The Brazilian stock market had a total capitalization value of US$9.22 billion in 1980. By 1994, market capitalization had increased to $US189.28 billion. The São Paulo Stock Exchange - BOVESPA was founded on August 23, 1890. BOVESPA has a long history of services rendered to the capital market and to the Brazilian economy. Up to the mid sixties, BOVESPA and other Brazilian exchanges were official entities linked to the finance departments of state governments, and brokers were appointed by the public sector.

After the enactment of the Securities Act in 1965, the Brazilian financial system and capital market underwent a series of reform that provided the institutional character the Brazilian stock exchanges still has today. The Brazilian exchanges became non-profit self-regulating institutions, with administrative and financial autonomy. Government securities brokers were replaced with brokerage firms, companies established as joint stock companies or private limited liability companies.

Since the 1960s, BOVESPA has been steadily improving its technology and the quality of services provided to investors, market intermediaries and listed companies. In 1972, BOVESPA pioneered the implementation of automated trading sessions with information displayed on-line and in real-time via a computer terminal network. In the late 1970s, BOVESPA was the first exchange to introduce the options market in Brazil and in the 1980s it implemented a Private Telephone Operations System (SPOT).

At this time, BOVESPA implemented an on-line service network for brokerage firms. In 1990, trading operations started being carried out through the Computer Assisted Trading System/CATS, which operated simultaneously with the traditional

Open Outcry System. BOVESPA successfully implemented the Mega Bolsa, its new electronic trading system in 1997. Besides using highly advanced technology, Mega Bolsa expanded the potential information processing volume and allows BOVESPA to consolidate its position as the most important trading center in the Latin American market.

The extensive use of information technology to develop and maintain markets, as exemplified by the launching of the Home Broker and After-Market systems, highlighted BOVESPA's activities in 1999. The two new systems have made it feasible and easier for small and medium-sized investors to participate in the market.

The Home Broker system allows investors, through the brokerage firms' websites on the Internet, to transmit their buy or sell orders directly to the MEGA BOLSA. The After-Market, BOVESPA's other innovations, is a pioneering effort in world terms, offering evening electronic trading. Besides serving market professionals, this mechanism is also of interest to small and medium sized investors, since it allows orders to be placed up to 10 o'clock at night, through the Home Broker system or through communication with the brokers.

Table 3.6 reports other important characteristics of the Brazil stock market between 1990 and 1999. Market capitalization has grown from 16.3 billion US$ in 1990 to about 227.9 billion US$ in 1999. In the same period, the number of companies listed dropped from 581 to 478. The table also shows that trading value has increase over the years despite a high level of variability.

Table 3.6

Characteristics of Brazilian Stock Market (1990-99)

Year	No. of Listed Companies	Market Capitalization (US$ Millions)	Trading Value (US$ Millions)
1990	581	16354	5598
1991	570	42759	13373
1992	565	45261	20525
1993	550	99430	57409
1994	544	189281	109498
1995	543	147636	79186
1996	551	216990	112108
1997	536	255478	203260
1998	527	160887	146683
1999	478	227962	87276

Source: IFC, Emerging Stock Market Factbook 2000.

Chilean Stock Market

In Chile, the first attempts to create a Stock Market were made in 1840 with little success. In 1884 there were 160 incorporated companies, which made it necessary to establish a specialized stock market towards which the transactions of securities shifted. On November 27, 1893 the Santiago Stock Exchange was founded to inject vitality and dynamism to the national economy

During the last century, many important events occurred that affected the operations of the Santiago Stock Exchange. The first was the economic crisis in the beginning of the '30s, which struck Chile, and most countries of the world. The period of 1930-1960 was not very favorable for the stock exchange. This trend continued until 1973, when it became more serious in the era of the Unidad Popular, a period in which, the country was experiencing hyperinflation with an annual rate close to 400%.
In 1973, a general consensus was reached to implement economic reform, mainly oriented to the liberalization of the economy, decentralization, the opening of the economy to foreign markets and the respect for private property. The economic reform package included a pension fund reform. This system replaced the old regime based on the distribution of a common fund with another one based on individual capitalization, in which pension savings were managed by private institutions.

Under the model of a free-market economy adopted in 1973 and within the main frame of economic growth (which has been predominant in the country since the '80s), the Chilean Stock Market gone through an extraordinary development. This has been characterized by a substantial growth of stock market operations, the amount of securities issued, the diversification of the instruments transacted and the opening of new markets.

During that period, important institutional investors such as the pension funds management institutions, insurance companies, foreign investment and mutual funds were incorporated to the Santiago Stock Exchange. Another process worth mentioning during the '90s was the opening of Chilean companies to the international market through the issuance of American Depository Receipts (ADRs) and the internationalization of local companies through their participation in the ownership of important companies mainly located in Latin America.

Since 1981 the Stock Exchange adopted the use of modern technologies, beginning with the computerization of its main processes. It currently has its own network of over 100 terminals connected to its Tandem equipment that is highly tolerant to failures and has access to a huge variety of services through Internet. The leading indicators of performance in the Chilean stock market are the Indice de Precios Selectivo de Acciones (IPSA) and the Indice General de Presios de Acciones (IGPA). Created in 1977, The IPSA, measures the price performance of the 40 most important stocks. The index includes the stock that trade the most for the previous 12 months using December as the based date. IGPA was created in 1958 and includes all the stocks listed on the Santiago Stock Exchange.

Table 3.7 reports some important characteristics of the Chile stock market between 1990 and 1999. Market capitalization has grown from 13.6 billion US$ in 1990 to about 68.2 billion US$ in 1999. In the same period, the number of companies listed rose from 215 to 285. The table also shows that trading value has increase over the years despite a high level of variability.

Table 3.7

Characteristics of Chilean Stock Market (1990-99)

Year	No. of Listed Companies	Market Capitalization (US$ Millions)	Trading Value (US$ Millions)
1990	215	13645	783
1991	221	27984	1900
1992	245	29644	2029
1993	263	44622	2797
1994	279	68195	5263
1995	284	73860	11072
1996	291	65940	8460
1997	295	72046	7445
1998	277	51866	4417
1999	285	68228	6874

Source: IFC, Emerging Stock Market Factbook 2000

Mexican Stock Market

Mexico is one of the largest emerging markets. The Bolsa Mexicana de Valores (or BMV) was founded in October 31, 1894 and started operation in several trading offices and one main office in Mexico City. Initially, the BMV consisted of 70 mining stocks, 20 industrial stocks, and 30 bank stocks. The limited number of listed companies reflected the subordinate role that the stock market played in the Mexican economy. In 1916, the government established a body to regulate the BMV consisting of the Secretaria de Hacienda and the Comisión Nacional de Valores (the regulatory agency for the BMV).

The first stock market comprehensive trading law was enacted in 1975. The new law called the Securities Market Act (Ley del Mercado de Valores), opened broad new possibilities of development for the organized securities market. First, the legislation institutionalized bokerage houses, with individual brokers given strong incentives to incorporate through specific operating advantages. Second, the structure of the markets was modernized and the main authority for monitoring compliance with the law was given to the Comision Nacional de Valores (national securities commission). The Bolsa de Valores de Mexico also changed its name to the current Bolsa Mexicana de Valores (BMV). By 1982, a new era in the development of financial markets started in Mexico, specifically, the Mexican government looked to use the stock market as an important tool in the financing of economic development (Hensler *et al.*, 2000).

There is a high degree of concentration in the Mexican Stock Exchange as three sectors (communication, financial and retail) of the economy make up close to 69 percent of the total market capitalization. The capitalization of the market has gone down in some years, for example it fell from 98 to 91 billion U.S. dollars from 1991 to 1995 (Eun and

Resnick, 1998). Figure 2.4 shows that the negative change coincides with the peso crisis of December 1994.

An electronic trading system was introduced in 1995 for debt instruments and this was followed in 1996 by the introduction of a similar system for equities. This decentralized and automated system allows users to perform equity trades in real time through hundreds of computer terminals interconnected by a network. The terminals are located in brokerage firm offices and controlled by the Trading Control station at BMV. Transactions are closed or entered through on-screen formats specifying issuer, series, amount and price of the securities the user wishes to buy or sell.

The leading indicator of the performance of the stock market, the Price and Quotations Index (IPC) is expressed as a value based on the prices of a balanced, weighted, and representative sample of all the stocks traded on the Bolsa. The sample stocks are made up of 35 issuers participating in different sectors of the economy and are reviewed once every two months.

Table 3.8 reports some important characteristics of the Mexico stock market between 1990 and 1999. Market capitalization has grown from 32.7 billion US$ in 1990 to about 154. billion US$ in 1999. In the same period, the number of companies listed has fluctuated and declined from 199 to 188. The table also shows that trading value has increased over the years despite a high level of variability.

Table 3.8

Characteristics of Mexican Stock Market (1990-99)

Year	No. of Listed Companies	Market Capitalization (US$ Millions)	Trading Value (US$ Millions)
1990	199	32725	12212
1991	209	98178	31723
1992	195	139061	44582
1993	190	200671	62454
1994	206	130246	82964
1995	185	90694	34377
1996	193	106540	43040
1997	198	156595	52646
1998	194	91746	34164
1999	188	154044	36042

Source: IFC, Emerging Stock Market Factbook 2000

CHAPTER 4

HYPOTHESES

Studies on the link between macroeconomic variables and stock returns can be broadly grouped into three strands based on the level of market integration. The first strand promotes the view that markets are generally integrated and, as a result, global risk factors are more important in explaining returns volatility than country factors. Most of the studies that emphasize the role of global risk factors have modeled returns as a linear function of global risk factors and focused exclusively on developed countries (Ferson and Harvey, 1994a; Dumas and Solnik, 1995; Harvey, 1995a). Harvey (1995a) is one of the few studies that test the relationship between returns in emerging stock markets and a set of global variables. The global variables used by Harvey included world inflation, world GDP, world oil prices and trade-weighted world exchange rate and the study concludes that global variables have only a limited impact on the returns volatility in emerging stock markets. It is often argued that the developed markets are more strongly integrated in terms of their trade links and level of economic development, hence the incentive to look at global variables in that context. The few studies that looked at the role of global risk factors on the stock returns of emerging markets have also implicitly or explicitly emphasized the relevance of market integration in their analysis.

The proponents of complete market segmentation highlight the overriding role of domestic macroeconomic variables in their investigation of return volatility. Again most of these studies are predominantly focused on developed markets (Chen *et al.*, 1986; Jorion, 1991; Ely and Robinson, 1997). It has been argued that in less integrated markets, correlation with the world portfolio is typically weaker. According to Harvey (1998, 2000), only local market variance explains the cross-section in emerging markets. Investigating the relative effects of country and global factors on return volatility of emerging equity markets would provide insights on the question of complete market segmentation in those markets.

Bilson *et al.* (2001) have argued that the difference between the two approaches is driven by the assumptions about the level of integration. Empirical studies that have investigated the levels of integration have generally found that emerging stock markets are only partially integrated (Bekaert and Harvey, 1995). Since markets are neither perfectly integrated nor perfectly segmented, investigating the role of macroeconomic variables at the two extremes may lead to inconclusive results. One major shortcoming of conducting research at the two extremes is that capital markets are at different levels of integration and are evolving towards globalization. At the one extreme of this evolving path are the more highly segmented frontier capital markets and at the other extreme are the more integrated developed markets. In between these two extremes are the emerging markets. Hence, the third research strand calls for the consideration of both domestic and global variables in the study of emerging markets. The current study examines the relevance of macroeconomic variables in the framework of partial integration. In other

words, the study investigates the effects of both country and global variables on the volatility of emerging market stock returns.

Macroeconomic announcements influence stock market returns if changes in the information set revealed by the news affect either expectations of the pricing operator, future dividends, or both. This study focuses on the effects of macroeconomic news on pricing. Expected cash flows change in response to both real and nominal forces and changes in the expected level of real production clearly have effects on the current real value of cash flows. Changes in the expected rate of inflation would also affect nominal expected cash flows as well as the nominal rate of interest. While changes in the discount rate can affect both the level of rate of return and the term-structure spreads across different maturities, as well as the risk premium. Innovations in the risk-free interest rate will therefore have an influence on pricing both directly and through their influence on future cash flows. Real forces can bring unanticipated changes in the risk premium and innovation in real consumption, for example, changes the indirect marginal utility of real wealth, and it in turn changes the risk premium.

One important area of disagreement among academicians is the underlying hypothesis that governs the risk – return tradeoff. According to finance theory as outlined below, reward to local or world risk should be positive if investors' expectations are positive. But the empirical evidence on the relationship between market risk premium and volatility is mixed. Some studies have established a significant negative relationship (Glosten *et al.*, 1993 and Fletcher, 2000). Bollerslev, Engle and Woolridge (1988), Chou (1988) and Scruggs (1998) have on the other hand reported a significant positive relationship between market risk premium and the conditional market volatility. Still,

others argue that the relationship is not significant (French *et al.* 1987; Baillie and De Gennaro, 1990 and Fama and French, 1992).

Impact of Money Supply

It has been well established in the literature that unanticipated increases in the money supply lead to immediate increases in interest rates and thus decreases in security prices. There are two competing explanations for the role of monetary news in affecting the stock market. The first hypothesis is the policy anticipation effect (or the liquidity effect), which says an unanticipated expansion of the money supply might lead market participants to expect the central bank to tighten in order to offset the increase, which will result in higher real interest rates in the future. The second, the inflation expectation effect, postulates that a positive shock in the money supply leads to an upward adjustment of inflation expectations, which in turn leads to higher nominal interest rates. Both hypotheses lead to a negative effect of monetary information on stock prices. However, Monetary Portfolio Theory suggests that changes in money supply alter the equilibrium position of money, thereby altering the composition and price of assets in an investor's portfolio (Cooper, 1974; Rozeff, 1974). Furthermore, changes in money supply may impact on real economic variables, thereby having a lagged influence on stock returns (Rogalski and Vinso, 1977). In both cases, it is suggested that a positive relationship exist between changes in money supply and stock returns. Therefore the sign for a money supply increase may not be determined a priori. Based on the above relationships, this study formulates the following hypotheses for testing the effect of money supply on stock returns.

H_1: There is no significant relationship between the money supply and the mean return and volatility of the equity market of each country.

H_2: Past money supply volatilities do not significantly impact the volatility of the equity market of a country.

H_3: There is no significant difference in the impact of negative and positive innovations in money supply on the volatility of each equity market.

H_4: A volatility shock from money supply to a country's stock index is not persistent over time, but dies quickly.

Impact of Inflation

If interest rates, and hence stock prices, respond to money supply announcements because of inflationary expectations, they should also be affected by shocks contained in inflation rate announcements. A negative effect should emerge if a positive surprise in announced inflation induces agents to raise their level of expected inflation. Such effects are well documented, e.g., in the study by Fama and Schwert (1977). Inflation surprises could also affect the financial market through channels other than changes in inflationary expectations. Unanticipated higher inflation may lead to the expectation of more restrictive monetary policies, which in turn will lead to the reduced cash flows and lower stock prices. A positive inflation surprise could also induce agents to adjust their savings, resulting in higher interest rates and lower stock prices. In any event, all these potential links suggest that surprises in CPI and PPI announcements could be positively related to interest rates and negatively related to stock prices.

This negative relationship is surprising for stocks, which, as claims against real assets, should compensate for movement in inflation (Boudoukh and Richardson, 1993

and Boudoukh *et al.* 1994). Equity is generally seen to represent a contingent claim on the real assets of a firm, hence, common stock is traditionally considered as a hedge against inflation. This means that higher inflation leads to upward revision of these contingent claims and should not affect the real rates of return on equity (Day, 1984). At the same time, the monetary assets of the firm (cash, securities, accounts receivables and debt) will be independent of the fluctuations in price levels. Based on this reasoning, Hong (1977) argues that it is only the real component of the firm that will be hedged against changes in inflation. It is therefore difficult to predict the direction of the relationship between stock returns and inflation in emerging stock markets since there is an apparent lack of agreement between theory and empirical evidence. Bilson *et al.*, (2001) emphasize that such a problem is particularly important for Latin American countries that have experienced periods of extremely high inflation.

For instance, Pearce and Roley (1985) find no significant CPI announcement effects on stock prices, and Roley and Troll (1983) find no significant effects of unanticipated inflation on the U.S. Treasury bill yields. Urich and Wachtel (1984), however, find some announcement effects of inflation rates on the futures contracts for 3-month Treasury bills, but not for the U.S. Federal Funds Rate. Following the above discussion, the hypotheses below are formulated to test for the relationship between inflation and volatility of the returns of emerging equity markets.

H_1: There is no significant relationship between the inflation and the mean return and volatility of the equity market of each country.

H_2: Past inflation rate volatilities do not significantly impact the volatility of the equity market of a country.

H_3: There is no significant difference in the impact of negative and positive innovations in inflation rates on the volatility of each equity market.

H_4: A volatility shock from inflation to a country's stock index is not persistent over time, but dies quickly.

Impact of Interest Rate

Fisher (1930) claims that the nominal interest rate fully reflects the available information concerning the possible future values of the rate of inflation. This hypothesis has come to be known as "Fisher effect" in economic literature; it states that expected nominal rates of interest on financial assets should move one-to-one with expected inflation.

Discount rate changes for example may reveal new information about short-run policy objectives. An increase, for example, corresponds to short-run objective of returning to the implied long-run money growth target more quickly. With short-run money growth reduced and the long-run objectives unchanged, the change will raise market interest rates, and stock prices should fall as a result.

While the discount rate may be considered a weak and infrequently used tool of monetary policy, discount rate changes generally attract close attention from both researchers and market participants. Discount rate changes typically send a clear signal of the U.S. Federal Reserve Board's monetary policy stance and can be easily interpreted by market participants. Furthermore, rate changes are established by a public body, which is perceived as being competent to judge the economy's cash and credit needs, and rate changes are made only at substantial intervals, thus capturing widespread attention once they are announced.

Smirlock and Yamitz (1985), Cook and Hahn (1988), and Jensen *et al.* (1996) find evidence for the responses of financial markets to interest rate changes. Unlike other announcements, changes in the Fed's discount rate and surcharges are announced intermittently with no typical announcement day or time, and no survey data are available for them. So all such changes can be treated as unanticipated. The following hypotheses are tested to determine the relationship between interest rates and volatility of returns in emerging equity markets.

H_1: There is no significant relationship between the interest rate and the mean return and volatility of the equity market of each country.

H_2: Past interest rate volatilities do not significantly impact the volatility of the equity market in each country.

H_3: There is no significant difference in the impact of negative and positive innovations in interest rates on the volatility of each equity market.

H_4: A volatility shock from interest rates to a country's equity market is not persistent over time, but dies quickly.

Impact of Real Economic Activity

Fama (1990) points out that because stock prices reflect the value of cash flows at all future horizons, stock returns are related to variation in all future growth rates. There are various reasons for such a relationship. A positive innovation in real economic activity may increase agents' expectations of future growth and, thus, cause an increase in share prices. Alternatively, greater than expected real economic activity may also cause agents to worry about a more restrictive monetary policy in the future and thus likely depress stock prices. Therefore, the exact impact of real activity surprise on

security prices cannot be determined a prior. This perhaps explains why many announcements concerning real activity that receive considerable attention in the financial press find no grounds in empirical research. Hardouveils (1987)b, for instance, concludes that financial markets respond primarily to monetary news. Pearce and Roley (1985) fail to find significance of announcements concerning unemployment and industrial production. Using monthly stock returns, Chen, Roll and Ross (1986) and Cutler, Poterba and Summers (1989) find that the explanatory power of real macroeconomic variables is low. Fama (1990) and Geske and Roll (1983) suggest that there is a positive relationship between industrial production and stock prices. So the level of economic activity as proxied here by industrial production is hypothesized to have a direct relationship with stock prices through its effects on expected future cash flows. Gjerde and Saettem (1999), using Norwegian data, also demonstrated that the stock returns have a positive and delayed response to changes in industrial production.

H_1: There is no significant relationship between the industrial production and the mean return and volatility of the equity market of each country.

H_2: Past industrial production rate volatilities do not significantly impact the volatility of the equity market of a country.

H_3: There is no significant difference in the impact of negative and positive innovations in industrial production rates on the volatility of each equity market.

H_4: A volatility shock from the industrial production rate to a country's equity market is not persistent over time, but dies quickly.

Impact of Exchange Rates

The link between exchange rates and equity returns is based on simple and intuitive financial theory. The appreciation of the currency of a country lowers the cost of imported goods, which in most cases constitute a large part of the production inputs for emerging countries. According to Pebbles and Wilson (1996), an appreciating currency is generally accompanied by increases in reserves and money supply and a decline in interest rates. The positive sign suggested by these relationships is only consistent with returns denominated in local currency. The effect will be the opposite for U.S. dollar denominated returns. For example, Bilson *et al.* (2001) show that a devaluation of the domestic currency will result in an increase in U.S. dollar denominated returns. Under perfect purchasing power parity (PPP) conditions, exchange rates will adjust to reflect relative inflation levels, and the law of one price will be upheld. Therefore, exchange rate risk will not be separately priced. But since deviations from PPP may occur in the short-to-medium term (Frenkel, 1981; Adler and Lehmann, 1983), exchange rate risk will be borne by investors (Jorion, 1991; Dumas and Solnik, 1995). Therefore exchange rate movements can be expected to have an inverse relationship with stock returns denominated in U.S. dollars.

H_1: There is no significant relationship between the exchange rate and the mean return and volatility of the equity market of each country.

H_2: Past exchange rate volatilities do not significantly impact the volatility of equity market

H_3: There is no significant difference in the impact of negative and positive innovations in exchange rates on the volatility of each equity market.

H_4: A volatility shock from exchange rates to a country's stock index is not persistent over time, but dies quickly.

Impact of MSCI World Index

Previous studies have found that a number of predetermined worldwide information variables can predict country returns over time. This study includes the MSCI world index as a global variable. The reason for its inclusion is that the expectations in the model should be conditioned on the state of the global economy as captures by the variable (see Ferson and Harvey, 1998). Stulz (1981a, 1981b) and Adler and Dumas (1983) provide conditions under which a single-beta CAPM based on world market portfolio holds globally, which motivates the use of a world-equity market risk factor. Empirical studies have used a similar risk factor with some success in conditional asset pricing context (Giovannini and Jorion, 1989; Harvey, 1991a, b).

H_1: There is no significant relationship between the MSCI world index and the mean return and volatility of the equity market of each country.

H_2: Past MSCI world index volatilities do not significantly impact the volatility of equity market

H_3: There is no significant difference in the impact of negative and positive innovations in MSCI world index on the volatility of each equity market.

H_4: A volatility shock from the MSCI world index to a country's stock index is not persistent over time, but dies quickly.

Impact of the U.S. 3-month T-bill

The level of the U.S. interest rates has often been cited as one major variable affecting stock market performance in Latin American countries. Many Latin American

banks have high external debt commitments and as establish by Bekaert *et. al.* (2002), the major Latin American equity markets have a high US equity ownership. These two characteristics tend to establish a possible link between the U.S. interest rates and stock prices in the region. For example if policymakers foresee a tightening of external financing, which leads them to contract monetary and/or fiscal policy, the economy may go into a recession ahead of the feared external tightening. More importantly, the private sector often reacts to an anticipated tightening of external financial bottleneck by running against domestic assets, thus driving down asset prices - a scenario similar Mexico in 1994-95 and Argentina in 1995 and 2002. Earlier studies find empirical evidence suggesting that Treasury bill yield changes contain incremental information relevant to the determination of security prices (Tandon and Urich, 1987; Johnson and Jensen, 1993). A study by Soydemir (2000a) finds a strong and negative impact of T-bill yields on the U.S. equity market, but a slow and varying impact on the equity markets of a number of Latin American countries.

H_1: There is no significant relationship between the U.S. 3-month T-bill and the mean return and volatility of the equity market of each country.

H_2: Past U.S. 3-month T-bill volatilities do not significantly impact the volatility of equity market

H_3: There is no significant difference in the impact of negative and positive innovations in the U.S. 3-month T-bill on the volatility of each equity market.

H_4: A volatility shock from the U.S. 3-month T-bill to a country's stock index is not persistent over time, but dies quickly.

Summary

These hypotheses are tested by using data from four emerging market countries in Latin America and for a different sample period than the previous studies. There are a number of advantages for using emerging market data. Because of their low correlations with the more developed markets, emerging markets present a separate data source, so that any data-snooping biases are lessened (Saatcioglu and Starks, 1998). Also, information flows and institutions have been previously conjectured to have important implications for stock price movements. Aggarwal *et al.* (1993) and Harvey (1995) have argued that the information flows in emerging markets are not equivalent to those in the more developed markets and that there are significant institutional differences across markets. Such differences are expected to impact the transmission and significance of macro shocks in these countries.

The set of questions investigated in this study are also quite unique. As discussed in the chapter on literature review, very few studies have investigated the effects of macroeconomic variables on stock returns and volatility, and more importantly, the relative effects of country and global factors on expected returns and volatility has not been investigated. Gamkhar and Olson (2001) have pointed out that researchers frequently assume that the influence of economic variables is symmetric. The dissertation questions that assumption and seeks to determine whether there are any asymmetric effects of macroeconomic factors on stock volatility. To my knowledge, no empirical investigation has been conducted on this question for emerging countries.

CHAPTER 5

DATA AND DESCRIPTIVE STATISTICS

This chapter describes in detail the data used in this dissertation. First, the sources and types of data used in the study are examined. Second, the descriptive statistics of returns are reported and analyzed. Third, the chapter presents the market characteristics and economic indicators of the four Latin American countries examined.

Equity Market Returns

This study uses U.S. dollar denominated total monthly returns on stock indexes for four Latin American countries; Argentina, Brazil, Chile, and Mexico. The return indices are obtained from Morgan Stanley Capital International (MSCI) and cover the period January 1986 to August 2001. They are calculated with gross dividend reinvestment. They also represent value-weighted portfolios of the larger firms traded on the national equity markets, and are designed to cover a minimum of 60% of the market capitalization.

Country and Global Variables

The selection of variables in these kinds of studies is usually subject to criticism on the grounds of subjectivity. This is an unavoidable problem associated with this area of research (Fama, 1991). It is often suggested that a wide range of variables are important in this type of study. Such variables include goods, money supply, real activity, exchange rates, political risk, oil prices, the trade sector and regional stock market indices (Bilson

et al., 2001). But previous studies have shown that some of these variables are either irrelevant or not appropriate. For example, political risk indices and oil prices have been shown to be only be weakly correlated with emerging stock market returns (Harvey, 1995a; Erb *et al.*, 1996). Considering the above concerns regarding the appropriateness or relevance of various factors, this study selects it variable based on theoretical propositions and existing evidence in the literature. These variables have the additional appeal that they are all "exogenous" in the sense that they come from outside the stock markets (see Ferson and Harvey, 1998).

The domestic macroeconomic variables used for each country are money supply, monthly CPI, Industrial production, federal funds rate and exchange rates, while the U.S 3-month Treasury bill rate and the Morgan Stanley Capital International (MSCI) world index are used as global variables. The U.S 3-month Treasury bill rate and domestic macroeconomic variables for each country are obtained from the International Finance Corporation, an outfit of the IMF. Data on all macroeconomic variables cover the period January 1986 to August 2001.

The empirical analysis in this study is conducted using data at the country level. According to Ferson and Harvey (1998), the use of country data has a number of advantages over studies that have focused on individual firms. For example, the data on returns that are obtained from Morgan Stanley are constructed in "real" time. Therefore, the analysis avoids the look-ahead biases that may be present in studies using COMPUSTAT and similar sources of data on individual firms. They also argue that working at the aggregate, country-portfolio level has no "survivorship" requirement that a

firm has data at some future date in order to be included in the database at the current date.

Descriptive Statistics

Table 5.1 below, reports the summary statistics for the monthly returns series of each country in the sample. The mean monthly returns range from 1.603 in Mexico to 1.103 in Chile. The standard deviation is high for each country, indicating the high volatility of returns that characterizes these markets. In general, Argentina and Brazil have much higher standard deviations than Chile and Mexico. That may be an indication that the markets in Argentina and Brazil are far more volatile than Chile and Mexico. In terms of skewness, Argentina and Mexico have returns distributions that are positively skewed while those for Brazil and Chile are negatively skewed. The skewness statistics indicate a lack of normality in the distribution of the returns series. The values of the kurtosis statistic suggest that the returns of each country are leptokurtotic compared to the normal distribution; that is, they are more peaked than the normal distribution. While the high kurtosis of the returns is a well-established fact, the situation is much more obscure with regard to the symmetry of the distribution (Peiro, 1999). The relevance of symmetry analysis transcends the pure determination of the statistical distribution. The Capital Asset Pricing Model (CAPM), for example, assumes that only the mean and variance of returns matter in asset pricing. This implies that upside and downside risks are considered equal by investors, but this assumption is not reasonable given that most investors have a preference for positive skewness (Peiro, 1999). In fact, several attempts have been made to capture this skewness preference (Sortino and Vandermeer, 1991; Leland, 1996), and

many financial models allow or even incorporate an asymmetric behavior of financial returns. This dissertation uses an exponential EGARCH model to investigate the asymmetric behavior of the stock returns.

The Ljung-Box test statistics, LB and LB^2, provide test for the absence of autocorrelation and homoskedasticity, respectively. The significant value of the LB statistic indicates the presence of autocorrelation in the stock return series. The null hypothesis of white noise is rejected. The significant value of the LB^2 statistic points to strong autocorrelation in the squares of the stock returns, a property that results in volatility clustering in the distribution of the returns series. Ng (2000), suggests that the LB statistics indicate the persistence of linear dependence of shocks that could be due to market imperfections while the LB^2 shows evidence of non-linear dependence due to autoregressive conditional heteroscedasticity (ARCH). In addition, the Bera-Jarque normality test rejects the assumption of normality. These are typical characteristics of financial data that fit ARCH-type modeling techniques.

Table 5.1

Preliminary Statistics on the time Series of Returns

	Country			
	Argentina	Brazil	Chile	Mexico
Mean	1.3	1.121	1.103	1.603
Std. Dev.	15.8	18.222	7.435	10.695
Skewness	0.7293	-1.330	-0.391	0.984
Kurtosis	6.7698	11.695	5.210	5.920
LB	22.488	19.107	4.693	23.372
	(0.0123)	(0.039)	(0.030)	(0.016)
LB^2	16.296	6.544	10.106	8.057
	(0.001)	(0.038)	(0.083)	(0.018)
B-J	111.64	565.06	37.57	110.92
	(0.001)	(0.001)	(0.001)	(0.001)

Notes: LB is the Ljung-Box statistic identifying the presence of autocorrelation, while LB^2 is the Ljung-Box statistic identifying the presence of heteroscedasticity. B-J is the Bera-Jarque test for the null hypothesis of normality. P-values are given in parentheses.

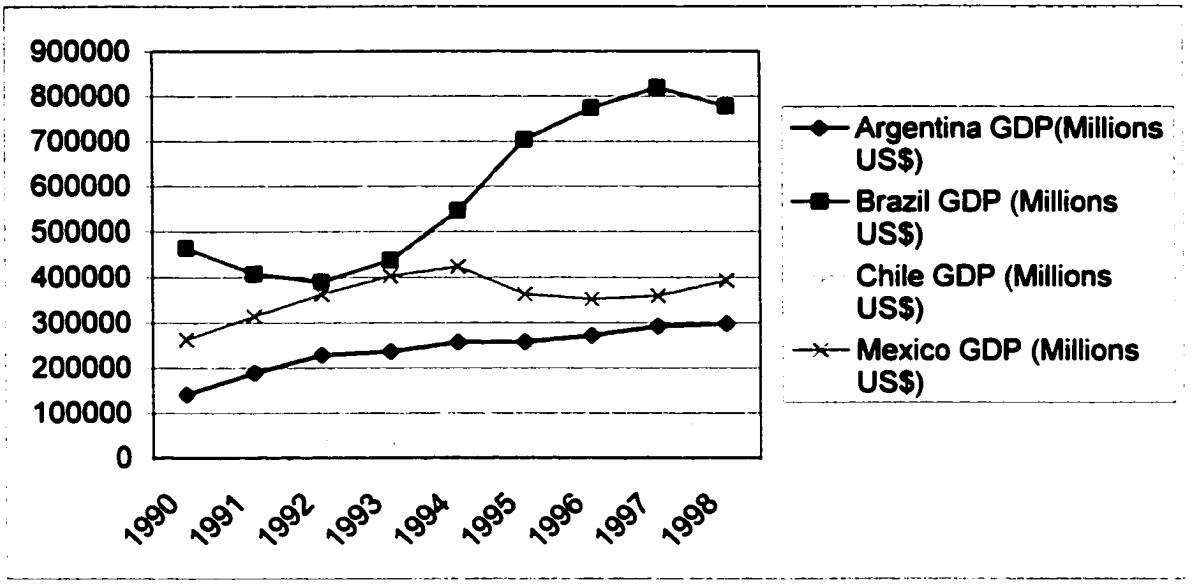
Macroeconomic Statistics of Countries

This section examines the macroeconomic environments of the four Latin American countries and how they may relate to the performance of stock markets. Following the structural reforms in the last two decades, these countries have witnessed considerable economic growth. Figure 5.1which plots the gross domestic product of each country shows that each country's economy grew between 1990 and 1998. Another important issue highlighted by the figure is the variation in the size of the four countries. Figure 5.1 shows that Brazil and Mexico are the first and second largest economies respectively in the region as evidenced by the level of gross domestic product (GDP). In 1998 for example Brazil, Mexico, Argentina and Chile had GDP figures of US$778 billion, US$393 billion, US$298 billion and US$ 78 billion respectively. Chile's economy is still relatively small compared to the other three countries.

Despite the region's impressive success in stabilizing inflation and carrying out important reforms, high volatility of real macroeconomic aggregates has persisted over the years (Caballero, 2000). This point is readily summarized by the (unconditional) standard deviations of variables that have an important bearing on the performance of stock markets. Table 5.2 reports and compares the volatility of macroeconomic aggregates in Latin America to emerging Asia and advanced countries. The table shows that macroeconomic aggregates in Latin America have generally been far more volatile than in advanced countries or emerging Asia despite the substantial improvement during the 1990s. Considering the fact that stock prices reflect economic fundamentals, one would expect the high macroeconomic volatility in these countries to influence their stock markets.

Figure 5.1

Gross Domestic Product (Nominal) of the four Latin American Countries (1990-98).



Source: Created by author from IFC 2000 Factbook.

This raises the question of what drives macroeconomic volatility in Latin America and how that affects the stock markets of the region. A key difficulty in this connection is to isolate the exogenous factors at play, not only because most of the variables respond to both external shocks and domestic policy actions, but also because they feed back on each other. One variable that can be taken as largely exogenous and volatile is the terms of trade, since Latin American countries are, generally, price takers in the world markets. Such terms-of-trade volatility partly reflects the heavy weight of a handful of primary commodities these countries' exports – a long standing structural feature of these economies with the exception of Brazil and Mexico, where manufactured goods have recently accounted for nearly 60 and 90 percent of exports, respectively.

Table 5.2

Volatility of Selected Macroeconomic Variables (1970 – 2000)

	Standard Deviation					
Group	Real GDP growth	General government revenues (percent of GDP)	General government expenditures (percent of revenue)	Terms of Trade	Real effective exchange rates	Real interest rates
1970-80						
Latin America	3.79	3.18	13.41	33.63	6.61	8.65
Emerging Asia	2.91	1.75	8.52	14.16	5.26	5.45
Advanced economies	2.50	2.58	4.43	17.60	2.51	2.92
1981-90						
Latin America	4.89	2.81	16.47	27.36	39.24	15,797.41
Emerging Asia	2.85	1.96	10.28	7.65	24.83	3.32
Advanced economies	3.09	1.11	5.27	7.20	6.21	2.39
1991-2000						
Latin America	3.74	2.19	7.94	8.70	18.00	13.18
Emerging Asia	4.11	1.82	8.29	5.92	8.65	2.52
Advanced economies	2.09	1.02	7.23	3.73	5.90	2.07

Source: IMF staff estimates, 2001.

Note: Selected Macroeconomic variables are: Volatility of real GDP growth, government revenues, real effective exchange rate, real domestic interest rate, terms of trade, and government expenditures measured by standard deviation over the period.

In terms of trade with rest of the world, Mexico and Brazil have placed first and second and followed by Argentina and Chile in that order. According to the IMF estimates, in 1991 each country's share of world merchandise imports (in percent) was 1.57, 0.73, 0.24 and 0.22 for Mexico, Brazil, Argentina and Chile respectively. Although each country increased its share of world merchandise in the past decade, the order of importance in world trade remained the same. In 2000, the share of each country's in world merchandise imports (in percent) was 2.51, 0.95, 0.40 and 0.26 for Mexico, Brazil, Argentina and Chile respectively (IMF, 2002). Table 5.3 for example reports the size of external trade in terms of the U.S. exports and imports from these four countries. Evidence from the table shows that Mexico has consistently imported and exported more to the U.S. than any of the four other countries and followed by Brazil. Argentina places third in terms of imports from the U.S. and fourth in terms of exports. Chile on the other hand places third in terms of exports to the U.S and fourth in terms of imports.

Table 5.3 reports each countries share of world merchandise imports in percentage terms. Again, Mexico and Brazil place first and second respectively and followed by Argentina and Chile in that order. Given that Mexico and Brazil have higher levels of trade activities with the U.S. and the rest of the world as compared to Argentina and Chile, *a priori* one would expect global variables to influence the stock markets of Mexico and Brazil more heavily than those in Argentina and Chile.

Table 5.3

Imports and Exports from the U.S. and Share of World Merchandise Imports (1993-2000)

	1993	1994	1995	1996	1997	1998	1999	2000
Imports from the U.S. (Millions of US$)								
Argentina	3776	4462	4189	4517	5810	5886	4950	4696
Brazil	6058	8102	11439	12718	15915	15142	13203	15321
Chile	2599	2774	3615	4140	4368	3979	3078	3460
Mexico	41581	50844	46292	56792	71388	78773	86909	111349
Exports to the U.S. (Millions of US$)								
Argentina	1206	1725	1761	2279	2228	2231	2598	3100
Brazil	7479	8683	8833	8773	9626	10102	11314	13853
Chile	1462	1821	1931	2262	2293	2453	2953	3269
Mexico	39917	49494	62101	74297	85938	94629	109721	135926
Share of World Merchandise Imports (%)								
Argentina	0.46	0.53	0.38	0.46	0.56	0.59	0.45	0.40
Brazil	0.84	0.87	1.09	1.12	1.25	1.17	0.96	0.95
Chile	0.30	0.28	0.31	0.33	0.35	0.34	0.24	0.26
Mexico	1.95	2.08	1.60	1.88	2.22	2.55	2.74	2.51

Source: IMF staff estimates, 2001.

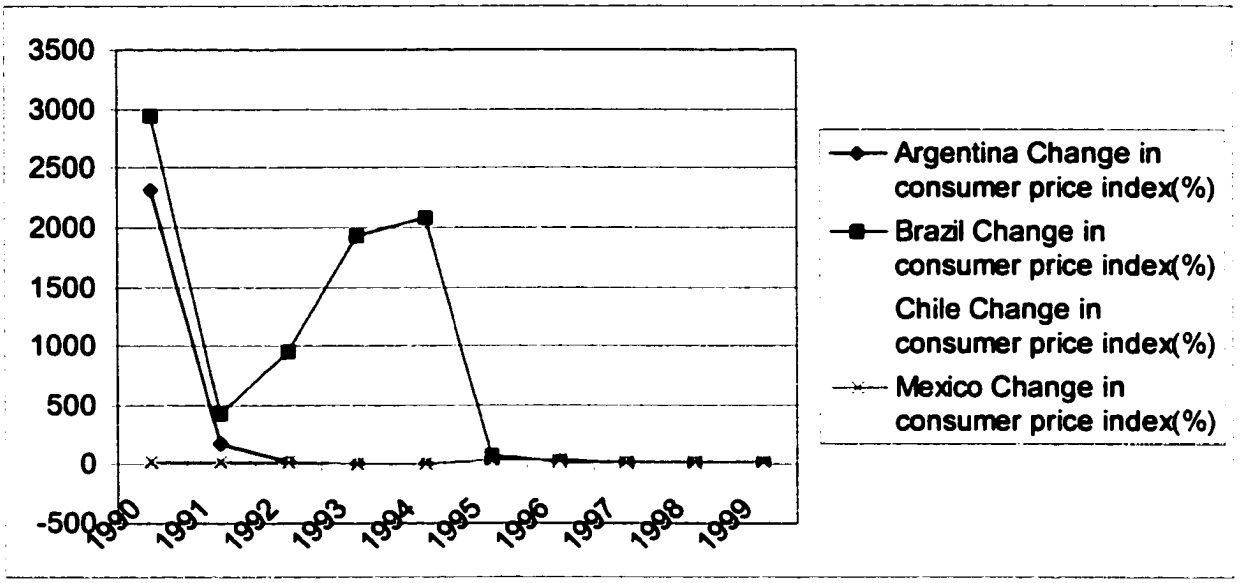
Policy-induced macroeconomic instability in Latin America has not been confined to fiscal policy. Monetary policy, in particular, is well known to have been historically very unstable, although largely reflecting the passive accommodation of fiscal imbalances and inflationary financing of fiscal deficits before the 1990s. Figure 5.2 plots the inflation rates of the countries and shows the hyperinflationary rates in Brazil and Argentina in the early 1990s. Mexico and Chile on the other hand exhibit more stable inflationary pressures. This pattern is probably related to the varying implementation of various economic reform programs in these countries over the period.

Two other areas in which economic policy in Latin America has been particularly unstable are trade and capital controls. The latter, in particular, has historically oscillated between liberalization and stringent foreign exchange controls. In the light of the well-documented links between capital account liberalizations and lending booms, and the fact that lending booms in Latin America have often been followed by financial crises and sharp recessions, have undoubtedly contributed to overall macroeconomic instability (Diaz-Alejandro, 1985).

Over the past decade capital flows to emerging markets have increased rapidly as investors included emerging market securities in their portfolios to take advantage of potential diversification benefits. Latin American countries have serve as good destination of foreign portfolio capital over the years. But following the recent increase in the number of financial market crisis in emerging countries, the role of capital flows on the volatility of emerging equity markets has been brought into question. Volatile international bond and equity portfolio flows

Figure 5.2

Inflationary trends in the four Latin American Countries (1990-99)



Source: Created by author from IFC 2000 Factbook.

are frequently viewed as a destabilizing force in asset markets and, more generally, in the financial system (Edison and Reinhart, 2001). The destabilizing effects of capital flows to each country however would depend on the size and proportion of the flow to other macroeconomic indicators. Table 5.4 for example reports U.S. equity flows to the four countries in terms of the ratio of the average of cumulative flows to equity market capitalization and GDP. Mexico has the highest U.S. equity ownership in terms of the ratio of average cumulative equity flows to market capitalization. Brazil comes second and followed by Argentina and Chile in that order. In terms of the average of cumulative equity flows/GDP, Mexico is first and followed by Chile, Brazil and Argentina. These differences in the size of U.S. equity ownership may have important implications regarding the influence of U.S. macroeconomic policy in these countries. The issue is examined later when the effect of the U.S. 3-month T-Bill on the stock markets of these countries is examined.

The ratio of foreign reserves to GDP for country is a good indicator of the country's ability to sterilize or reduce the effects of externally generated shocks. Figure 5.3 plots the ratio of foreign reserves to GDP for Argentina, Brazil, Chile and Mexico. The ratio of foreign reserves to GDP for Chile has been consistently high and stable over the years. The ratios for Argentina, Brazil and Mexico have generally been far lower than those for Chile. It can also be noted form the figure that from the mid 1990s to 2000, Argentina had much higher foreign reserves to GDP ratios than either Brazil or Mexico. The information shown in the figure is consistent with the view that given an external shock, Chile would be able to sterilize the effects on domestic credit better than Argentina, Brazil and Mexico. It is also expected that Argentina would perform better

than Brazil and Mexico, but the recent crisis in 2001 may have depleted the foreign reserves and Argentina more vulnerable.

Table 5.4

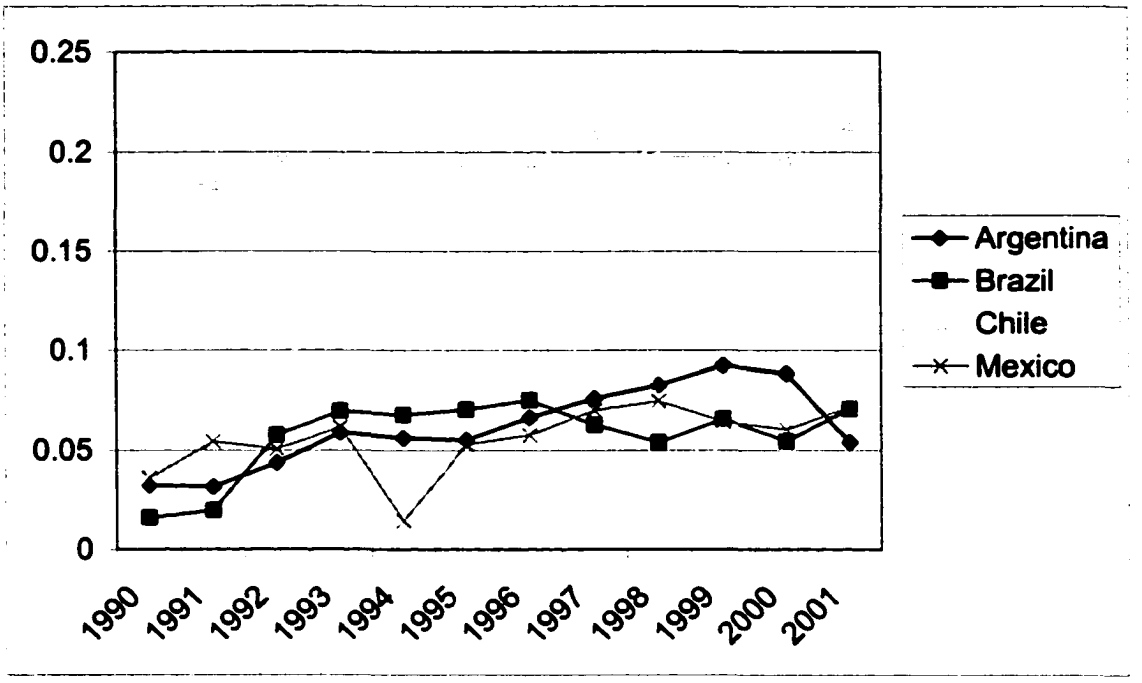
Share of Net U. S. Equity Flows to the four Countries

	Average of cumulative equity flows/equity capitalization	Average of cumulative equity flows/GDP
Country	Post 1990	Post 1990
Argentina	0.0837	0.0090
Brazil	0.1271	0.0093
Chile	0.0578	0.0226
Mexico	0.2411	0.0253

Source: Bekaert *et. al.* (2002).

Figure 5.3

Foreign Exchange Reserves to GDP Ratio for Latin American Countries



Source: Created by author from IFC 2000 Statistics.

Trends in the Risk and Return Statistics of the four Stock Markets

The causal links between the macroeconomic volatility and stock market volatility are unclear at this point, but seem, on the whole, to underpin the relationship between risk, return and stock market volatility in the emerging Latin American stock markets. Tables 5.4 and 5.5 below report the performance of the four Latin American stock markets over the 1986-1996 and 1995-1999 subperiods, respectively. The stock markets of Argentina, Brazil, Chile and Mexico have performed differently between these two subperiods in terms of risk and return and mainly due to changes in currency, exchange rates regimes and inflation. Historically, Argentina until December 1991 used the austral as it official currency as well as a floating exchange rate regime. The peso became its official currency in 1992 under practically fixed exchange rate regime. Thus the variability of the Argentinean peso has been very low since 1991.

Brazil used the cruzeiro as its official currency until June 1994 when it was changed to the real under a floating exchange rate regime. The change to the real was part of a successful anti-inflationary program. The Chilean economy on the other hand has exhibited a more stable exchange rate regime. The exchange rate has been adjusted quite frequently to reflect other economic indicators, and so has been less variable as compared to other Latin American markets.

Mexico has used the peso as it official currency under a floating exchange regime. The devaluation of the Mexican peso in December 1994 caused a 40% depreciation of the currency and affecting the variability of the exchange rate. The spillover effect of the

peso crisis was felt across the markets in the region, as equity prices plummeted in the major Latin American stock markets.

Table 5.5 reports the risk and return characteristics of the four markets. The high variability of these stock markets during 1986-1996 is quite clear from the table. The volatility of the markets was 87.2%, 62.3%, 27.7% and 46% for Argentina, Brazil, Chile and Mexico respectively. The Latin American average for the same period was 14.4%. The results are more pronounced when volatility is measured in local currency. For example Argentina had a volatility of 155.5% in local currency compared with 87.2% in U.S. dollars and Brazil had a volatility of 93.8% in local currency compared with 62.3% in U.S. dollars. While the currencies of all the four countries depreciated over the period, the Argentinean and Brazilian currencies depreciated by 193.4% and 641.4% respectively.

The annual percentage return for all the countries is higher than the Latin American average as shown in the first column. The sum of the capital gain and dividend yields is also high for all countries when compared to the Latin American average. Brazil and Argentina exhibit much higher capital gain plus dividend yields of 226.6% and 654.6% respectively, but notice that the high currency depreciation in both countries reduces that to annual returns of only 33.2% and 13.3% respectively. The correlation of these markets with the Latin American index is generally low.

Table 5.6 reports the same risk and return indicators for the four countries in the period between 1995 and 1999. There are clear differences between the indicators in this table and those presented for the 1986-1996 period. First, the annual returns are much lower for all countries except Brazil, and the same is true for the Latin American average

Table 5.5

Risk and Return Characteristics of Latin American Emerging Stock Markets

(December 1986 – December 1996, in U.S. dollars).

	Annual Return %	Capital Gain + Dividend Yield %	Currency Gain %	Total Risk %	Domestic Risk %	Correlation with Latin America
Latin America	11.5	11.5	0.0	14.4	14.4	1
Argentina	33.2	226.6	-193.4	87.2	155.5	0.02
Brazil	13.3	654.6	-641.4	62.3	93.8	0.11
Chile	32.9	42.9	-10.1	27.7	26.8	0.12
Mexico	24.7	55.0	-30.3	46.0	43.5	0.35

Source: MSCI Perspectives, Emerging Markets, 1999.

Table 5.6

Risk and Return of Latin American Emerging Stock Markets

(December 1995 – December 1999, in U.S. dollars).

	Annual Return %	Capital Gain + Dividend Yield %	Currency Gain %	Total Risk %	Domestic Risk %	Correlation with Latin America
Latin America	5.8	5.8	0.0	31.6	31.6	1
Argentina	7.2	6.9	0.3	26.5	26.4	0.79
Brazil	21.2	45.2	-24.0	45.8	70.9	0.96
Chile	-4.2	1.5	-5.7	22.6	26.4	0.62
Mexico	20.0	29.9	-9.9	51.5	39.9	0.95

Source: MSCI Perspectives, Emerging Markets, 2000.

return. The currency depreciation is also lower for all countries. Compared with table 5.4, the volatility of the markets for all countries is lower as shown by the lower risk levels for both the U.S. dollar (total risk) and local currency (domestic risk).

For the same period, the correlation between the individual markets and the Latin American index increases, with Brazil and Mexico showing near perfect positive correlation with the regional index. Such high correlations with the regional index may be indicative of a high degree of interdependence across the Latin American stock markets in that period. It has been argued that the high correlations of local indexes with regional or global indexes are not indicative of market integration. To use the correlation of the local market return with the world return as a measure of integration is flawed (Bekaert and Harvey, 1995). This is because a country could be perfectly integrated into the world markets but have a low or negative correlation because its industry mix is much different from the average world mix. However, the correlations suggest that for diversification purposes, the Chilean market has a low correlation with the regional index and may provide some benefits in comparison to a portfolio invested in the remaining three countries.

CHAPTER 6

ECONOMETRIC METHODOLOGY

The distribution of the return series of the four Latin American stock markets does not follow a normal distribution; time dependency among returns is present, which suggest the presence of heteroscedasticity. The nature of the distributions suggest volatility clustering, where large returns are followed by large returns and small returns tend to be followed by small returns, leading to contiguous periods of volatility and stability. Such data require appropriate econometric modeling techniques in order to ensure proper interpretation and conclusions.

Engle (1982) developed a model to capture time-varying variance – the Autoregressive Conditional Heteroskedastic (ARCH) approach. The basic ARCH model has led to other related formulations describing the evolution of the variance of time series, such as the Generalized ARCH (GARCH) model. Among the various formulations of the GARCH models, the EGARCH approach has been identified as the most appropriate model for stock indexes (Kim and Kon, 1994), such as those used in this study. Moreover, parameter restrictions are not necessary because EGARCH models the log of the conditional variance, thereby guaranteeing that the variance will be positive. Furthermore, Engle and Ng (1993), report that asymmetric models such as EGARCH provide the best forecast of volatility. Based on the conceptual underpinnings of the

study, the hypothesized questions and the past performance of the exponential GARCH model, this study uses a multivariate EGARCH model.

Multivariate EGARCH model

The multivariate EGARCH model used in this study is based on one estimated by Christofi and Pericli (1999). Let $R_{i,t}$ be the logarithmic return at time t for each market i, for j macroeconomic variable, given that $j = 1, 2, 3, 4, 5, 6$ (1 = Exchange rate, 2 = Domestic interest rate, 3 = industrial production , 4 = money supply, 5 = MSCI world index, 6= the U.S. 3-month T-bill), $\mu_{i,t}$ and $\sigma^2_{i,t}$ the conditional mean and conditional variance respectively, and k is the lag length. $\epsilon_{i,t}$ is the innovation at time t (i.e. $\epsilon_{i,t} = R_{i,t} - \mu_{i,t}$) and $Z_{i,t}$ the standardized innovation (i.e. $Z_{i,t} = \epsilon_{i,t} / \sigma_{i,t}$) at time t. The model is specified as follows:

$$\mu_{i,t} = \beta_{i,0} + \sum_{j=1}^{7} \sum_{k=1}^{2} \beta_{i,j,(k)} R_{i,t-k} + \varepsilon_{i,t} \qquad (1)$$

$$\sigma^2_{i,t} = \exp\left[\alpha_{i,0} + \sum_{j=1}^{7} \sum_{k=1}^{2} \alpha_{i,j(k)} X_{j,t-k} + \gamma_i \ln\left(\sigma^2_{i,t-1}\right)\right] \qquad (2)$$

$$X_{j,t-1} = [|Z_{j,t-1}| - E(|Z_{j,t-1}|) + \delta_j Z_{j,t-1}] \qquad (3)$$

Equation (1) models the conditional mean return of country i, and is specified as a function of the lagged values of its exchange rates, interest rates, industrial production, money supply, the MSCI world index and the U.S. 3-month T-bill rates. Similar to Fama (1990), the residuals from first-order autoregressions fitted to these variables are used as

proxies for shocks to returns. This specification is meant to investigate the first question of the study – whether the mean shocks of macroeconomic variables are transmitted to the stock market in each emerging market. The coefficient $\beta_{i,j}$ measures the degree of effects across macroeconomic variables. A significant $\beta_{i,j}$ coefficient would imply that variable *j* leads market *i*, or equivalently, that current returns in variable *j* can be used to predict future returns in market *i*.

The hypothesis tested is that each macroeconomic variable is important in explaining the returns of a given country. So the null hypotheses here is that:

H_0: $\beta_{i,1} = 0$

H_0: $\beta_{i,2} = 0$

H_0: $\beta_{i,3} = 0$

H_0: $\beta_{i,4} = 0$

H_0: $\beta_{i,5} = 0$

Eq. (2) describes the conditional variance process as an extended EGARCH process, which allows the testing and measuring of the asymmetric impact of both its own and the domestic and global macroeconomic variables' past standardized innovations on the conditional variance of a market. The specification here examines the research questions regarding the transmission of macroeconomic volatility shocks and whether they are persistent over time. The coefficient $\alpha_{i,j}$ in Eq. (2) captures the effect of innovations from macroeconomic variable *j* to market *i*. This coefficient specifically measures the significance of past volatilities (standardized residuals) in each macroeconomic variable on the conditional variance of the equity returns.

Significant $\alpha_{i,j}$ implies that the past volatilities of a macroeconomic variable impacts the conditional volatility of the equity returns. The null hypotheses tested here are that past volatilities in the *j's* do not impact the conditional variance of the equity returns:

H_0: $\alpha_{i,1} = 0$

H_0: $\alpha_{i,2} = 0$

H_0: $\alpha_{i,3} = 0$

H_0: $\alpha_{i,4} = 0$

H_0: $\alpha_{i,5} = 0$

H_0: $\alpha_{i,6} = 0$

The coefficient γ_i in Eq. (2) measures the persistence in volatility. A high value suggests that an information shock tends to persist for some time into the future. The presence of persistence in volatility clustering may imply the inefficiency of the market (Apergis and Eleptheriou, 2001). Potential determinants of this inefficiency could be the lack of technical organization, resulting in the gradual spread of information reflected in stock prices, as well as the low trading volume (Dockery and Kavussanos, 1996).

The variable $X_{j,t-1}$ is specified in Eq. (3) and is intended to capture the asymmetric effect of past standardized innovations, $Z_{j,t-1}(Z_{j,t-1} = \epsilon_{j,t-1}/ \sigma_{j,t-1})$, on current volatility. This specification is intended to investigate the third research question, whether there are asymmetric effects in the transmission of the volatilities of macroeconomic variables. The term $| Z_{j,t-1}| - E(|Z_{j,t-1}|)$ measures the size effect, while the term $\delta_j Zj_{,t-1}$ measures the sign effect. If the lagged values of the market and/or macroeconomic variable advance and decline impacts volatility symmetrically, the coefficient δ_j would not be expected to

be significant. The degree of asymmetry or leverage effect can be measured by the ratio $|\delta - 1|/(1+\delta)|$. This measure is based on the fact that the slope of $X_{j,t-1}$ is equal to $-1+\delta$ for negative values of $Z_{j,t-1}$ and $1 + \delta$ for positive values of $Z_{j,t-1}$ (Nelson, 1991; Koutmos and Booth, 1995). However, if declines in macroeconomic variable j ($Z_{j,t-1} < 0$) are followed by higher (lower) volatility than the variable's advances ($Z_{j,t-1} > 0$), then δ_j would be expected to be negative (positive) and significant. Assuming that $\alpha_{i,j}$ is positive, the larger the deviation of past standardized innovation from its expected value, the larger the impact (positive or negative) on the current variance. The null hypothesis tested is that:

H_0: $\alpha_{i,j} = 0$ and $\delta_j = 0$, for $\alpha_{i,j} > 0$ and $\delta_j < 0$

In other words, a significant positive $\alpha_{i,j}$ coupled with a negative δ_j implies that negative innovations in variable *j* have a higher impact on volatility of market *i* than positive innovations, i.e. the volatility transmission mechanism is asymmetric. Thus, bad news lowers stock returns, increases financial leverage, and increases volatility.

The above regression is associated with two possible shortcomings. One is the forward-looking element of asset prices. The EGARCH model is a nonlinear model and as discussed in Potter (1994), nonlinear models produce responses that are history and shock-dependent. The other shortcoming is the dynamic rather than static response of emerging stock markets to changes in macroeconomic variables (see IMF World Economic Outlook, 2002). The implication of these shortcomings is that there might be important interactions between shocks to the different variables that are not captured by the EGARCH model.

According to Ortiz and Arjona (2001), time dependency might extend itself beyond the first lag in the case of Latin American markets. They also argue that because

of the lack of sound and continuous information about Latin American economies and markets, as well as instabilities derived from non-economic facts, there is also the possibility of irregular lag significance. Ortiz and Arjona (2001) argue that due to the intrinsic characteristics of Latin American stock markets, not a single (G)ARCH model is found to depict market activity in all six markets. These problems can be addressed by estimating a vector autoregressive (VAR) model, and investigating dynamic responses generated from the VAR estimates.

VAR model and Impulse Response Functions

This study uses a six-variable vector autoregressive (VAR) model in order to capture such potential interactions in each market. The VAR model is particularly useful to analyze the postulated impacts in this study because no restrictions are imposed on the structure of the system, moreover, a VAR model can be viewed as a flexible approximation to the reduced form of the correctly specified but unknown model of the true economic structure (Soydemir, 2000b). Furthermore, artificial orthogonal shocks can be introduced in the system (Doan, 1990; Sims, 1980; Hamilton, 1994) to capture the "pure" effects of innovations and thus assess the degree of Latin American stock markets' sensitivity to the each macroeconomic variable.

The use of the VAR model also allows for the inclusion of the appropriate lag lengths in the investigation of the impact of the each macroeconomic variable. This is important because of the time delays in the production of information concerning the macroeconomic variables (Bilson et al., 2001; Ortiz and Ajorna, 2001). In particular, the transmission and incorporation of information contained in the variables into stock prices is not always instantaneous. It is possible that reporting delays create a lag between the

observation of data concerning a macroeconomic variable and the incorporation of that information into stock prices. Hence, a contemporaneous model in which all variables are measured at time *t*, would imply an assumption of contemporaneous association. As a result, the empirical VAR model and impulse response functions used this study lags the explanatory variables to incorporate delays in the release of information. Most studies find it adequate to model the time series behavior of stock market activity in terms of the most recent lag, *t*- 1. However, in the case of the Latin American markets, time dependency might extend itself beyond the first lag (Ortiz and Arjona, 2001). Because of the lack of sound and continuous information about their economies and markets, and because of instability derived from non-economic facts, there is also the possibility of irregular lag significance. This study employs the Akaike Information Criteria (AIC) and the Schwarz Criteria (SC) to select the appropriate lag length for VAR model.

The time series properties of the data are checked, by first testing for stationarity using the Augmented Dickey Fuller (ADF) test to avoid the possibility of finding spurious relationships.

After the estimation of the VAR model, the impulse response functions are derived from the estimated VAR model. An impulse response function measures the time profile of the effect of a shock on the behaviour of a series. As such, we can think of an impulse response function as the outcome of a conceptual experiment (Koop et. al., 1996). We could, for example, conceptualize an experiment where we investigate the time profile of the effect of a positive unit shock hitting a series at time *t*, assuming no further shocks hit the system afterwards as compared with a baseline or benchmark profile suitably defined. The idea is very similar to Keynesian multiplier analysis, with

the difference that the analysis is carried out with respect to shocks or "innovations" of macroeconomic time series, rather than the series themselves (such as investment or government expenditure). Reporting the IRFs without standard errors or confidence intervals is equivalent to reporting regression coefficient without t-statistics (Runkle, 1987). Instead, one can use confidence bands around the mean response (Doan and Litterman, 1986) for statistical inference. When the upper and lower bounds carry the same sign, the responses become statistically significant at the 95% confidence level.

CHAPTER 7

EMPIRICAL RESULTS OF THE EGARCH MODEL

This chapter presents the empirical results of the study. First, the exponential GARCH results for the relative effects of country and global factors on returns are reported. Second, using Wald test statistics, the results on integration are reported. Third, results for checking the specification of the E-GARCH model in this study are examined by showing Lagrange multiplier test statistics and diagnostic statistics for squares of the standardized residuals.

Analysis of EGARCH Coefficients

Table 7.1 reports the empirical results for all the Latin American countries, the past returns, modeled as lagged returns in the GARCH model are positive and significant in explaining current returns. This result is consistent with the volatility clustering phenomena of most emerging markets. That is, higher periods of returns are followed by higher returns and vice versa.

Table 7.1 also reports that the estimated coefficient of stock prices to exchange rate depreciation is negative and significant for Brazil and Mexico with coefficients of –0.028 and –0.114 respectively. This means that as the currency depreciates in these countries, stock prices fall. The negative signs of the coefficients on the exchange rate variables are consistent with the analysis being conducted from an international investor's perspective.

When investing in a risky asset, the investor is uncertain about its return, and will, if risk averse, require a market risk premium. According to the Capital Asset Pricing Model (CAPM) the expected risk premium in is proportional to the non-diversifiable risk exposure, which is the covariance between the asset return and the return of the market portfolio. Again, if the investor is risk averse, he or she should require both a market and an exchange rate risk premium. Moreover, if the asset is denominated in a foreign currency, the investor must also bear the exchange rate risk, and should demand an additional exchange rate premium. For example, a depreciation of the domestic currency will result in a decrease in the U.S. dollar denominated returns. Therefore increased risk of depreciation of the domestic currency increases the risk of dollar returns and should lead to an increase in the exchange rate premium. Such increase in risk premium can lead to an increase in the discount factor and a decline in stock prices.

The finding is also consistent with Akyuz (1993), who points out that external financial liberalization in Latin America has led to an interaction between two inherently unstable markets – the stock market and the market for foreign exchange. In the context of internal or external economic shocks, the relationship between these two unstable markets can lead to a negative feedback loop and even greater instability. The coefficients for Argentina and Chile on the other hand are negative and positive respectively and not significant. The non-significant coefficients for Argentina and Chile may be attributed to the exchange rate policies of the two countries. Argentina for example, has operated pretty much a fixed exchange regime for most part of the 1990s, thus limiting variability of the value of its currency. Chile on the other hand has exhibited a more stable exchange rate regime by adjusting frequently to reflect other economic

indicators. It is thus expected that the low exchange rate volatility in Argentina and Chile will have less impact on stock prices. Also, figure 5.3 shows that for the study period Chile had a high and stable reserve ratio to GDP and Argentina had quite a low although much higher ratio than Brazil and Mexico. So one would expect exchange rate shocks to be much felt in Brazil and Mexico than Chile and Argentina.

Table 7.2 reports the estimated coefficients of the conditional equation and shows that only exchange rate volatility in Brazil has a significant effect on stock price volatility. The coefficient is positive and significant at the 1% level. The implication of this result is that increases in exchange rate volatility in Brazil leads to increases in the volatility of the stock market. Again, looking at Figure 5.3, Brazil had a more unstable foreign reserve to GDP ratio than the rest of the countries, hence, investors tend to pay more attention to its exchange rate variability than the rest of the countries. As expected, the exchange rate coefficients for the rest of the countries are not significant and are consistent with the information presented in Figure 5.3. In that figure, Mexico, Chile and Argentina have higher external reserves/GDP than Brazil, thus reducing the risk associated with the exchange rate volatility in those countries.

Table 7.1 reports that the industrial production coefficient is positive for all four countries but significant in only Brazil and Chile. The positive signs are consistent with the view that financial securities are claims against future output therefore an increase in expected future economic activity will induce a higher expected return. The different industrial backgrounds of the four countries may provide some insights into the reason why Brazil and Chile have significant coefficients while Mexico and Argentina do not have. Peres and Stumpo (2000) find that in the 1990s, small and medium-size

manufacturing enterprise (SMEs) increased their share of total industrial productivity relative to large firms in Argentina and Mexico, while the opposite was true for Chile and Brazil. And since few large firms make up a large portion of market capitalization in these markets, one would expect the effect of industrial growth on stock returns to be less felt in the stock markets of Argentina and Mexico. In particular, Chile has an industrial base that is strongly related to its copper mines and so it is expect that an increase in that sector would significantly impact the economy. And although Mexico has a large manufacturing base, a good proportion of that belongs to foreign companies in the maquilas and most of them are not listed on the stock exchange. Moreover, the mixed result is not surprising considering arguments in the literature that the exact impact of real activity surprises on security prices cannot be determined a priori.

In fact most previous studies have found low or no effect of industrial activity on security prices. Hardouvelis (1987a), for instance concludes that financial markets respond primarily to monetary and not real activity news. Also, Pearce and Roley (1985) fail to find significance for announcements concerning unemployment and industrial production. According to Cheung *et al.* (1997), growth rates in industrial production proxying for expected future cash flows explain the variance of quarterly returns better than monthly returns. Using monthly stock returns, Chen, Roll and Ross (1986) also find that the explanatory power of real activity variables is low. So the failure to detect any significant effects may be due to the fact impact horizon is short under this model.

The interest rate variable performed better than exchange rates and industrial production in explaining the mean changes in the stock returns of the markets investigated. Table 7.1 reports that the coefficients for interest rates in the mean equation

are negative and significant as expected for all countries except for Mexico. The coefficients for Argentina, Brazil and Chile are – 0.013, -0.031 and –0.057 respectively and suggesting that increases in the interest rates of these countries significantly reduces stock prices. According to theory, increases in interest rates can lead to higher discount rates or cost of capital and so result in the reduction of stock prices. The negative coefficient for Mexico is however not significant. This is probably because since the peso crisis, Mexico has used a flexible exchange rate instead of interest rates to smooth money supply changes.

Ogaki and Santaella (2000) have also pointed out that there is an anomaly in modeling interest rates in Mexico for the 1990s. They point out that the normal-looking yield curve of Mexico before the Russian crisis became highly inverted at the onset of the crisis. They also suggest a structural break in interest rates and question whether short-term interest rate is a relevant instrument to achieve foreign exchange market objectives in Mexico. To control for such an anomaly, the model was re-estimated with a dummy to account for the suggested structural break. The result was still insignificant and so it is suggest that the apparent anomaly should be considered for future research.

Estimates of the conditional variance equation in Table 7.2 show that innovations to interest rate volatility are important in explaining stock price volatility in Brazil and Chile. The coefficients of Brazil and Chile are 0.3068 and 0.7604 respectively and both are positive and significant. That finding indicates that increases in interest rate volatility leads to higher stock market volatility. In the case of Argentina and Mexico, the coefficients are not significant in explaining stock market volatility. This result is not

surprising because Argentina has relied on its currency boards and used a fixed exchange rate as a policy tool rather than interest rates.

The money supply variable is negative and significant in Argentina (-0.219) and Brazil (-0.032). The tight exchange rate regimes in both countries coupled with their low foreign reserves/GDP ratios suggest that increases in money supply are not supported by adequate reserves. Consequently, as figure 5.2 shows, these two countries have experienced high levels of inflation that tends to depress stock prices. The coefficients of Mexico and Chile are negative but not significant. A possible explanation is that the frequent adjustment of the exchange rate in both countries to reflect other economic indicators reduces the inflationary impact of money supply increases. Also, both countries have had more stable economies in the recent pass, the main exception being the peso crisis, which of course was short lived because of external intervention.

In terms of the ratio of foreign reserves to GDP, Figure 5.3 shows that both Chile and Mexico higher ratios than Argentina and Brazil by the close of 2001. Which means they had enough foreign reserves to support money supply increases and prevent inflation. Figure 5.2 supports that argument by showing that both Mexico and Chile have had low and stable inflationary episodes as compared to Argentina and Brazil. It has been argued that money supply is related to the stock market in several ways (Cheung and Ng, 1992). For example, money supply fluctuations can affect stock prices through their effects on inflation uncertainty. Higher inflation uncertainty increases risk, the discount factor and so leads to a decline in stock prices. The differences in significance of the money supply variable may therefore reflect investors' perceived differences in the expected inflation across the four countries.

Table 7.2 reports that volatility in money supply is only important in explaining stock market volatility in Argentina. Historically, Argentina until December 1991 used the austral as its official currency as well as a floating exchange rate regime. The peso became its official currency in 1992 under practically fixed exchange rate regime. The low external reserves and lack of credibility for the fixed exchange rate tends to make any money supply increase a recipe for inflation and market instability. This is evident from the positive and significant coefficient of the money supply variable for Argentina in the conditional variance estimates. The result shows that money supply volatility does not significantly affect stock market volatilities in Brazil, Chile and Mexico. As has been explained earlier these countries have had relatively more credible monetary policies than Argentina and one can expect to see less volatility effects from them.

Table 7.1 reports the mean equation results and shows that all four countries are positively impacted by the global factor, MSCI world index. The coefficients for Argentina (0.036), Brazil (0.055), Chile (0.017) and Mexico (0.033) are all positive and significant. Looking at the coefficients, Chile appears to be less impacted by the global variable than the rest of the countries. The result is consistent with Soydemir (2000b) and Figure 5.3 which shows that Chile has had high and stable foreign reserves to GDP ratios and so more capable to sterilize against external shocks. This finding is also consistent with those established by previous studies and the International Capital Asset Pricing Model (ICAPM). The ICAPM implies that if international markets are integrated, then the world market risk is a significant pricing factor and assets with the same risk have identical expected return irrespective of the market. This finding suggests that the market reform and liberalization policies in these countries over the past two decades have

increased their interaction with the global economy. The findings are also consistent with Ferson and Harvey (1993) who show that most of the predictability in returns over time is related to the world index.

The MSCI world index variable performs weakly in the explaining volatility in all the four markets. All the estimated coefficients for this variable are insignificant, indicating that increased volatility of the world index does not necessarily lead to increased volatility of the four stock markets. This result may not be an indication of the lack of integration of these markets but probably due to their thin nature in terms of market capitalization and number of listed companies.

Table 7.1 also reports that in the mean equation, the U.S. 3-month Treasury bill is important in explaining the stock prices of the four Latin American countries. The coefficients for Argentina (-0.183), Brazil (-0.209), Chile (-0.216) and Mexico (-0.232) are significant and carry the expected negative sign. It has been found in previous studies that Latin American countries tend to have high U.S. equity ownership (Bekaert et al., 2002), therefore, the significant effect of the U.S. 3-month T-bill is expected.

The high coefficients for Mexico and Chile may be indicative of their strong financial links with the U.S. Table 5.4 reports U.S. equity flows to the four countries and shows that Mexico and Chile are first and second respectively in terms of U.S equity flows to GDP in Latin American countries. It is thus expected that the U.S. interest rates would impact these two countries more than Brazil and Argentina. In terms of the magnitude of the impact, Mexico has the highest. That finding is consistent with Soydemir (2000b), who finds that the U.S. T-bill had a relatively slow and varying impact on the equity markets of Mexico, Argentina, Venezuela, Columbia and Brazil. But

unlike the VAR used in that study, the result reported here is based on an EGARCH model and a different sample period. It has also been argued that T-bill yield changes are important to investors as they provide signals about future economic performance (Johnson and Jensen, 1993) and may also increase the discount rate factor for stock price valuation.

Table 7.2 reports that the conditional variance estimates for the U.S. 3-month T-bill are positive and significant for Chile and Mexico and insignificant for Argentina and Brazil. These results suggest that volatility of the U.S. interest rates tend to increase the volatility of the stock markets in Chile and Mexico but not those in Argentina and Brazil. It has already been suggested that a possible explanation for this finding is that Chile and Mexico have stronger economic ties with the U.S. by way financial flows, hence, the stronger transmission of interest rate volatility.

Table 7.1

Mean Effects of Macroeconomic Variables on Stock Returns

$$q_{i,t} = \beta_{i,0} + \sum_{j=1}^{7} \sum_{k=1}^{2} \beta_{i,j,(k)} R_{j,t-k} + \varepsilon_{i,t}$$

	Argentina		Brazil		Chile		Mexico	
	Est.	S.E	Est.	S.E	Est.	S.E	Est.	S.E
Past Returns	0.9667***	0.0106	0.9196***	0.0117	0.9548***	0.0057	0.9578***	0.0147
Exchange Rate	-0.0113	0.0157	-0.0279***	0.0061	-0.1507	0.1121	-0.1136*	0.0661
Industrial Productivity	0.0258	0.0179	0.0003*	0.0114	0.1661*	0.1736	0.3308	0.2956
Interest Rate	-0.0128**	0.0065	-0.0309***	0.0059	-0.0586**	0.0247	-0.0233	0.0365
Money Supply	-0.2193**	0.0103	-0.0322**	0.0069	-0.1376	0.1475	-0.1341	0.1376
MSCI World Index	0.0359***	0.0114	0.0548***	0.0126	0.0173*	0.0088	0.0328***	0.0104
U.S. 3-month Treasury bill	-0.1829***	0.0174	-0.2085***	0.0114	-0.2155***	0.0068	-0.2319***	0.0104

Notes: ***, ** and * indicate significance at the 1%, 5% and 10% levels. The dependent variable is the expected return for each stock market and the independent variables are exchange rate, industrial productivity, interest rate, money supply, Morgan Stanley Capital International – World Index and the U.S. 3-month T-bill.

Table 7.2

Effects of Macroeconomic Variables on Conditional Variance of Returns

$$\sigma^2_{i,t} = \exp\left[\alpha_{i,0} + \sum_{j=1}^{7}\sum_{k=1}^{2}\alpha_{i,j(k)}X_{j,t-k} + \gamma_i \ln\left(\sigma^2_{i,t-1}\right)\right]$$

	Argentina		Brazil		Chile		Mexico	
	Est.	S.E	Est.	S.E	Est.	S.E	Est.	S.E
Exchange Rates	0.0550	0.0312	0.1543***	0.0852	-2.6376	1.7179	3.1509	3.2406
Industrial Productivity	0.6805	0.3634	0.0842	0.0786	2.7135	2.0442	0.5258	2.4342
Interest Rate	0.0155	0.0174	0.3068***	0.0765	0.7604*	0.4343	1.0734	1.1591
Money Supply	2.7272***	0.8078	0.1192	0.1153	0.0105	2.7107	1.6646	1.7109
MSCI World Index	-0.3331	0.2904	-0.0624	0.0962	-0.0381	0.0898	-0.0313	0.1643
U.S. 3-month Treasury bill	0.0251	0.0647	0.0605	0.0392	0.3032**	0.1277	0.2875*	0.1694
Asymmetric effect	-0.1815*	0.1082	-0.4119***	0.1252	0.5683***	0.1667	0.0243	0.1284
ARCH + GARCH Terms	0.9069		0.9368		0.3024		0.1363	
R^2	0.976		0.968		0.994		0.990	

Notes: ***, ** and * indicate significance at the 1%, 5% and 10% levels. The conditional variance equation above specifies the conditional variance of each index as a function of lagged standardized innovations from the country and global factors.

Analysis of Asymmetric Component

The exponential GARCH (EGARCH), proposed by Nelson (1991) estimates the conditional variance as a function of standardized innovations and allows the conditional variance to respond asymmetrically to positive and negative innovations. The estimates from the multivariate EGARCH model shows that the country and global variables do not impact stock prices symmetrically as has been assumed by previous studies. Table 7.2 reports that the symmetry effect hypothesis is rejected in three markets out four, suggesting that macroeconomic variables do exhibit asymmetric effects. In the case of Argentina and Brazil the coefficients are –0.182 and –0.412 respectively, and both are significant. The negative signs indicate that negative news about macroeconomic variables in these countries affect stock prices more than positive.

The results also suggest that stock market sensitivity to macroeconomic news depends on the size and sign of the surprise in the news. For Argentina and Brazil, the results suggest that bad economic news is followed by higher stock market volatility than good economic news. In addition to interpreting the asymmetric coefficient in the EGARCH model, a sign bias test was conducted to explore the impact of positive and negative innovations on volatility not predicted by the model. In that estimation, $\varepsilon_{i,t}$ is the error from the conditional mean equation of the *i*th market as of *t* and $\sigma_{i,t}$ is the square root of its conditional variance. The standardized residuals are regressed against a constant and a dummy D_t , which takes the value of 1 if ε_{t-1} is negative and zero otherwise. The test is carried out based on the *t* statistic of the coefficient for D_t.

Table 7.3 reports the results of tests for the asymmetric effect of new information on the volatility of stock market returns as developed by Engle and Ng (1993). The

results show that for the four Latin American markets, the negative innovations have significant effects on their volatility beyond what is predicted by a model with symmetric responses. Besides the coefficients for the four markets are all negative as expected and consistent with the leverage effect discussed above.

Table 7.3

Volatility Specification based on News Impact Curve

$$(R_{i,t}/\sigma_{i,t})^2 = a + \alpha D_{i,t} + \varepsilon_{i,t}$$

	Argentina	Brazil	Chile	Mexico
Sign bias (t-values)	-13.616	-17.330	-16.762	-17.384

The table presents the results of tests for the asymmetric effect of new information on the squared residuals as developed by Engle and Ng (1993).

This finding is consistent with previous findings and has been linked to the "leverage effect". According to this conjecture, negative stock returns yield a higher debt-to-equity ratio. One explanation is that the leverage of the firm increases with negative returns, inducing a higher volatility. According to Bekaert and Harvey (1997), these leverage effects will most likely be found in firms that already employ considerable debt financing. Therefore, the finding is also consistent with the relatively high level of debt in the capital structure of most Latin American firms (see Aggarwal and Baliga, 1995).

Analysis of Market Integration

Wald Coefficient test

In this section, the Wald test is used to test the hypothesis regarding the influence of the country and global variables and to investigate the existence of segmentation/integration. This approach is consistent with previous studies such as Bekaert and Harvey (1997a) and Cheung *et al.* (1997).

Table 7.4 reports the Wald test statistics on whether all the coefficients for the domestic macroeconomic variables are different from zero. The Wald statistic measures how close the unrestricted estimates come to satisfying the restrictions under the null hypothesis that the effect of the variables is zero. In other words, do innovations from exchange rates, industrial production, interest rates and money supply impact the conditional volatility of the returns in each of the four markets. The hypothesis that the domestic macroeconomic variables do not influence returns is rejected.

The significant p-values for Argentina, Brazil, Chile and Mexico suggest evidence that the domestic macroeconomic factors significantly influence each country's stock returns. This finding is consistent with Harvey (1998, 2000), who reports that only local market variance explains the cross-section in emerging markets; and in such markets, market price of risk reflects how risk is treated locally. These results also indicate that evidence of perfect integration of these market with the world economy is lacking since domestic variables seem be important.

Table 7.5 reports the results for the Wald coefficient test for the global factors. It is evident that MSCI world index and the U.S. 3-month T-bill are together significant in explaining part of the dynamics observed in the stock markets of the four Latin American

countries. The hypothesis that these factors do not influence stock returns in the four countries is rejected. According to Bekaert and Harvey (1995), if a market is segmented from the rest of the world, its covariance with a common world factor may have little or no ability to explain its expected returns. The fact that the four markets show significant responses to the two world factors would suggest that some level of integration with the world economy exist. The finding is also consistent with asset pricing studies that assume that world capital markets are perfectly integrated. These include studies of a world CAPM (Harvey, 1991b), a world CAPM with exchange risk (Dumas and Solnik, 1995) and world multibeta models (Ferson and Harvey, 1993; 1994a, 1994b). However, Bekaert and Harvey (1995) cautions that rejection of these models can be viewed as a rejection of the fundamental asset pricing model, inefficiency in the market, or rejection of market integration.

Table 7.6 reports the Wald test result of the hypothesis that the combined effect of the country and global factors does not explain the stock prices of the four countries. The null hypothesis that both country and global factors do not influence stock prices in each country is rejected at the 1% significance level. The result points to the joint importance of both the country and global variables in explaining stock returns, hence, the existence of the so-called mild segmentation/integration model (see Errunza, Losq, and Padmanabhan, 1992).

Table 7.4

Wald Coefficient test for Domestic Factors

	Domestic Macroeconomic Variables H_0 : c(2)=c(3)=c(4)=c(5)=0 in the mean equation	
	F-statistic	Probability
Argentina	2.2344	0.0682
Brazil	17.2573	0.0000
Chile	6.0231	0.0002
Mexico	2.6139	0.0377

Note: c(2), c(3), c(4) and c(5) denote coefficients for exchange rates, interest rates, industrial production and money supply respectively.

Table 7.5

Wald Coefficient test for Global Factors

	Global Variables H0 : c(6)=c(7)=0 in the mean equation	
	F-statistic	Probability
Argentina	66.6213	0.0000
Brazil	182.7572	0.0000
Chile	579.8365	0.0000
Mexico	259.8937	0.0000

Note: c(6) and c(7) denote coefficients for MSCI world index and the U.S. 3-month T-bill respectively.

Table 7.6

Wald Coefficient test for Domestic and Global Factors

	Country and Global Factors H_0 : c(2)=c(3)=c(4)=c(5)=c(6)=c(7)=0 in the mean equation	
	F-statistic	Probability
Argentina	33.3407	0.0000
Brazil	75.1722	0.0000
Chile	222.9262	0.0000
Mexico	595.2108	0.0000

Note: c(2), c(3), c(4), c(5), c(6), c(7) denote coefficients for exchange rates, interest rates, industrial production, money supply, MSCI world index and the U.S. 3-month T-bill respectively.

Model Evaluation

Given the complexity of financial markets and the absence of specific theoretical models for the appropriate functional form, model selection is a difficult issue (Loudon *et. al.*, 2000). It is therefore important that specification test be conducted to evaluate estimated models. To evaluate the performance of the EGARCH model estimated in this study, several benchmarks and diagnostic statistics are examined.

Lagrange Multiplier Test

The Lagrange Multiplier (LM) test can be used to test for serial correlation in the presence of a lagged dependent variable by analyzing how well the lagged residuals explain the residual of the original equation (in an equation that includes all the explanatory variables of the original model). In this study, the LM test is carried out to test whether the standardized residuals of the EGARCH model exhibit additional ARCH effects after estimation. If the variance equation is correctly specified, there should be no ARCH left in the standardized residuals. Table 7.7 reports results that show that the ARCH effects are insignificant as demonstrated by the p-values for the four countries.

Diagnostic Statistics

Table 7.8 reports some residual-based diagnostic tests that verify that the multivariate exponential GARCH model is correctly specified. The statistics show a reduction in the standard deviation of the standardized residuals as compared to those shown on the descriptive statistics of the raw returns. The reduction is an indication that the EGARCH model is specified well in terms of capturing the ARCH components of the data. The skewness and kurtosis figures are also lower and closer to zero and 3, respectively. These characteristics suggest that the EGARCH model used in this study is

able to capture most of the observed skewness and kurtosis in the data (see, Loudon *et al.*, 2000). Moreover, the correlograms (autocorrelations and partial autocorrelations) of the standardized and the squared standardized residuals also suggest that no ARCH effects remain. This is shown on the table by the Ljung-Box Q-statistics, LB for the standardized residuals and LB^2 for the square of the standardized residuals respectively. In both cases, the statistics are not significantly different from zero for all four countries. The test also fails to reject the Bera-Jarque test for the null hypothesis of normality.

Table 7.7

LM Test for Remaining ARCH effects in the Standardized Residuals

	Diagnostic Checks on Residual (Arch LM Test)	
	F-statistic	Probability
Argentina	1.0500	0.4052
Brazil	1.1140	0.3558
Chile	1.3378	0.2162
Mexico	0.9852	0.4591

Table 7.8

Diagnostic Statistics of the Residuals

	Country			
	Argentina	Brazil	Chile	Mexico
Mean	0.0038	-0.0798	0.0039	0.0355
Standard. Deviation	1.0041	1.0007	1.0012	0.9958
Skewness	0.1114	-0.0035	0.1021	-0.9958
Kurtosis	3.6493	3.3029	3.0561	2.9149
LB	48.342	44.762	33.548	44.593
	(0.082)	(0.125)	(0.586)	(0.106)
LB^2	13.458	12.995	9.773	12.806
	(0.337)	(0.372)	(0.636)	(0.383)
B-J	3.1429	0.6160	0.2994	0.3732
	(0.2077)	(0.7348)	(0.8609)	(0.8297)
Number of Observations	160	160	160	160

Notes: LB is the Ljung-Box statistic identifying the presence of autocorrelation, while LB^2 is the Ljung-Box statistic identifying the presence of heteroscedasticity. B-J is the Bera-Jarque test for the null hypothesis of normality. P-values are given in parenthese.

CHAPTER 8

EMPIRICAL RESULTS OF THE VAR MODEL AND IMPULSE RESPONSE FUNCTIONS

This chapter presents the empirical results of the study as estimated by the VAR model and impulse response functions. First, the results of the ADF unit root test and coefficients of the VAR model estimation are discussed. Second, the impulse response functions for the four countries are plotted and the results analyzed to determine the relationship between the macroeconomic variables and stock market returns.

Augmented Dickey Fuller Unit Root Test

Before estimating the vector autoregressive model and the impulse response functions, unit root test are performed to check the time series properties of the data. Table 8.1 reports that the Augmented Dickey fuller test results and shows that the series are stationary and integrated of order one I(0). The stationarity of the series at levels is not surprising because similar to Fama (1990) and Cheung *et. al.* (1997), this study derives standardized innovations from first-order autoregressions and uses them as proxies for shocks to the VAR model. Based on the Akaike information criteria and the Schwarz criteria, the appropriate lag length is determined to be six.

Vector Autoregressive Coefficients for Market Response

Table 8.2 reports the VAR coefficients for the response of each stock market to the shocks from the country and global factors. The results show that the MSCI world

index and the U.S. 3-month T-bill are important variables explaining stock price performance in all the four countries examined. Interest rates and exchange rates, each significantly impact stock prices in three out of the four countries examined. The significant coefficients for the MSCI world index, the U.S. 3-month T-bill, interest rates and exchange rates do show the expected signs for the most part. The performance of the money supply and industrial production variable is generally weak and mixed in terms of the signs. This result is not unique since previous studies have documented weak and mixed signs for links between money supply and real activity on the one hand and stock prices on the other.

Table 8.1

Unit Root Tests

Augmented Dickey Fuller Test		
	Argentina	
	Standardized Innovations	Critical Value
Stock Returns	-5.892	
Exchange Rates	-5.382	-3.47 at the 1% level
Interest Rates	-6.678	-2.87 at the 5% level
Industrial Production	-7.527	-2.57 at the 10% level
Money Supply	-5.443	
	Brazil	
Stock Returns	-6.955	
Exchange Rates	-5.163	-3.47 at the 1% level
Interest Rates	-5.829	-2.87 at the 5% level
Industrial Production	-7.029	-2.57 at the 10% level
Money Supply	-4.684	
	Chile	
Stock Returns	-5.482	
Exchange Rates	-4.378	-3.47 at the 1% level
Interest Rates	-9.010	-2.87 at the 5% level
Industrial Production	-6.108	-2.57 at the 10% level
Money Supply	-5.812	
	Mexico	
Stock Returns	-5.719	
Exchange Rates	-4.874	-3.47 at the 1% level
Interest Rates	-5.597	-2.87 at the 5% level
Industrial Production	-6.511	-2.57 at the 10% level
Money Supply	-5.460	
	Global Factors	
MSCI World Index	-6.110	-3.47 at the 1% level
U.S. 3-month T-bill	-3.939	-2.87 at the 5% level
		-2.57 at the 10% level

Table 8.2

VAR Coefficients for the Response of Stock Markets to Macroeconomic Shocks

	Argentina		Brazil		Chile		Mexico	
	Est.	S.E	Est.	S.E	Est.	S.E	Est.	S.E
Constant	0.4870	1.1550	7.2225***	2.3806	-0.7303	0.7876	0.0054	0.0206
VRESMSCIWF(-1)	0.0334***	0.0158	0.0520***	0.0178	0.0312***	0.0093	0.0413***	0.0109
VRESMSCIWF(-2)	0.0264	0.0220	0.0343**	0.0252	0.0191**	0.0126	0.0121	0.0149
VRESMSCIWF(-3)	0.0037	0.0261	-0.0089	0.0288	0.0045	0.0143	0.0070	0.0166
VRESMSCIWF(-4)	0.0129	0.0267	-0.0212	0.0288	0.0160	0.0144	0.0004	0.0167
VRESMSCIWF(-5)	0.0124	0.0242	-0.0378	0.0261	0.0240***	0.0131	0.0098	0.0158
VRESMSCIWF(-6)	0.0265**	0.0179	-0.0054	0.0198	0.0207***	0.0099	0.0213***	0.0123
VRESUSFTB3M(-1)	-0.1996***	0.0180	-0.2244***	0.0214	-0.2200***	0.0113	-0.2457***	0.0129
VRESUSFTB3M(-2)	-0.2772***	0.0307	-0.3517***	0.0351	-0.2405***	0.0268	-0.3030***	0.0279
VRESUSFTB3M(-3)	-0.2729***	0.0409	-0.3648***	0.0464	-0.2018***	0.0341	-0.2892***	0.0388
VRESUSFTB3M(-4)	-0.2383***	0.0434	-0.2783***	0.0475	-0.1891***	0.0346	-0.2269***	0.0423
VRESUSFTB3M(-5)	-0.1507***	0.0409	-0.1351***	0.0373	-0.1324***	0.0331	-0.1256***	0.0379
VRESUSFTB3M(-6)	-0.0803***	0.0280	-0.0625***	0.0229	-0.0466***	0.0239	-0.0473***	0.0235
VRESEX(-1)	-0.0833	0.2383	0.0747	0.3119	-0.3912	0.9770	-1.3846***	0.3038
VRESEX(-2)	-0.2449	0.3375	-0.6325**	0.4509	-0.3786	1.5437	0.3626	0.3928
VRESEX(-3)	-0.0787	0.3231	-0.6006	0.4510	1.1759	1.5598	-0.0877	0.4024
VRESEX(-4)	0.4247	0.3550	-0.1615	0.4475	0.3423	1.5945	0.3172	0.4049
VRESEX(-5)	0.3893	0.3294	-1.7841***	0.4492	1.6325	1.5866	0.1571	0.3977
VRESEX(-6)	-0.6064	0.4311	-0.4747**	0.3163	0.1720	0.9716	0.1915	0.3896
VRESINT(-1)	-0.0523***	0.0224	0.0579	0.0463	-0.0233	0.0532	-0.1946	0.1213
VRESINT(-2)	-0.0205	0.0266	-0.0629	0.0615	-0.0988**	0.0643	-0.0743	0.1200
VRESINT(-3)	-0.0200	0.0281	0.0090	0.0580	0.0153	0.0652	-0.1245	0.1206
VRESINT(-4)	0.0159	0.0270	-0.3079***	0.0567	-0.1003**	0.0681	0.0827	0.1177
VRESINT(-5)	-0.0124**	0.0228	-0.1971***	0.0573	0.0448	0.0674	-0.1039	0.1125
VRESINT(-6)	-0.0176	0.0178	-0.0558***	0.0340	-0.0008	0.0548	-0.0123	0.1043

Table continues on next page

	Argentina		Brazil		Chile		Mexico	
	Est.	S.E	Est.	S.E	Est.	S.E	Est.	S.E
VRESIP(-1)	0.0023	0.2987	0.7826**	0.3502	0.0260	0.2037	0.4018	0.4322
VRESIP(-2)	0.2386	0.3471	0.4471	0.3944	0.3055**	0.1966	0.4533	0.4838
VRESIP(-3)	0.3227	0.3397	0.2868	0.3864	0.2796**	0.1875	0.6273	0.4751
VRESIP(-4)	0.0632	0.3149	0.4558	0.3669	-0.1243	0.1863	0.0168	0.4618
VRESIP(-5)	-0.0017	0.3120	-0.3753	0.3497	0.2672**	0.1744	0.0971	0.4443
VRESIP(-6)	0.0324	0.2586	-0.5474	0.4163	-0.0973	0.1790	-0.1095	0.3808
VRESM1(-1))	-0.0551	0.2318	-0.0141	0.0616	-0.0664	0.1908	-0.0866	0.1813
VRESM1(-2))	-0.0921	0.2428	0.0355	0.1215	-0.0165	0.1866	-0.0253	0.1976
VRESM1(-3))	-0.4961***	0.2319	-0.0209	0.1425	0.2155	0.1839	-0.0865	0.2158
VRESM1(-4))	-0.2413	0.2284	0.1335	0.1562	-0.0038	0.1941	0.1538	0.2108
VRESM1(-5))	0.1018	0.2345	-0.2312**	0.1412	-0.2644	0.1965	-0.0665	0.2023
VRESM1(-6))	-0.5406	0.2242	0.0960	0.0727	-0.1687	0.1743	0.2236	0.2676
R-squared	0.7448		0.9858		0.8632		0.8516	
Adj. R-squared	0.6482		0.9805		0.8114		0.7954	
Sum sq. resids	3.9005		5.2597		1.4043		1.9466	
S.E. equation	0.1875		0.2167		0.1125		0.1324	
F-statistic	7.7121		185.4422		16.6708		15.1622	
Log likelihood	64.5236		42.2747		143.1844		118.0405	
Akaike AIC	-0.2795		0.0094		-1.3011		-0.9746	
Schwarz SC	0.5685		0.8537		-0.4531		-0.1266	

Note: ***, ** and * denote significant at the 1%, 5% and 10% level respectively.

Summary of results from the estimated models

Table 8. 3 reports a summary of the results from the two models and impulse response functions estimated in this study. The stock market in Mexico appears to be significantly impacted by one domestic macroeconomic variable, exchange rates and the two global variables. The Brazilian stock market is significantly impacted by all domestic macroeconomic variables and the global factors. The size of the impact of the MSCI world index for example is much bigger in Mexico than in Brazil. The results of Chile and Argentina indicate that they each have two domestic macroeconomic variables and the global factors significantly impacting their markets. However, the impact of the MSCI world index is less strong in these countries than Argentina. Based on these findings, one may conclude that Mexico is more strongly integrated with the world economy and followed by Brazil, Chile and Argentina in that order.

The analysis of the individual countries also suggest that in terms of economic stability, Mexico and Chile have had more stable economic environments than Brazil and Argentina in that order. Brazil and Argentina have experienced very high levels of inflation, implemented fixed exchange rate regimes and generally have lower foreign reserves to GDP ratios than Chile and Mexico.

Taken together, macroeconomic variability and risk for that matter is lower in Mexico and Chile than Brazil and Argentina. Based on the findings in this study, Mexico and Chile appear to provide lower macroeconomic risk than to investors. And in terms of global risk factors, Chile and Argentina are more insulated than Mexico and Brazil. Investor may therefore achieve more stable returns by diversifying across these countries than concentrating their portfolios in one country.

Table 8.3

Summary of Results under the EGARCH and VAR Models

	ARGENTINA		BRAZIL		CHILE		MEXICO	
	EGARCH	VAR/IRFs	EGARCH	VAR/IRFs	EGARCH	VAR/IRFs	EGARCH	VAR/IRFs
Exchange Rate	(-) NS	(-) NS	(-) S	(-) S	(-) NS	(-) NS	(-) S	(-) S
Interest Rate	(-) S	(-) S	(-) S	(-) S	(-) S	(-) S	(-) NS	(-) NS
Industrial Production	(+) NS	(+) NS	(+) S	(+) S	(+) S	(+) S	(+) NS	(+) NS
Money Supply	(-) S	(-) S	(-) S	(-) S	(-) NS	(-) NS	(-) NS	(-) NS
MSCI World Index	(+) S	(+) S	(+) S	(+) S	(+) S	(+) S	(+) S	(+) S
U. S. 3-month T-Bill	(-) S	(-) S	(-) S	(-) S	(-) S	(-) S	(-) S	(-) S

Note: NS and S denote not significant and significant respectively. Sign of estimated relationship in parenthesis.

Impulse Response Functions

Brazil

Figure 8.1 plots the response of stock returns in Brazil to an exchange rate shock. The response is negative and significant by the third month. The response around the mean is large suggesting that exchange rate is important in explaining stock prices. This finding is consistent with the argument that exchange rate depreciation leads to stock price declines. Figure 8.2 plots the response of stock returns to interest rate in Brazil. The response is negative and significant around the fifth month and smaller than the one associated with the exchange rate. The response becomes slightly positive in the sixth month. The negative sign is consistent with the finance theory that argues that increases in interest rates lead to increases in the cost of capital and a decline in equity prices. So the change in signs may be reflecting a shifting investors' risk perception as the shock plays out. One reason why the sign may be positive is that if the interest rate increase is perceived as being a real increase, then Brazil may attract more capital inflows from foreign investors and this will result in an increase in stock returns. Both Froot *et al.* (2000) and Clark and Berko (1996) find that increases in capital flows raises stock returns. Clark and Berko, for example, find that unexpected inflows of 1% of Mexico's market capitalization drives stock returns up by 13%.

Figure 8.3 plots the response of stock returns to industrial production and shows that industrial productivity increases lead to positive gains in stock returns. There is a short but positive and significant response in the first month and the sixth month. In both cases the response around the mean is large. The significant response of industrial productivity in Brazil is not surprising considering its large manufacturing sector. Also,

the result is consistent with the view that industrial productivity growth can be an indication of higher future cash flows, and so leads to an increase in stock returns. For example, Cheung *et al.* (1997) argue that financial securities are claims against future outputs, and so any increase in expected future levels of economic activity should induce a higher expected equity return.

The impulse response function in figure 8.4 shows that a shock to money supply has an immediate response that is negative and significant. Both the response around the mean and the duration of the response are smaller than those associated with the exchange rate variable. Nazmi (1997) points out that in Latin America, money supply and exchange rate have repeatedly been used as stabilization tools. Of these, the exchange rate, which gives domestic money instant credibility, has become increasingly popular. So it can be expected that investors would pay more attention to changes in exchange rates than money supply. Also Brazil has low and unstable foreign reserves as depicted by Figure 5.3 and that may suggest the lack of credibility for its exchange rate policy.

The MSCI world index and the U.S. 3-month T-bill in figures 8.5 and 8.6 respectively, are important in explaining the movement of stock returns in Brazil. The response of stock returns to a MSCI world index shock is positive and significant as expected. The dispersion of the response around the mean for the MSCI world index for example is bigger and has a longer duration than those in Argentina (figure 8.17) and Chile (figure 8.23). It is only Mexico (figure 8.11) that has a similar response around the mean but a longer duration than Brazil. This result may reflect the fact that Chile and Argentina have higher foreign reserves to GDP so are more able than Brazil and Mexico to reduce the destabilizing effects of this global variable. These results are also consistent

with Table 5.3 which reports that Brazil and Mexico have strong trade links with the U.S. and the world merchandise. Therefore one would expect a stronger impact of the global shock to Brazil and Mexico than Chile and Argentina. The negative and significant effect of the U.S. 3-month T-Bill probably indicates the strong financial and trade links between Brazil and the U.S. Tables 5.3 and 5.4 report that Brazil is second to Mexico both in terms of trade with the U.S. and size of U.S. equity flows/market capitalization. Therefore, one can expect U.S. economic shocks such as the 3-month T-Bill rate to have significant effects on returns in Brazil.

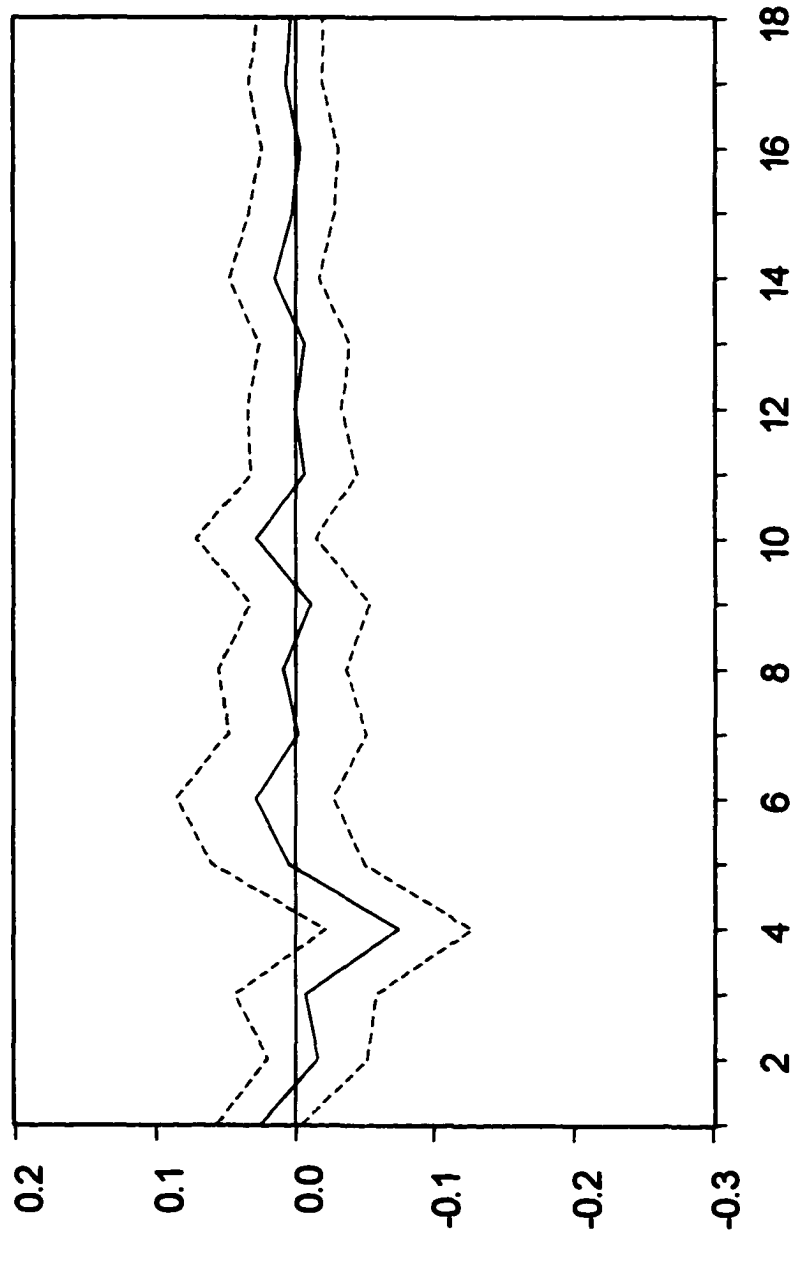


Figure 8.1

Response of Brazil to Exchange Rate

Figure 8.2

Response of Brazil to Interest Rate

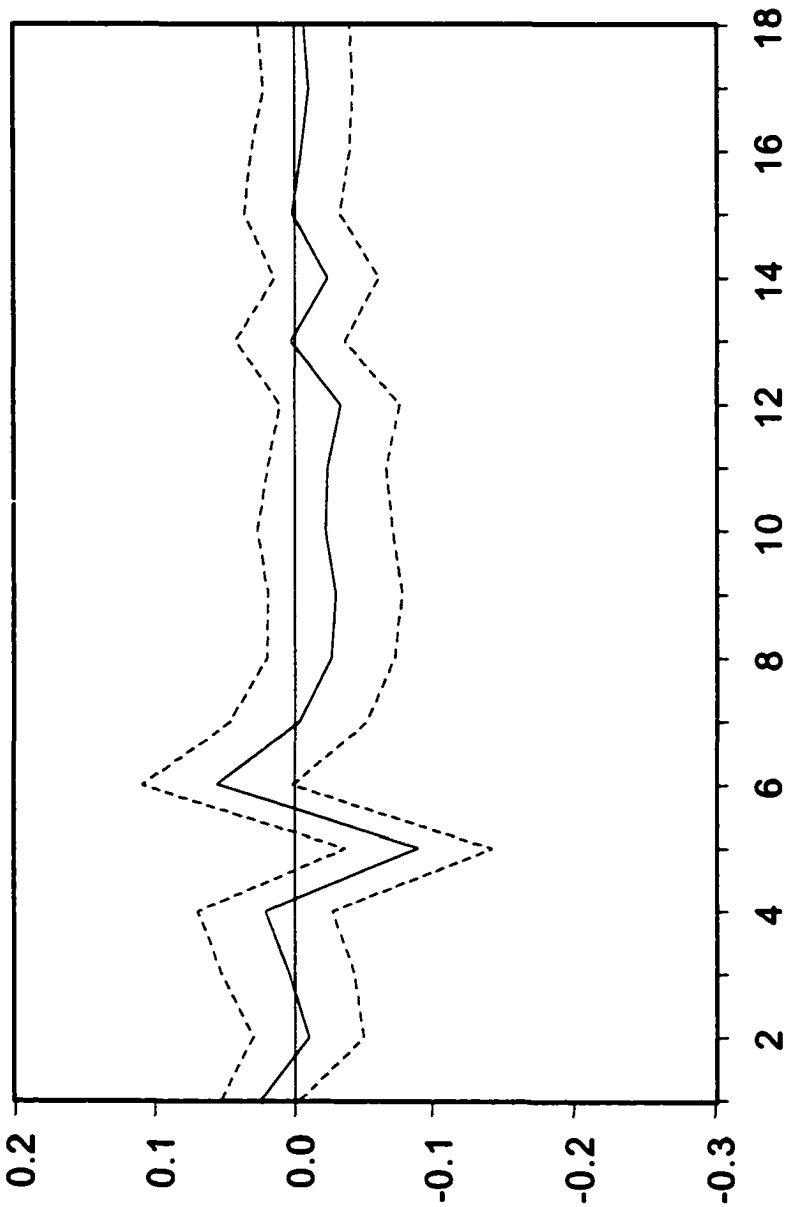
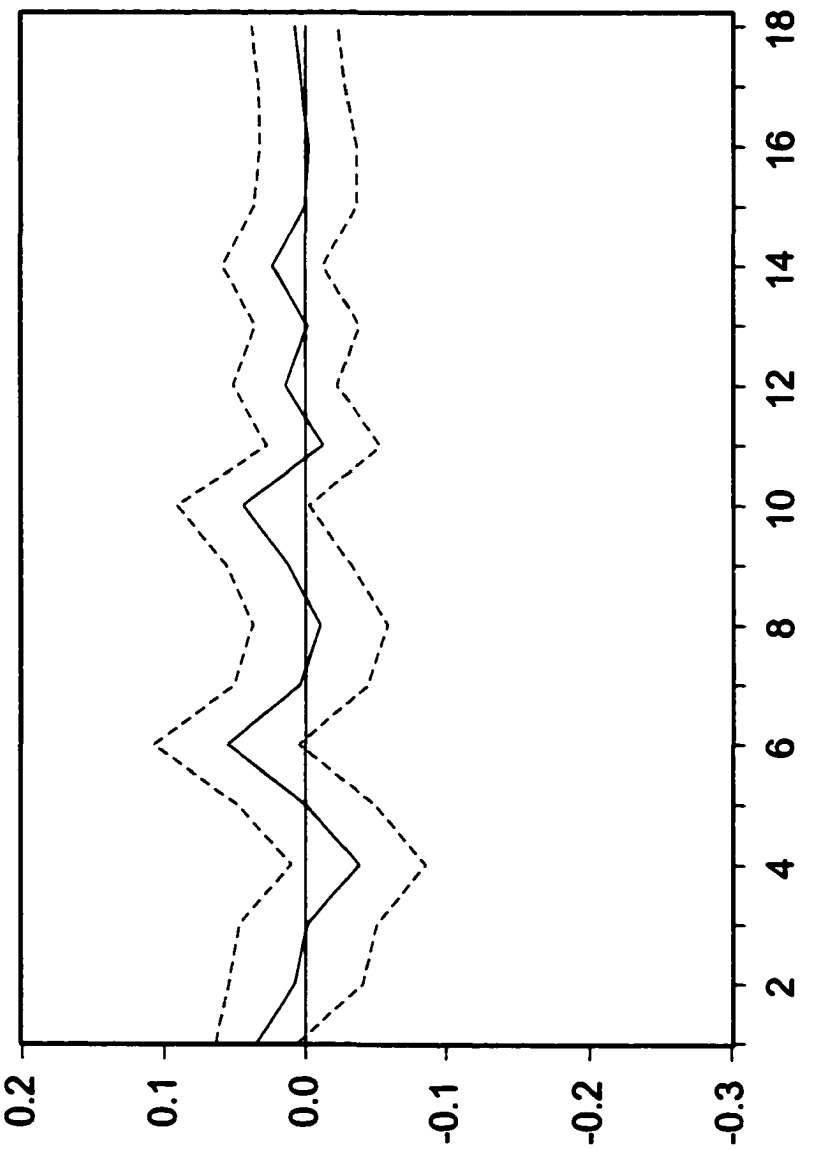


Figure 8.3

Response of Brazil to Industrial Productivity



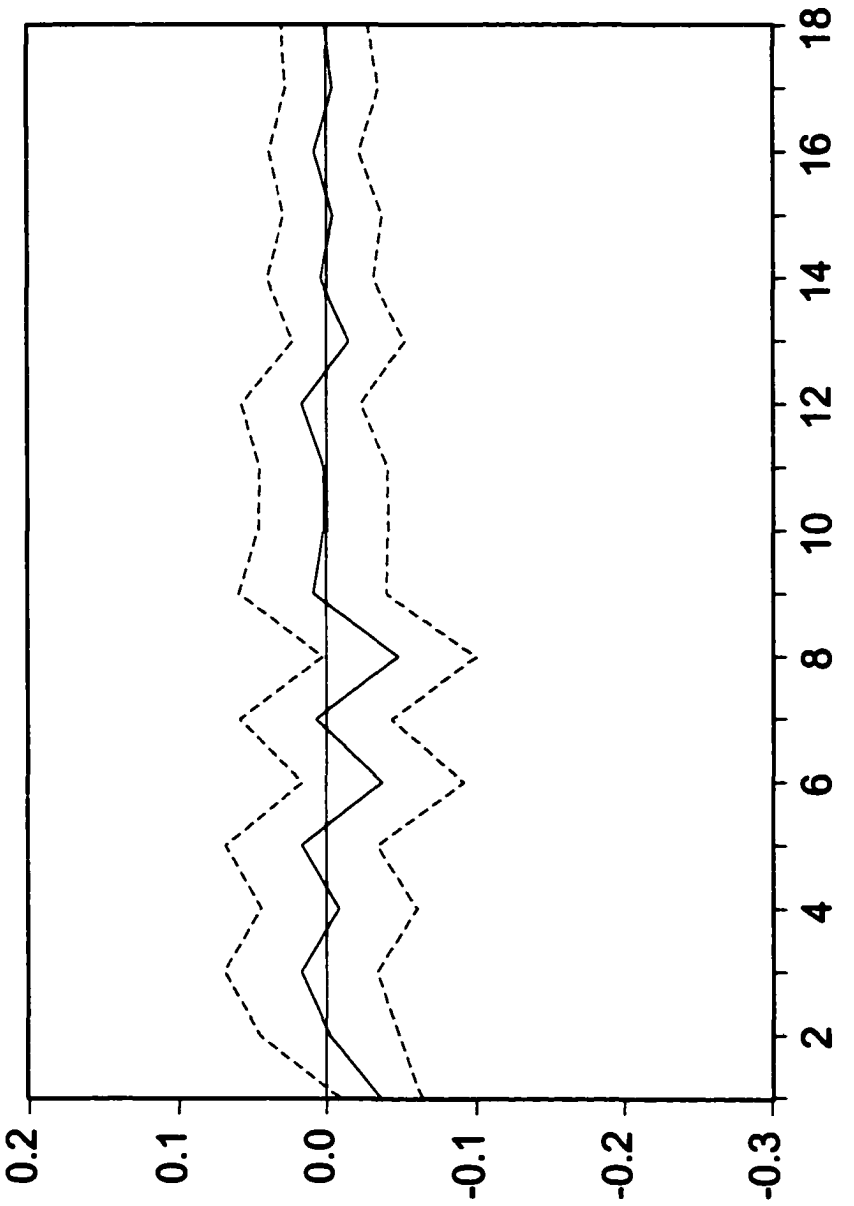


Figure 8.4

Response of Brazil to Money Supply

Figure 8.5

Response of Brazil to MSCI World Index

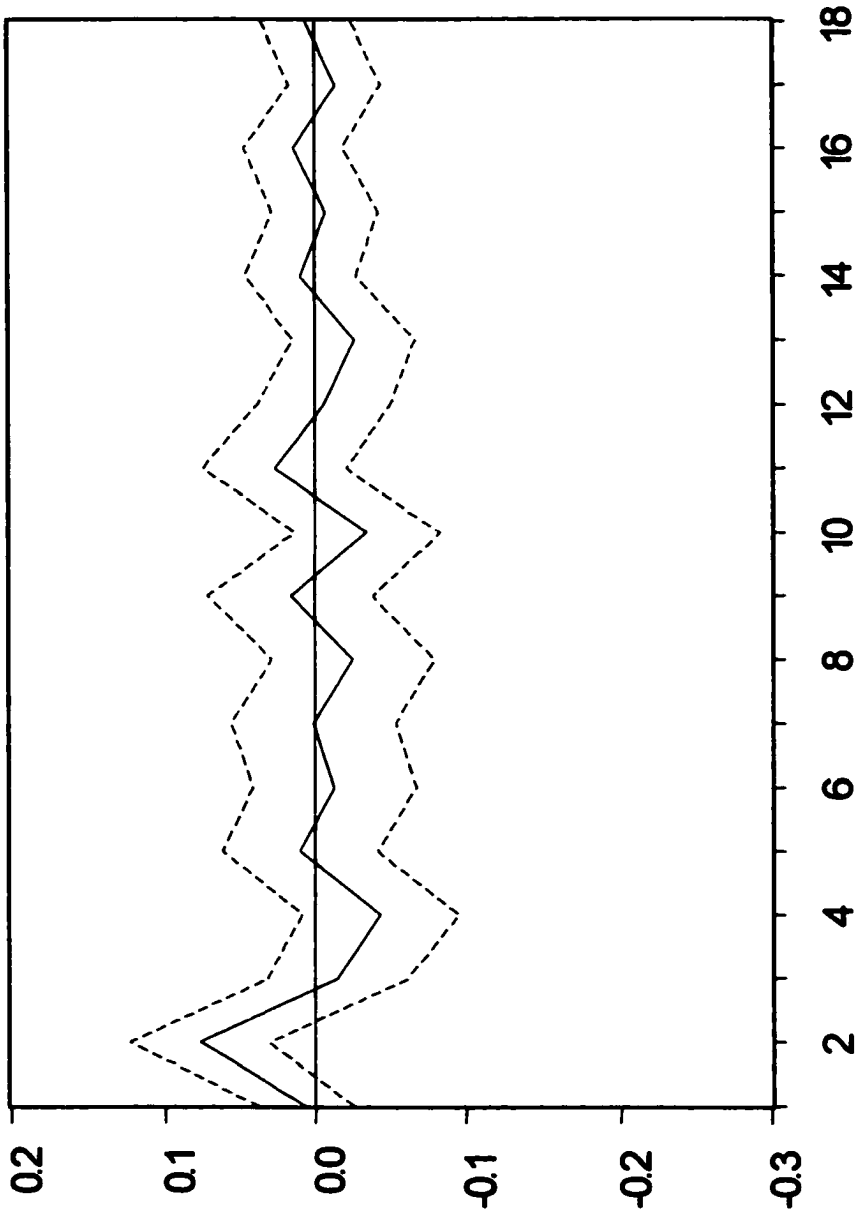
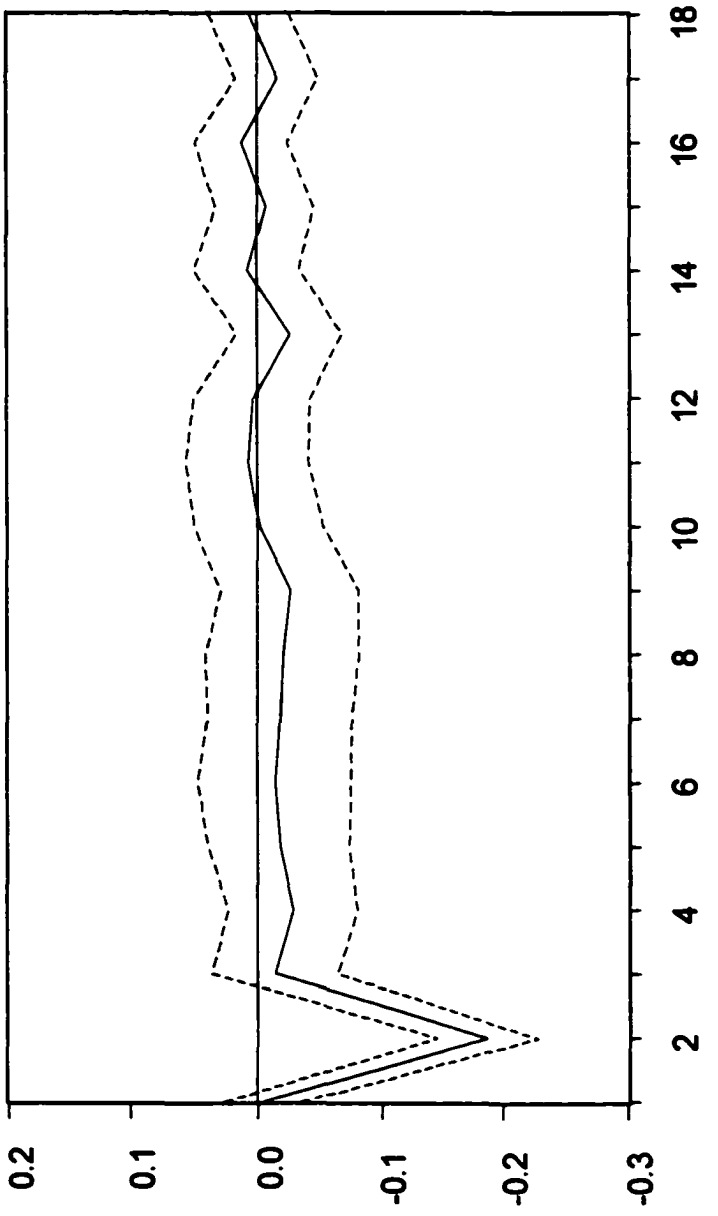


Figure 8.6

Response of Brazil to the U.S. 3-month T-bill



Mexico

The impulse response functions show that stock returns in Mexico respond significantly to a onetime innovation in exchange rates, MSCI world index and the U.S. 3-month T-bill. Figure 8.7 plots the response of stock returns to exchange rate and shows that it is negative and significant after half a month. The dispersion of the response around the mean is big and the duration ends immediately after the second month. Although Mexico has implemented a floating and stable exchange rate system since the peso crisis, the low external reserves of the country over the years makes exchange rate movement quite important. The result may also reflect the view that a depreciation of the currency leads to a shift away from Mexican equities because of a possible reduction in dollar denominated assets' return. The finding is also consistent with the foreign investor perspective as discussed under Brazil and would lead to a decline in the expected returns of Mexican stocks.

Figures 8.8, 8.9 and 8.10 plot the response of stock returns in Mexico to interest rates, industrial production and money supply respectively. The interest rate shock is barely significant and positive. The positive sign may appear to be inconsistent with the discount model that argues that an increase in interest rate should lead to a decline in stock prices through the discount factor. However, in the case of Mexico the positive sign may be valid because Mexico is known in the past to have attracted large amounts of capital flows because of its higher interest rates relative to the U.S. (Bekaert *et al.*, 2002). And focusing on Mexico, Clark and Berko (1996) find that an increase in capital flows raises stock prices, a phenomenon characterized as "price pressure" by Bekaert *et al.* (2002). Therefore, if foreign investors perceive the increase in Mexico's interest rates as

a real interest rate increase, capital inflows could increase and lead to stock price appreciation.

The impulse response functions for industrial production and money supply are not significant in explaining stock prices as shown in figures 8.9 and 8.10. Nazmi (1997) argues that instead of money supply, the exchange rate which gives domestic money instant credibility has become increasingly popular as a stabilization tool in Latin America. So it can be expected that investors would pay more attention to changes in exchange rates than money supply in Mexico. The explanation for the lack of significance of industrial productivity is similar to the one provided for the EGARCH model estimates.

Figure 8.11plots an artificial shock to the MSCI world index and shows that it leads to an increase in Mexican stock returns. The response is positive and significant at about one and a half month and last for another month. The duration of the response of the Mexican stock market to the MSCI world index is the longest among the four countries. This result can be explained by the information on trade links reported in Table 5.3. Between 1993 and 2000, Mexico outperformed the other three countries in terms of imports and exports to the U.S. as well as imports of world merchandise. Such huge trade links clearly demonstrates the links of the Mexican economy to the world. It is thus expected that a global shock would impact its stock market more strongly than the other markets. In terms of the ratio of foreign reserves to GDP, Mexico has one of the lowest among the four countries. So its ability to withstand external shocks is low and may be the reason why the duration of the shock is longer. This finding is also consistent with those established by previous studies and the International Capital Asset Pricing Model

(ICAPM). The ICAPM implies that if stock markets are integrated, then the world market risk is a significant pricing factor and assets with the same risk have identical expected return irrespective of the market.

Figure 8.12 plots the response of the Mexican stock market to the U.S. 3-month T-bill. The response is negative and significant, and may be attributed to the cost of capital effects of interest rate changes and its subsequent effect on stock returns. The Mexican economy has strong financial links to the U.S. in terms of bank lending and equity capital flows. Table 5.4 reports that since 1990, Mexico received the largest average U.S. equity ownership among the four Latin American countries. In terms of return-adjusted cumulative equity flows divided by market capitalization, Mexico was first and followed by Brazil and Argentina. Therefore, one would expect increases in U.S. interest rates to negatively affect the Mexican stock market as demonstrated by the IRFs. The strong trade links between the two countries as shown in Table 5. 3 also suggest that external shocks from the U.S. can greatly affect Mexico. Taken together, the results of the impulse response functions for Mexico are very similar to the ones reported for the EGARCH model.

Figure 8.7

Response of Mexico to Exchange Rate

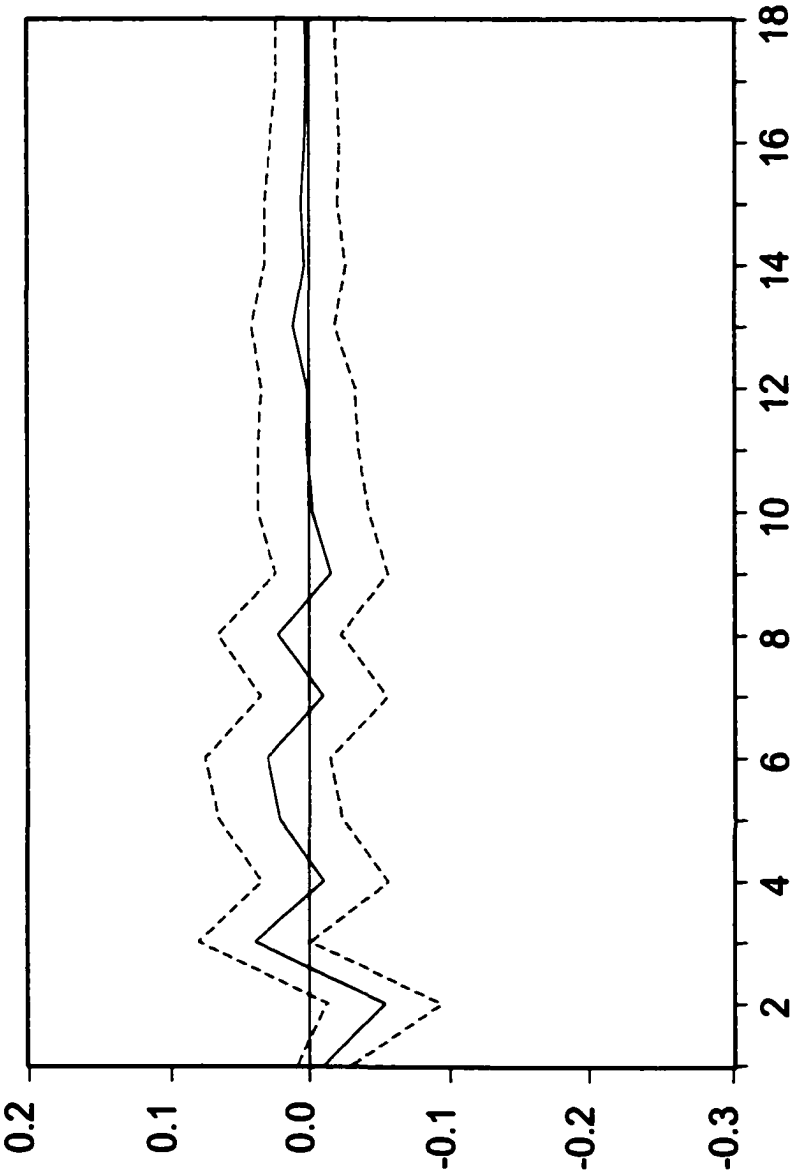


Figure 8.8

Response of Mexico to Interest Rate

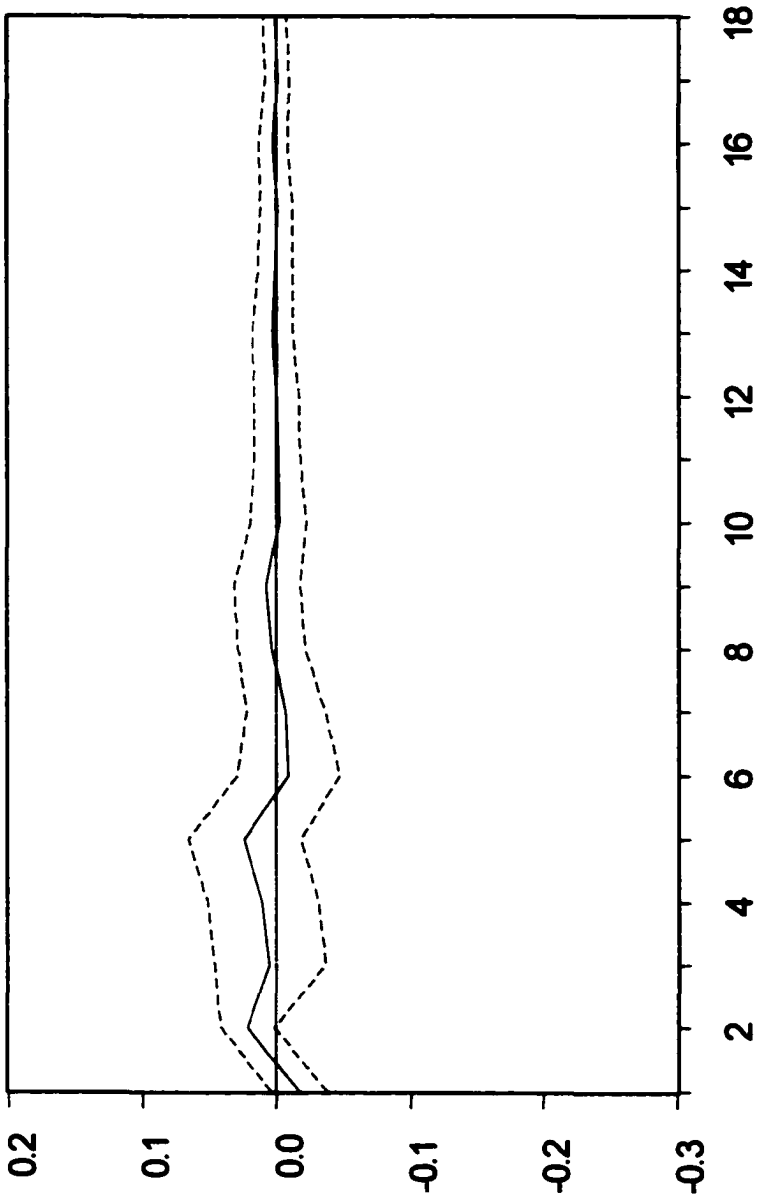


Figure 8.9

Response of Mexico to Industrial Productivity

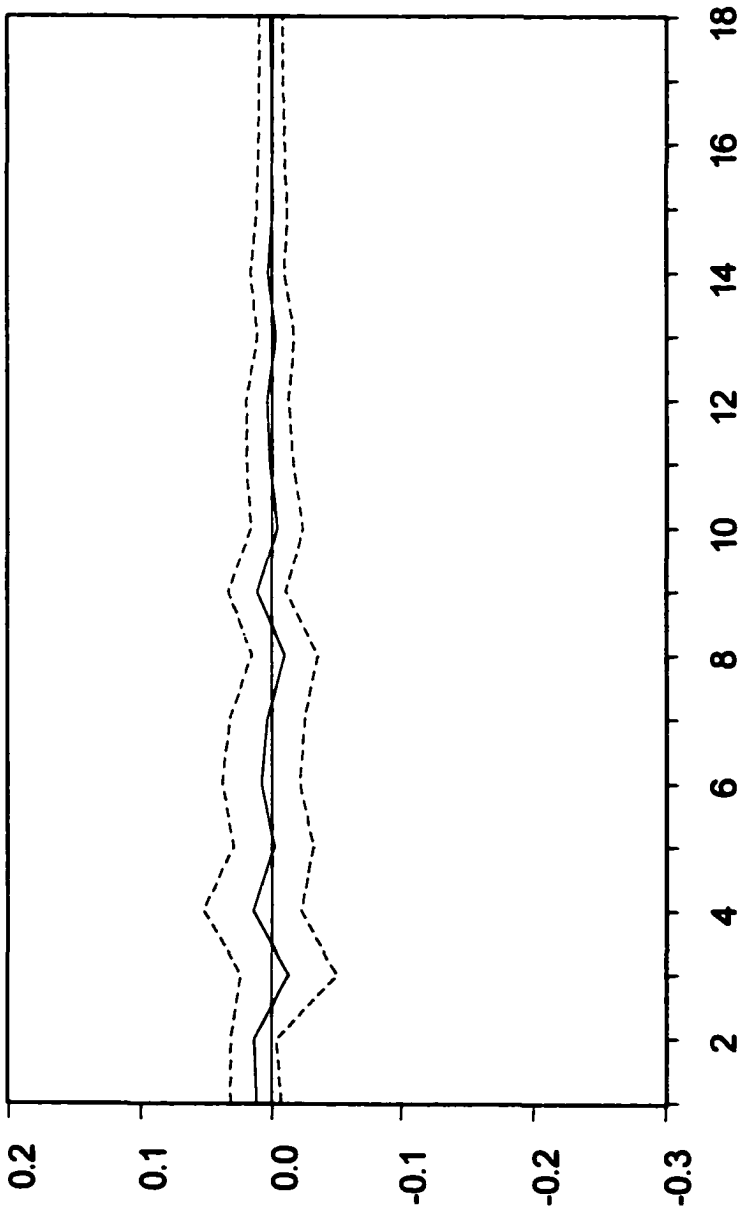
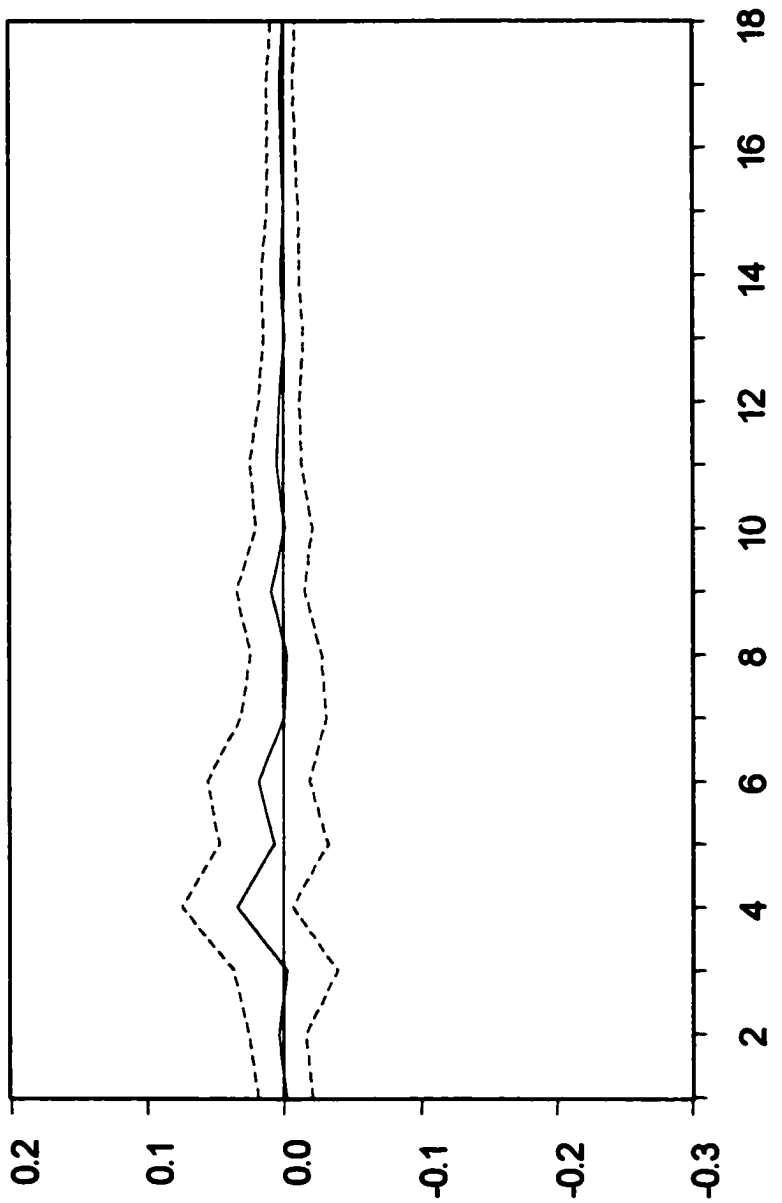


Figure 8.10

Response of Mexico to Money Supply



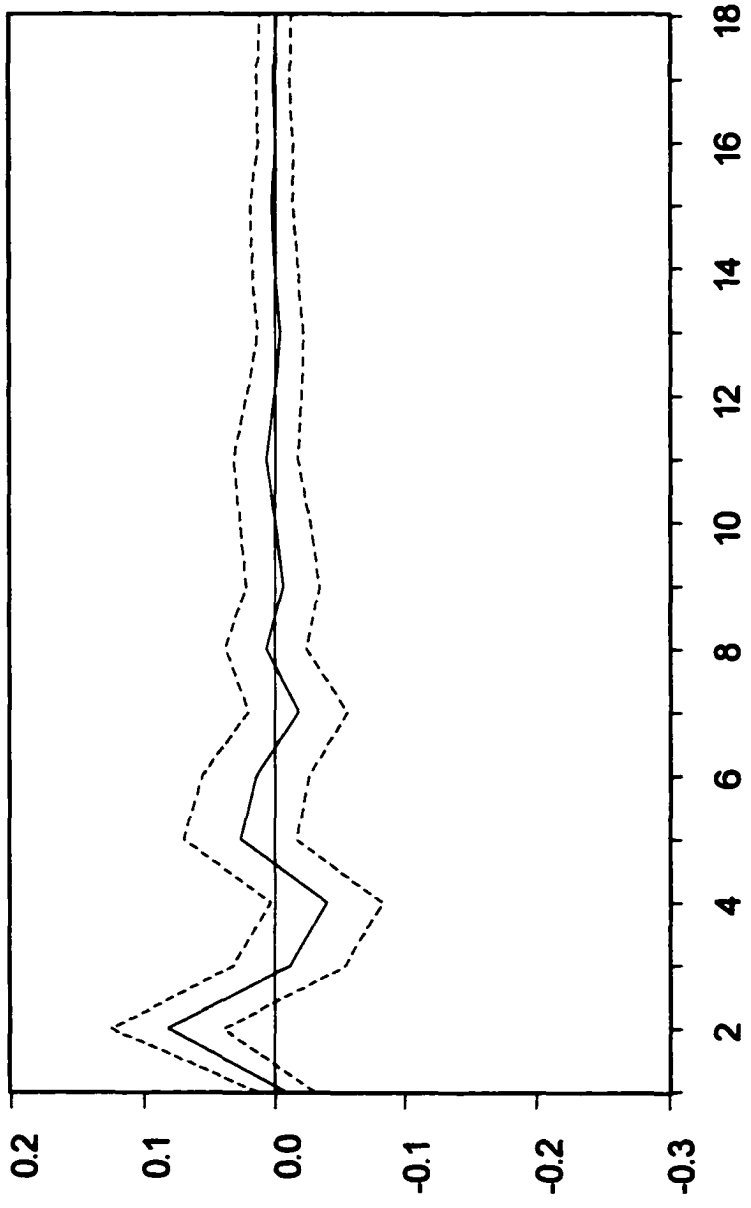


Figure 8.11

Response of Mexico to MSCI World Index

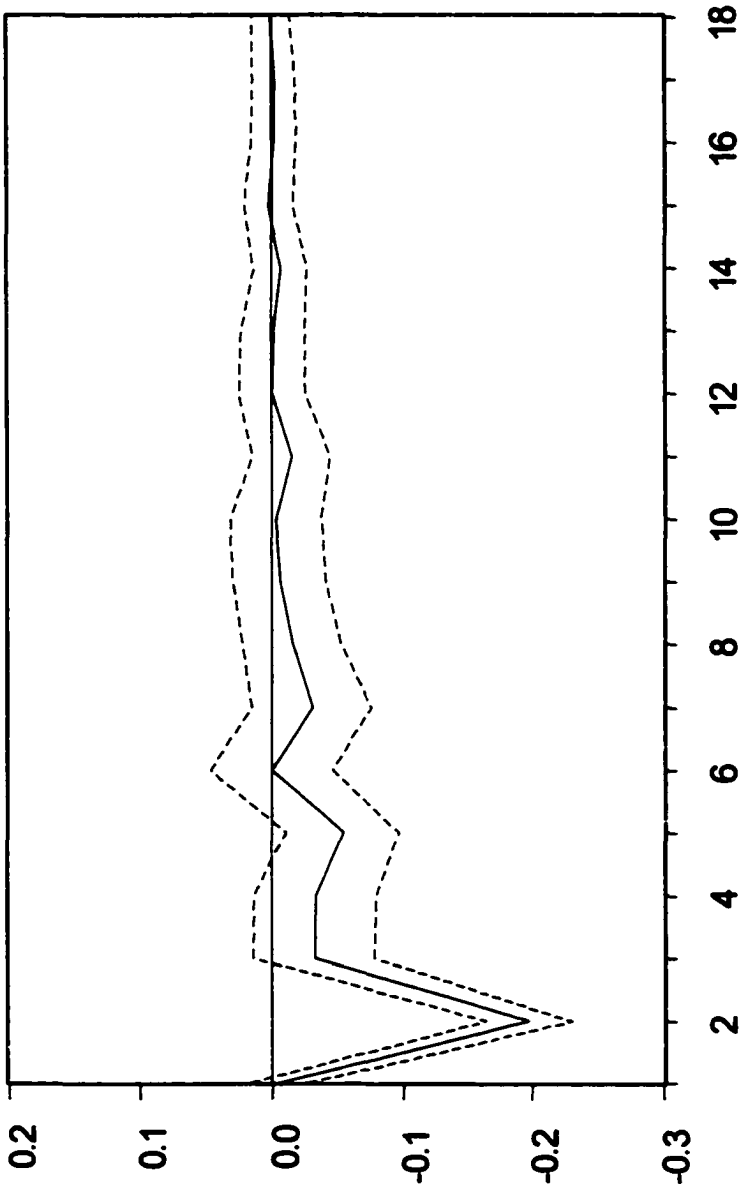


Figure 8.12

Response of Mexico to the U.S. 3-month T-bill

Argentina

The impulse response functions for Argentina show that interest rates, money supply, MSCI world index and the U.S. 3-month T-bill are important in explaining the dynamics of stock returns. In figure 8.13, the response of stock returns to exchange rates in Argentina is not significant. As explained in the EGARCH estimation results, Argentina has operated a more or less fixed exchange rate policy for the 1990s. Because of the fixed nature of the exchange rates, there is no variability and so it is normal that stock market investors do not react to that variable.

Figure 8.14 plots the response of Argentina stock market to a one-time interest rate shock. The response is initially negative and significant but changes to positive. The dispersion of the response around the mean is larger than those associated with industrial production, money supply, MSCI world index and the U.S. 3-month T-bill. The duration of the response is however brief. This finding indicates that an initial increase in interest rates leads to a decline in stock returns. Such a decline may be explained by the fact that an increase in interest rate raises the discount factor and leads to a lower present value for expected future cash flows. In terms of the positive response, Argentina has until recently been an attractive destination of emerging market capital flows. So if investor perceive the real interest rates in Argentina as been higher than for example, the U.S., capital flows to Argentina will be expected to surge and cause stock returns to increase – consistent with the findings of Froot *et al.* (2001) and Clark and Berko (1996).

Industrial production in Argentina does not appear to exert a significant impact on the stock returns. The impulse response function in Figure 8.15 shows that a shock to industrial production does not lead to a significant response by stock returns. The result is

similar to Mexico and can be attributed to the nature of the industrial structure and productivity in the two countries. A detailed discussion of this conclusion is provided for the two countries under the EGARCH model. This finding may also be due to the shorter return horizon (monthly) used in this study. For example, Fama (1981) and Kaul (1987) find that real activity explains more return variation for longer return horizons than shorter return horizons. According to Fama (1981), future production growth rates explain 6% of the variance of monthly returns on the NYSE value-weighted portfolio and the proportion rises to 43% for annual data.

Figure 8.16 shows a negative and significant response of stock returns to innovations in money supply. First, the response is barely significant in the second month and immediately turns insignificant and significant again in the sixth month. The duration of the significant response at the sixth month is longer than the first and those associated with interest rates. This probably indicates the high importance of the money supply variable relative to the other domestic variables. The fixed exchange rate system coupled with the low foreign reserves/GDP ratio of the country indicates that money supply increases may not be supported by external reserves. Besides Argentina has experienced very high and volatile inflation (figure 5.2) and the fixed exchange rate policy couple with low external reserves further suggest the inflationary potential of money supply increases. Based on the inflationary expectation view of money supply, positive innovations in money supply can lead investors to believe that higher inflation would occur in the future and so increase their estimation of risk associated with stocks. The high perceived risk will in turn led to a decline in stock returns.

Figures 8.17 and 8.18 plot the response of the Argentinean stock market to the MSCI world index and the U.S. 3-month T-bill respectively. First, the stock market in Argentina responds positively and significantly to an increase in the MSCI world index. The response is significant in the second month with a shorter duration as compared to Mexico and Brazil. This is consistent with Table 5.3 that reports that both countries have stronger external trade links than Argentina in terms of exports to the U.S. and imports of world merchandise. Also, Figure 5.3 shows that until 2001, Argentina had a higher ratio of foreign reserves/GDP than Brazil and Mexico and expected to be less impacted by external shocks than these two countries. As expected, a shock from the U.S. 3-month T-bill leads to a negative and significant response by the Argentina stock market. First, it is immediately significant, becomes insignificant after the third month and briefly significant in the fifth month. The negative response is consistent with the view that an interest rate increase in the U.S. drives capital flows away from Latin American countries and leads to the depression of stock prices (Bekaert *et. al.*, 2002). The results regarding the MSCI world index and the U.S. 3-month T-bill in the case of Argentina are similar to those reported for Brazil and Mexico and also consistent with those reported in the EGARCH estimation.

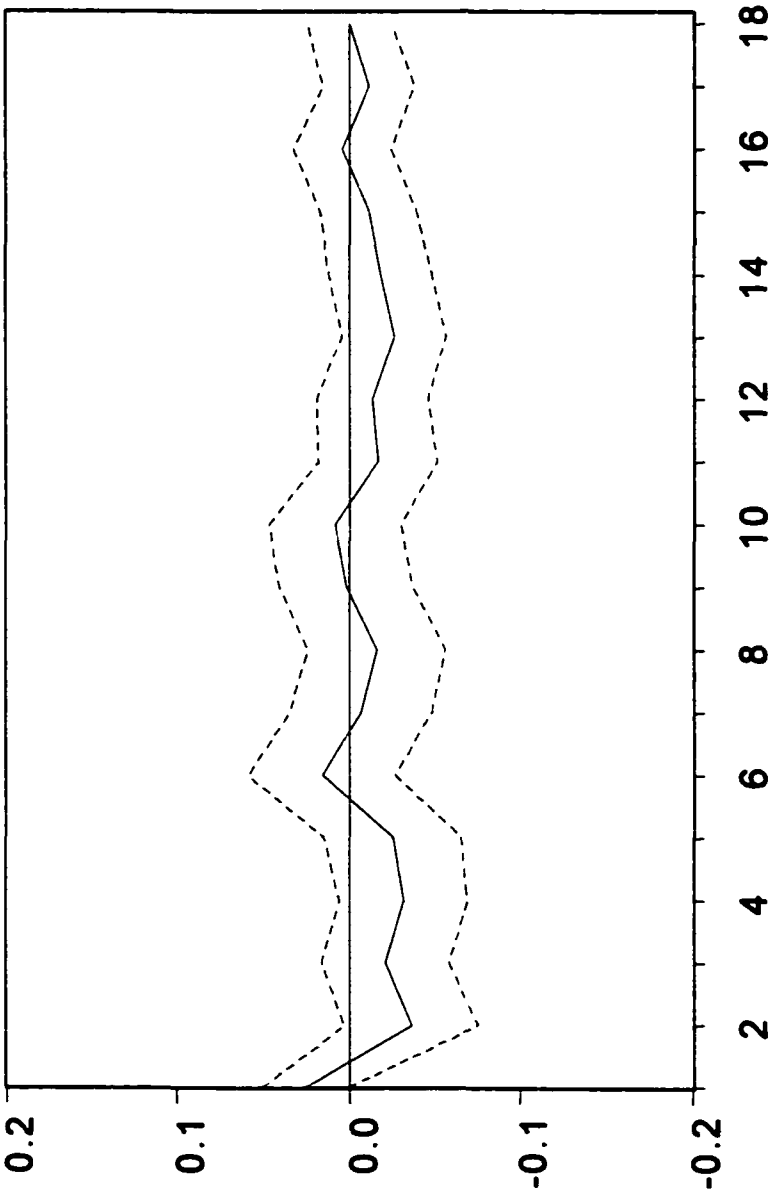


Figure 8.13

Response to Argentina to Exchange Rate

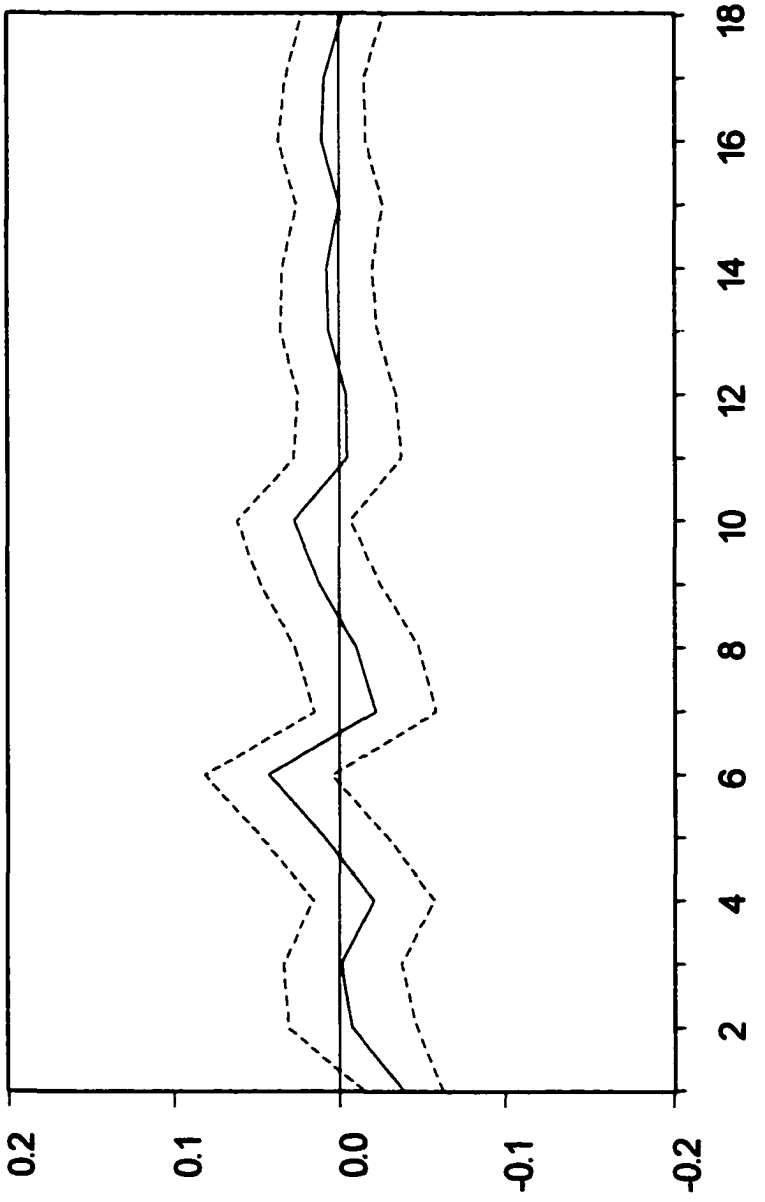


Figure 8.14

Response of Argentina to Interest Rate

Figure 8.15

Response of Argentina to Industrial Production

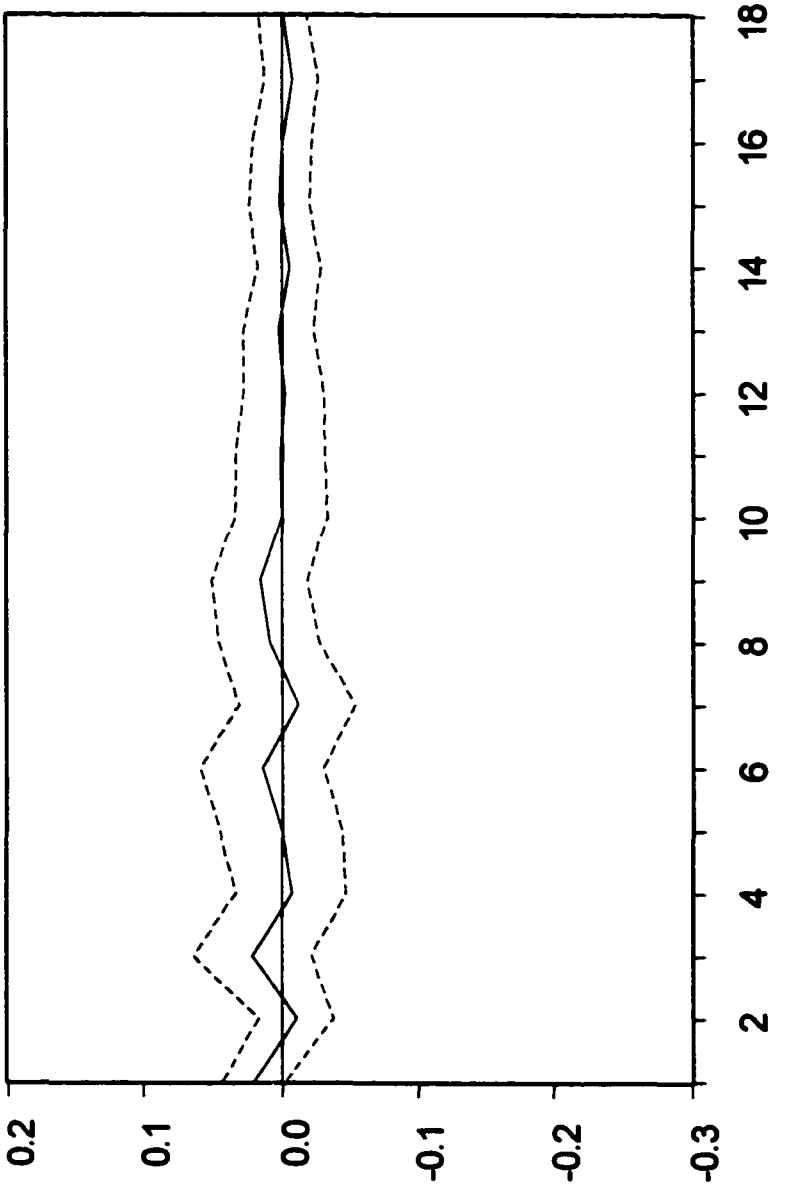


Figure 8.16

Response of Argentina to Money Supply

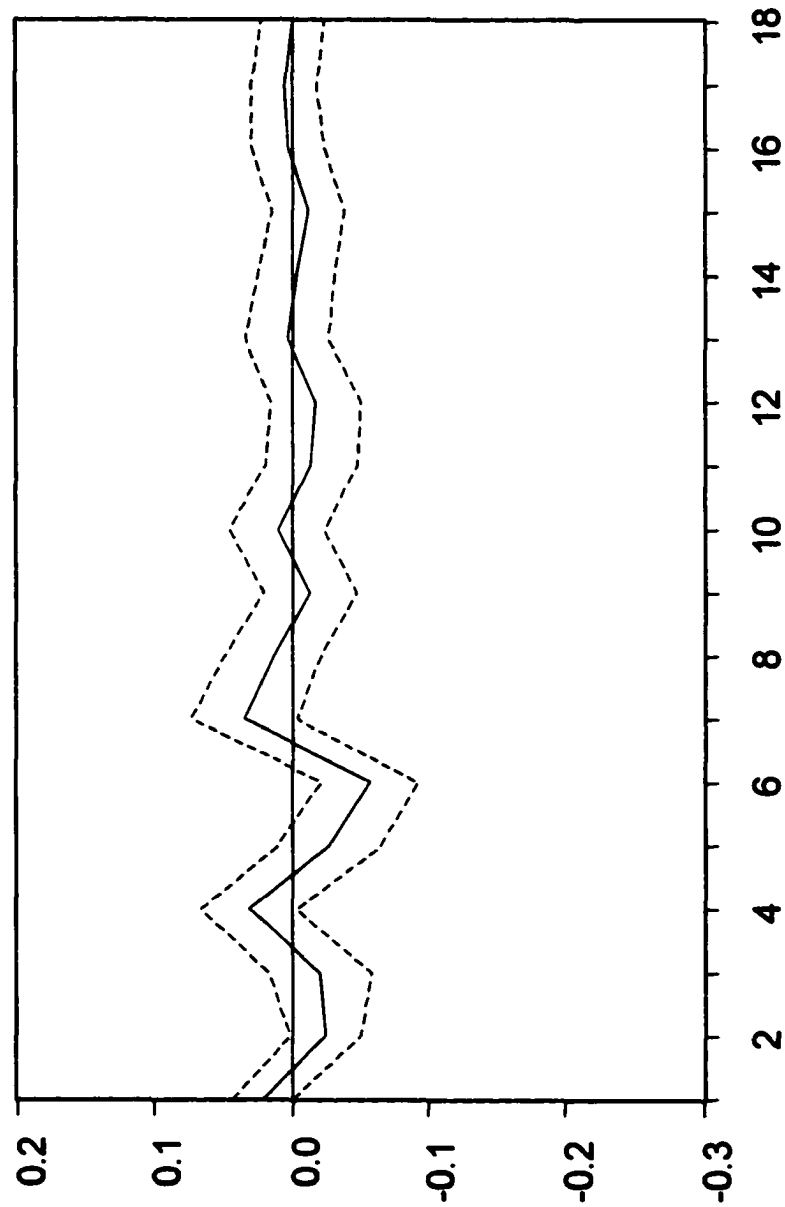
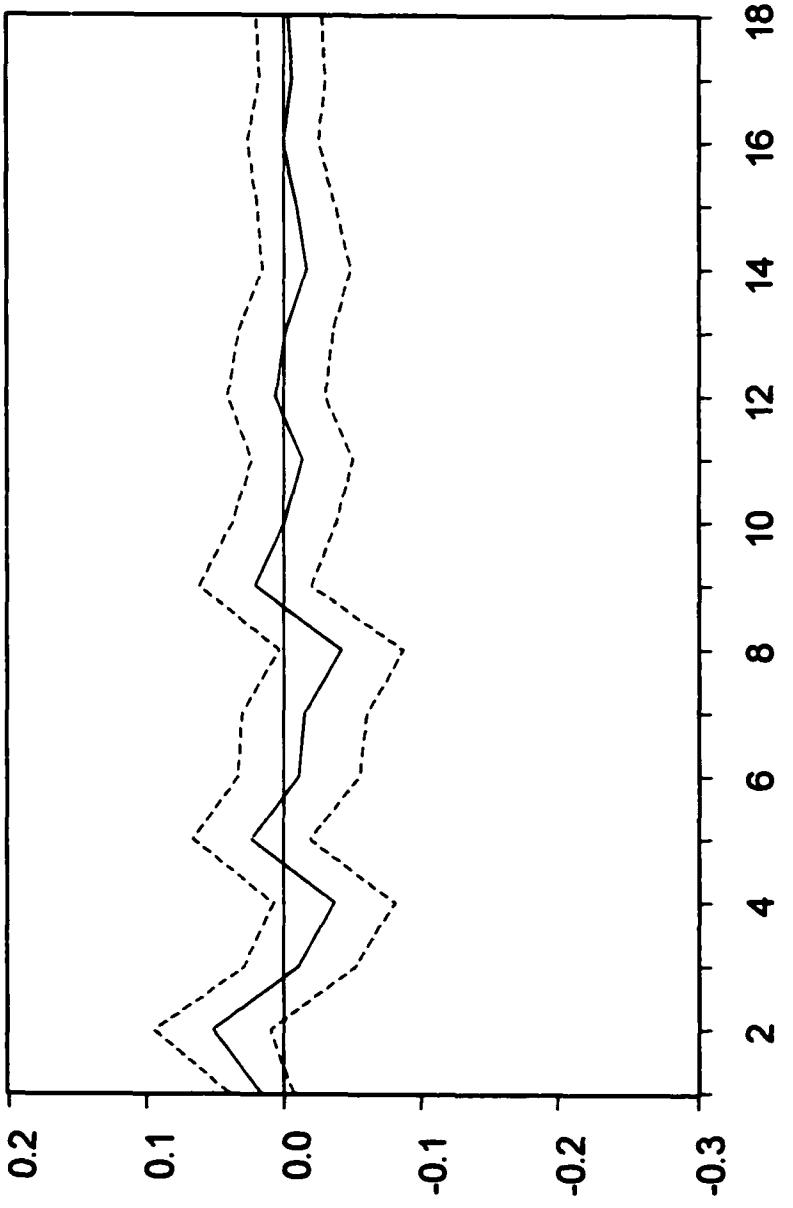


Figure 8.17

Response of Argentina to MSCI World Index



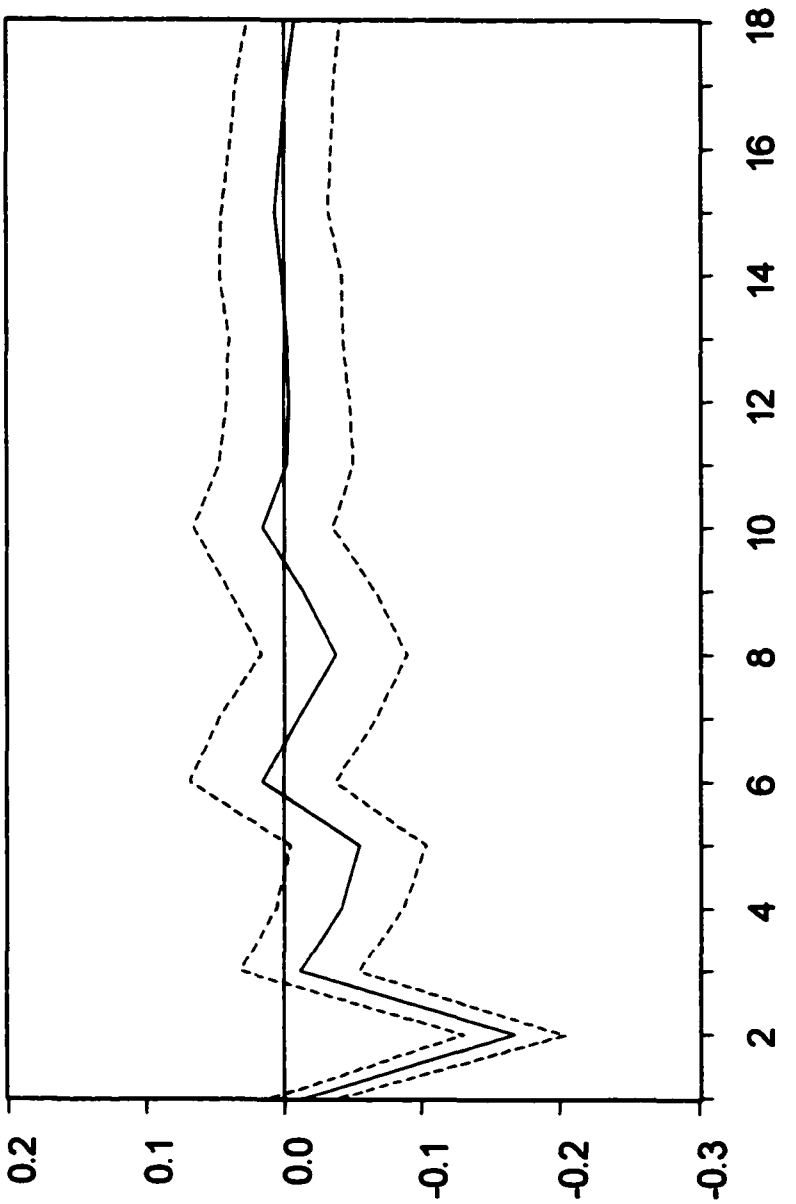


Figure 8.18

Response of Argentina to the U.S. 3-month T- bill

Chile

In the case of Chile, the important variables that explain stock returns are interest rates, industrial production, MSCI world index and the U.S. 3-month T-bill. The response function in Figure 8.19 shows that stock returns do not respond significantly to exchange rates in the sample period. This result can be attributed to the tight currency and capital flow restrictions implemented in Chile during the 1990s, such as the Tobin tax. Such policies have reduced the volatility of the currency and made currency risk insignificant. Chile has also implemented a flexible exchange rate policy and adjusted frequently to reflect other macroeconomic indicators and so reducing or eliminating the uncertainty surrounding the value of its currency. As shown in Figure 5.3, Chile has the highest ratio of foreign reserves/GDP among the four countries examined. The high reserve/GDP ratio serves as a cushion to the domestic currency and adds credibility to the exchange rate policy. Taken together, the risk associated with the currency is low and that may explain its lack of significance.

Figure 8.20 plots the response of stock returns in Chile to interest rates and shows a negative and significant relationship. The negative response is immediate and turns insignificant in less than a month. The dispersion of the response around the mean is small. According to "the Fisher effect", expected nominal rates of interest on financial assets should move one-to-one with expected inflation (Fisher, 1930). Hence, the response may indicate that investors are interpreting the increase in interest rate as an indication of higher future inflation risk. And according to the discount model, an increase in interest rate can raise the discount factor and lead to a decline in stock return. Previous studies support this negative relationship between interest rates and stock

returns and argue that part of the variation in stock returns can be traced to a "discount-rate effect" (French, Schwert and Stambaugh (1987).

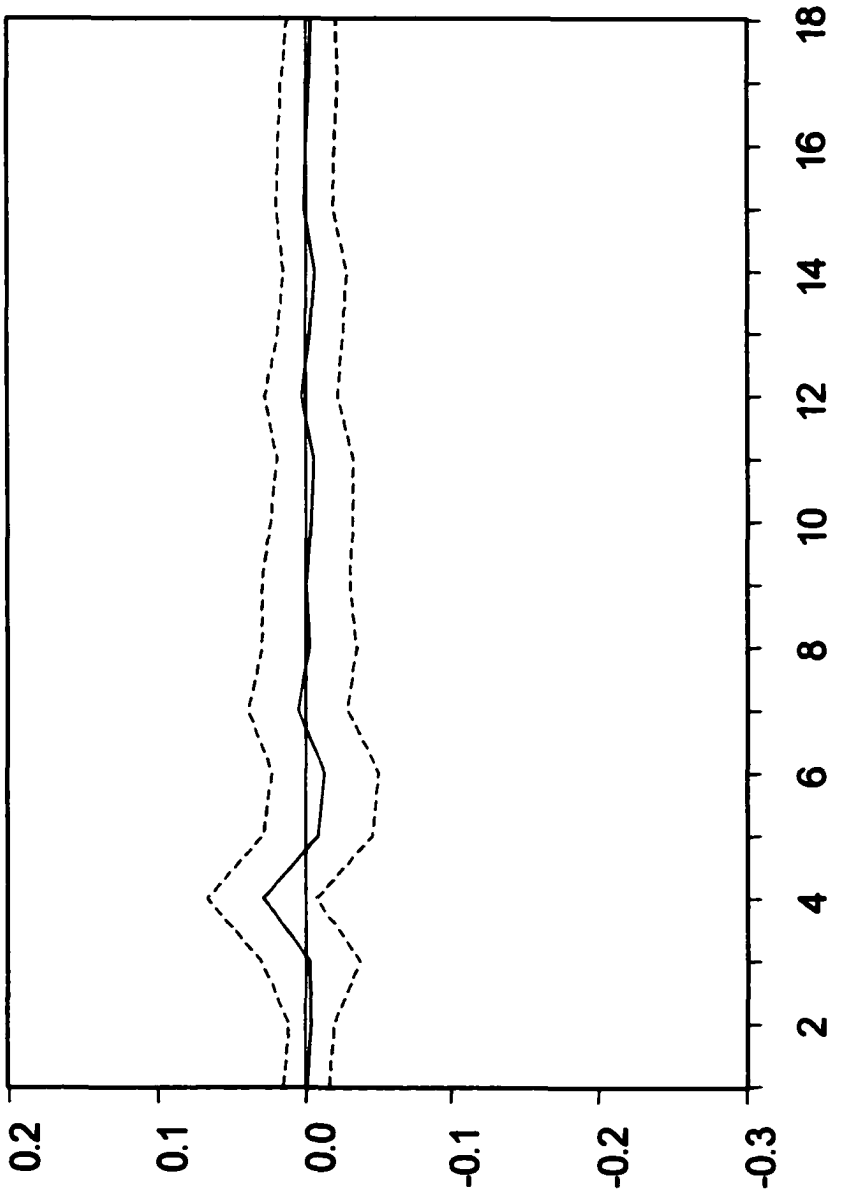
Figures 8.21 and 8.22 plot the response of stock returns to industrial production and money supply. The industrial production shocks have positive and significant effects on stock returns. The response is significant after the fourth month with a longer duration than the significant interest rate shock. Since financial securities are claims against future outputs, any increase in expected future level of economic activity will induce a higher expected return. The industrial production result is similar to the one found for Brazil earlier on. Figure 8.22 plots the response of the Chilean stock market to money supply. The response is insignificant, and may be explained by the fact that the stable exchanges rates and high external reserves of Chile makes money supply increase an unlikely source of inflation.

Figures 8.23 and 8.24 indicate that the response of stock returns in Chile to shocks of MSCI world index and the U.S. 3-month T-bill are positive and negative respectively. The duration of the response to the MSCI world index is smaller than what was reported for Mexico and Brazil. The smaller duration may be a reflection of how the Chilean economy is insulated from the global economy as compared to Mexico and Brazil. Table 5.3 reports that Mexico and Brazil have greater external trade links than Chile in terms of imports and exports to the U.S. as well as imports of world merchandise. Moreover, Chile as mentioned earlier has a higher foreign reserve/GDP ratio and so is expected to sterilize the effects of global shocks faster than these countries. The effect of the U.S. 3-month T-Bill is immediately negative, becomes insignificant and immediately significant again. In both cases, the duration is very long suggesting the important role U.S. interest rates play

in the Chilean stock market. The result is not surprising because Table 5.4 reports that in terms of cumulative U.S equity flows/GDP in Latin America, Chile placed second after Mexico. That may suggest the existence of strong financial link between Chile and the U.S., hence, the significant effect of the U.S. 3-month T-Bill.

Figure 8.19

Response of Chile to Exchange Rate



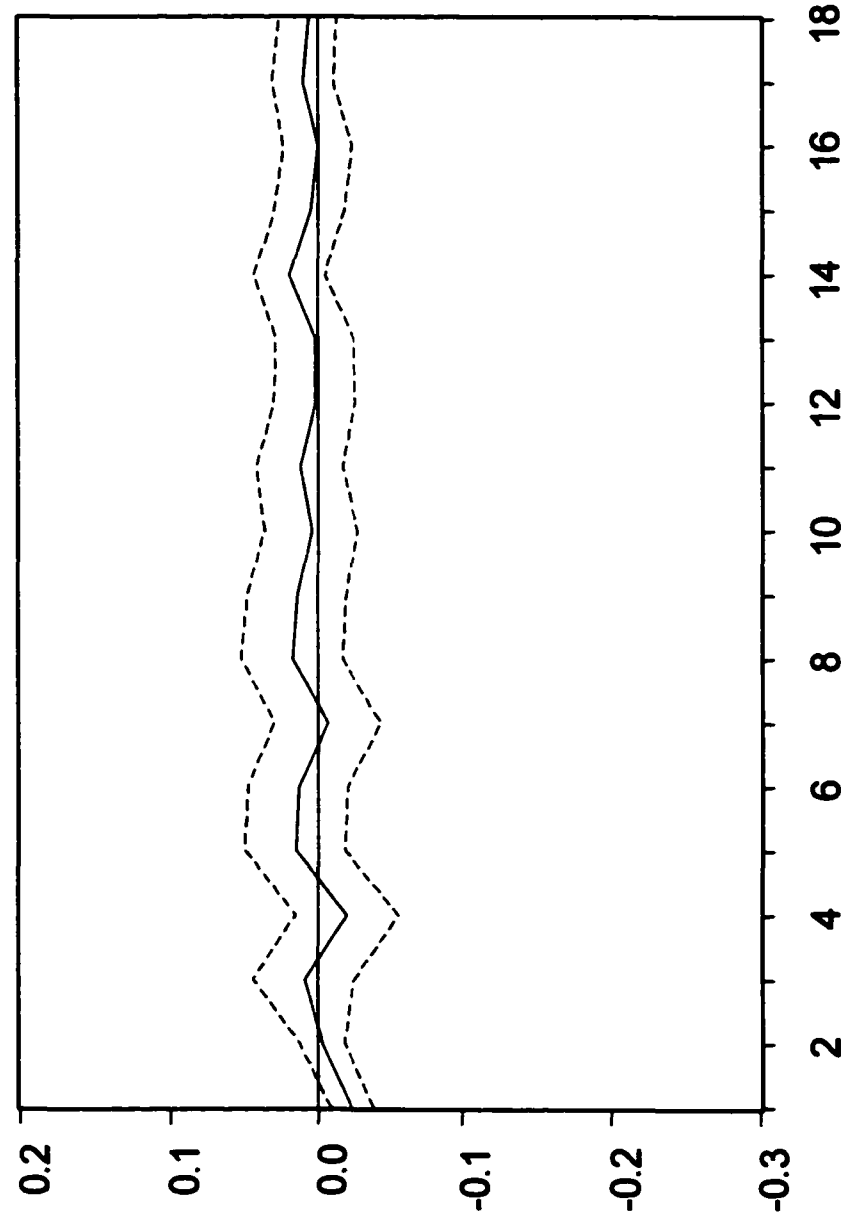


Figure 8.20

Response of Chile to Interest Rate

Figure 8.21

Response of Chile to Industrial Production

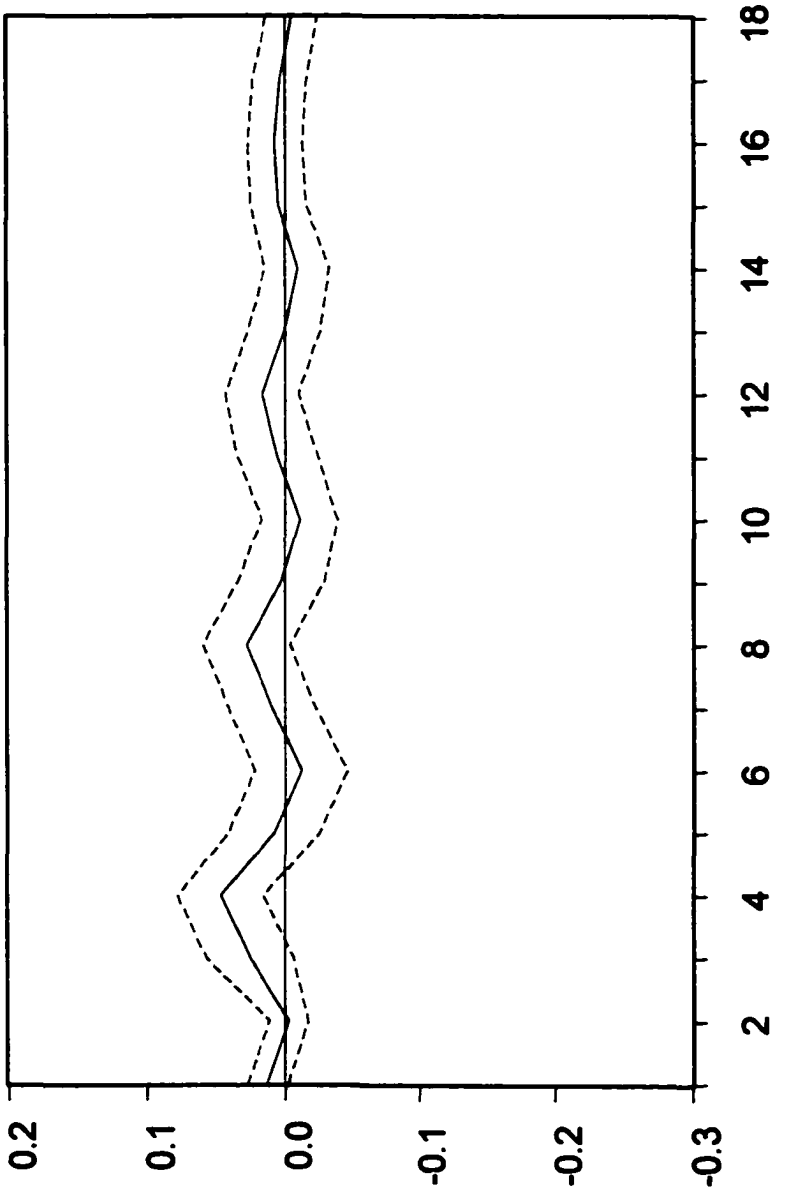


Figure 8.22

Response of Chile to Money Supply

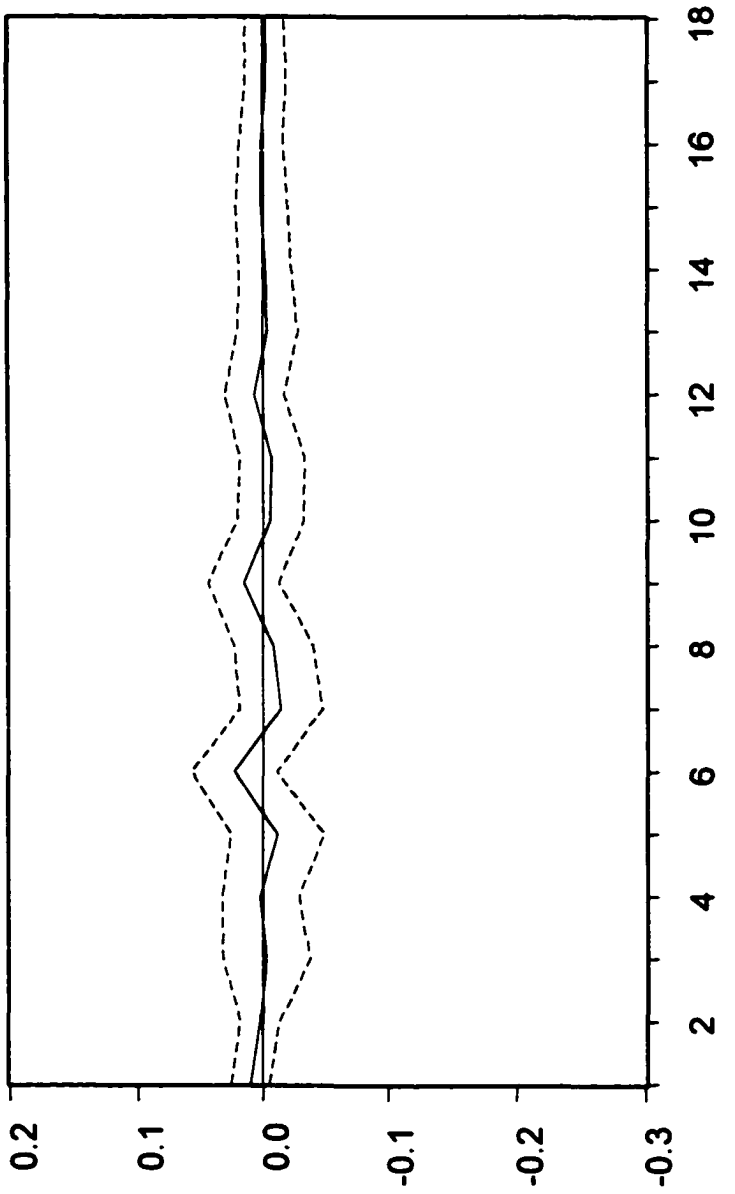


Figure 8.23

Response of Chile to MSCI World Index

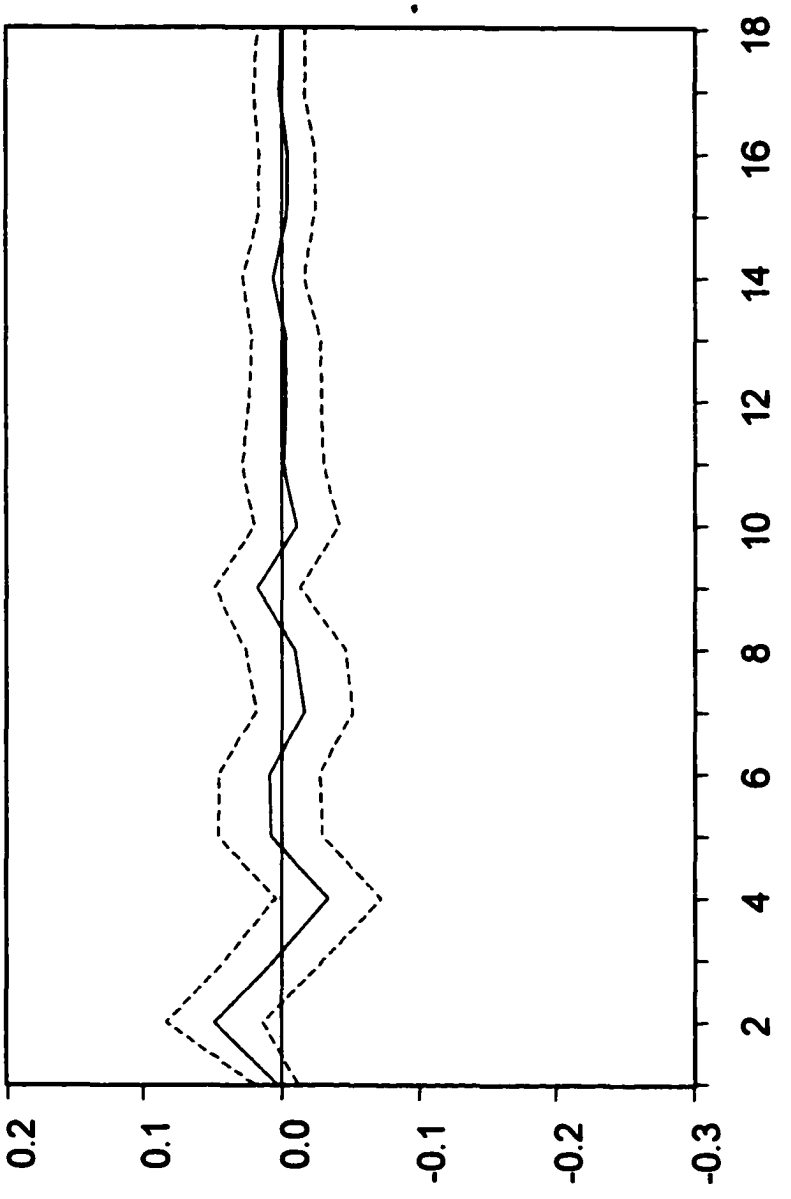
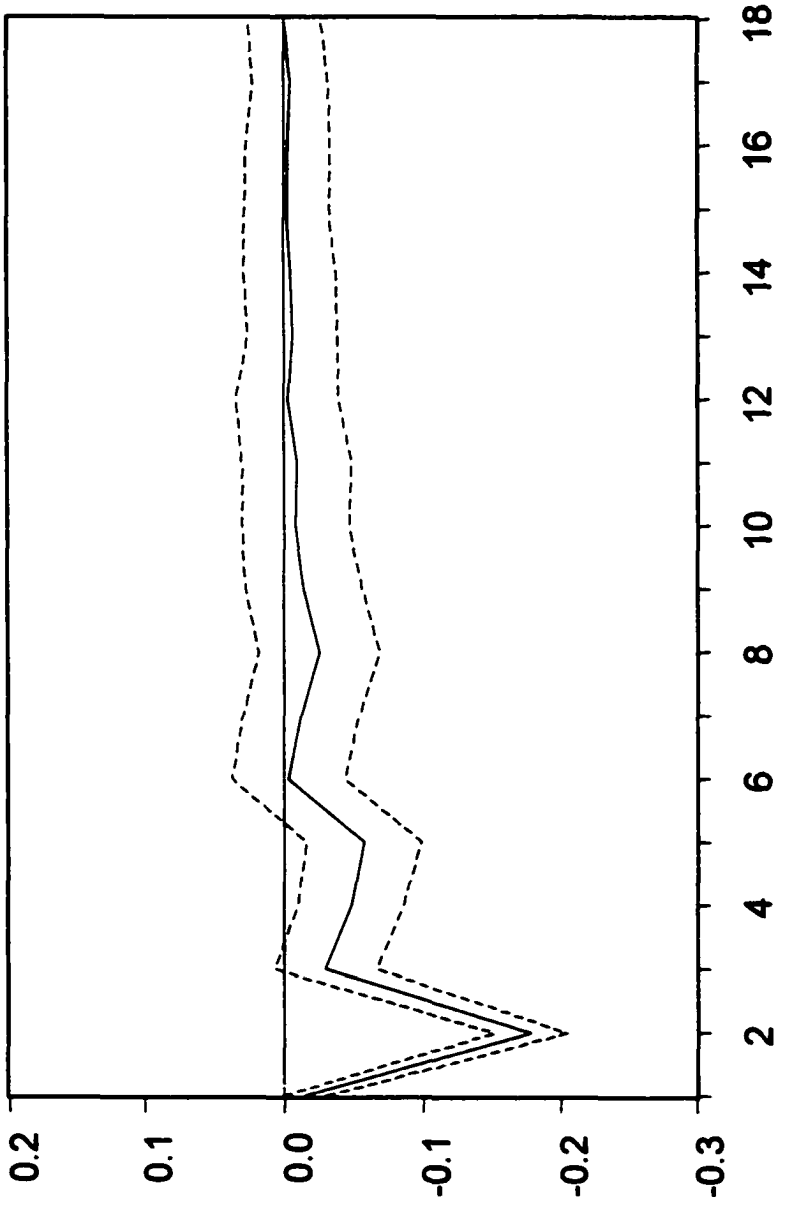


Figure 8.24

Response of Chile to the U.S. 3-Month T-bill



CHAPTER 9

CONCLUSIONS AND IMPLICATIONS

A number of previous studies have reported that a relationship exists between macroeconomic variables and equity market returns. However, most of these studies have typically focused on developed markets. This dissertation extends the literature by investigating whether there are relationships. According to CAPM, the rate of return of an asset is linearly related to systematic market risk and not the diversifiable firm specific characteristics. Therefore, one would expect that macroeconomic variables which impact most aspects of the economy would systematically affect stock returns.

It is therefore important to understand the role of macroeconomic variables in determining the relationship between stock prices and volatility. This dissertation uses two multivariate models, multivariate EGARCH and VAR models to investigate the postulated effects of exchange rate, interest rate, industrial productivity, money supply, MSCI world index and the U.S. 3-month T-Bill on stock prices in four Latin American countries.

The estimation shows that domestic macroeconomic variables have varying degrees of importance in explaining the relationship between stock returns and volatility in each country. The results show that the two global, MSCI world index and the U.S. 3-month T-bill variables used in this dissertation significantly explain the stock returns in each of

the four countries. An important conclusion drawn from the results is that macroeconomic variables exhibit asymmetric effects on returns volatility and that the countries vary in terms of their response to global shocks.

In particular, the results show that for the four Latin American countries, the past returns, modeled as lagged returns in the GARCH model are positive and significant in explaining current returns. This result is consistent with the volatility clustering phenomena of most emerging markets. That is higher periods of returns are followed by higher returns and vice versa.

The estimated coefficients of the EGARCH model show that stock returns respond significantly to exchange rate depreciation in Brazil and Mexico. Similar results are for the VAR and the impulse response functions. The finding is consistent with the analysis being conducted from an international investor's perspective. When investing in a risky asset, the investor is uncertain about its return, and will, if risk averse, require a market risk premium. According to the Capital Asset Pricing Model (CAPM) the expected risk premium in that case is proportional to the non-diversifiable risk exposure, which is the covariance between the asset return and the return of the market portfolio. Moreover, if the asset is denominated in a foreign currency, the investor must also bear the exchange rate risk, and should demand an additional exchange rate risk premium. Such an increase in risk premium can lead to an increase in the discount factor and a decline in stock prices. The EGARCH and VAR coefficients for the response of stock returns to exchange rate is negative and not significant. Also the impulse response functions show that exchange rates do not significantly affect stock returns in Argentina and Chile. The coefficients for Argentina and Chile may be attributed to the exchange

rate policies of the two countries. Argentina for example, under its currency boards has operated pretty much a fixed exchange regime for most part of the 1990s, thus limiting variability of the value of its currency. Chile on the other hand has exhibited a more stable exchange rate regime by adjusting frequently to reflect other economic indicators. It is thus expected that the low exchange rate volatility in Argentina and Chile will have less impact on stock returns.

The estimated coefficients of the conditional equation shows that only exchange rate volatility in Brazil has a significant effect on stock price volatility. The implication of this result is that an increase in exchange rate volatility in Brazil leads to an increase in the volatility of the stock market. The exchange rate coefficients for the rest of the countries are not significant. This may be due to the fact that Brazil had a low and more unstable foreign reserve to GDP ratio than the rest of the countries.

The industrial production coefficient as reported by the EGARCH estimates is positive for all four countries but significant in only Brazil and Chile. The estimated coefficients for the VAR model and the impulse response functions also report a significant impact in Brazil and Chile but not Argentina and Mexico. The positive signs are consistent with the view that financial securities are claims against future outputs therefore an increase in expected future economic activity will induce a higher expected return. The result has been attributed to differences in the industrial backgrounds of the four countries.

The interest rate variable performed better than exchange rates and industrial production in explaining the mean changes in the stock returns of the markets investigated. The coefficients for interest rates in the mean equation are negative and

significant as expected for all countries except for Mexico. The results of the EGARCH model are consistent with the estimated coefficients and the impulse response functions. According to theory, increases in interest rates can lead to higher discount rates or cost of capital and so result in the reduction of stock prices. The high trade links between Mexico and the U.S. as well as the strong financial links between the two countries may have weakened the effect of Mexican interest rates relative to those in the U.S.

The estimates of the conditional variance equation show that innovations to interest rate volatility are important in explaining stock price volatility in Brazil and Chile. The coefficients of Brazil and Chile are both positive and significant. This finding indicates that increases in interest rate volatility leads to higher stock market volatility in these two countries. In the case of Argentina and Mexico, the coefficients are not significant in explaining stock market volatility.

The money supply variable is negative and significant in Argentina and Brazil. The tight exchange rate regimes in both countries coupled with their low foreign reserves/GDP ratios suggest that increases in money supply may not be supported by adequate reserves. Consequently, as figure 5.2 shows, these two countries have experienced high levels of inflation that tends to depress stock prices. The reported coefficients of the EGARCH and VAR models show that responses of stock returns to money supply in Mexico and Chile are negative but not significant. The dissertation attributes these findings to the frequent adjustment of exchange rates and the high ratio of foreign reserves/GDP. Money supply is only important in explaining stock market volatility in Argentina. The low external reserves and fixed exchange system under its currency boards reduces the credibility for the fixed exchange rate policy. In that case an

increase in money supply may be perceived as a sign of future inflation and market instability. As explained earlier, Brazil, Chile and Mexico have operated relatively more credible monetary policies than Argentina, and so one can expect to see less volatility effects from their monetary indicators.

The markets of all the four countries are significantly impacted by the two global factors. This finding is reported in the results for both the EGARCH and VAR estimations. The impulse response functions also show the significant effects of the shocks to the global variables. In terms of the MSCI world index return, the coefficients for Argentina, Brazil, Chile and Mexico are all positive and significant. Looking at the magnitude of the coefficients, Chile appears to be less impacted by the global variable than the rest of the countries. The result is consistent with the high and stable foreign reserves/GDP relatively low level of global trade. Such characteristics may suggest that Chile is more capable of sterilizing against external shocks than the other countries.

The MSCI world index variable performs weakly in the conditional variance in all the four markets. All the estimated coefficients for this variable are insignificant, indicating that increased volatility of the world index does not necessarily lead to increased volatility of the four stock markets.

The estimated coefficients for Argentina, Brazil, Chile and Mexico in terms of the U.S. 3-month T-bill yield are significant and carry the expected negative sign. It has been found in previous studies that Latin American countries tend to rely more on equity financing and they generally have high US equity ownership (Bekaert et al., 2000), therefore, the significant effect of the U.S. 3-month T-bill yield is expected. The high coefficients for Mexico and Chile may be indicative of their strong financial links with

the U.S. For example, Mexico and Chile have place first and second respectively in terms of U.S equity flows to GDP in Latin American countries in the 1990s. It is thus expected that the U.S. interest rates would impact these two countries more than Brazil and Argentina.

The conditional variance estimates for the U.S. 3-month T-bill yield are positive and significant for Chile and Mexico and insignificant for Argentina and Brazil. These results suggest that volatility of the U.S. interest rates tend to increase the volatility of the stock markets in Chile and Mexico but not those in Argentina and Brazil. It has already been suggested that a possible explanation is that Chile and Mexico have stronger economic ties with the U.S. by way financial flows, hence, the stronger transmission of interest rate volatility.

The measure of persistence of volatility shocks in the EGARCH model suggest that news information in these markets does not die quickly but is persistent over time. This conclusion is drawn from the fact that the magnitude of the sum of the ARCH and GARCH terms in the conditional variance equations is less than one for each country. The exponential GARCH (EGARCH), proposed by Nelson (1991) estimates the conditional variance as a function of standardized innovations and allows the conditional variance to respond asymmetrically to positive and negative innovations. The symmetry effect hypothesis in this dissertation is rejected in three markets out four, suggesting that macroeconomic variables do exhibit asymmetric effects in those countries. In the case of Argentina and Brazil the coefficients are negative and significant. The negative signs indicate that negative news about macroeconomic variables in these countries affect stock prices more than positive. For Argentina and Brazil, the results suggest that bad

economic news is followed by higher stock market volatility than good economic news. This finding is consistent with previous findings and has been linked to the "leverage effect". According that conjuncture, negative stock returns yield a higher debt-to-equity ratio, and hence higher volatility.

In addition to interpreting the asymmetric coefficient in the EGARCH model, a sign bias test was conducted to explore the impact of positive and negative innovations on volatility not predicted by the model. In that estimation, the results show that for the four Latin American markets, the negative innovations have significant effects on their volatility beyond what is predicted by a model with symmetric responses. The results show that negative and positive innovations do not have the same effect on stock prices. The coefficients for the four countries are all negative as expected and consistent with the leverage effect discussed above. This is an important finding because no study has reported such a finding for emerging country markets.

Overall, the results show that these markets are partially integrated as shown by the significant role of both country and global factors. The hypotheses that they are either perfectly integrated or perfectly segmented are both rejected.

The above conclusions have important implications for both investors and policy makers in each country as outlined below. Also, they provide a sense of direction for future research in the area of emerging stock markets.

Implications and Future Research

The results reported in this study suggest that macroeconomic variables are very important with regards to stock market volatility in the four countries. However, the importance of each variable varies from country to country. Even where the same

variable significantly impacts the stock markets of different countries, the magnitude and duration of the shock varies. These findings may have important implications for decision-making by investors and policymakers.

Unlike previous studies that attribute market volatility in emerging countries to irrational behavior of investors, this dissertation finds that macroeconomic variables are very important in explaining market volatility. International investors can therefore improve their portfolio performance by considering the stability in economic fundamentals as determinants of stock market volatility. The implication of this finding is that returns will differ between these markets to the extent that they exhibit different responses to macroeconomic shocks with different magnitudes and durations. So from the investor's perspective, portfolio diversification across these countries rather than within each country can be beneficial. Overall, Mexico and Chile appear to be more stable than Brazil and Argentina in terms of macroeconomic fundamentals. During the sample interval the results suggest that investors would be better of investing in Mexico and Chile rather than Argentina and Brazil.

Policymakers on the other hand can concentrate their efforts to attain stability in economic fundamentals in order to reduce volatility and minimize investor uncertainty. The study also finds that there are important external shocks that are beyond the control of policymakers. The countries are extremely vulnerable to external economic shocks such as the U.S. 3-month T-bill yield and the MSCI world index return because of their growing integration with the world. However, the countries with stable economic fundamentals are more able to sterilize against the destabilizing effects of external shocks

than those with weaker fundamentals. Therefore policymakers should institute economic policies to improve economic performance and the standard of living of their citizens

Lastly, the study makes the important finding that negative macroeconomic news have stronger effects than positive news. Such a finding suggests the presence of market inefficiencies and asymmetric transmission of information. Previous studies have argued that stock market crashes may be linked to adverse selection and herd behavior of investors who are less informed about market fundamentals. The presence of asymmetric responses in these markets is also consistent with the high volatilities and spillovers that have characterized these markets. Policymakers should therefore be sensitive to asymmetric ripple effects of volatility in these markets. Effective macroeconomic management, market transparency and availability of information can provide a market environment with low asymmetric information and its related problems of adverse selection and moral hazards.

One important factor that has not been tested with the models in this study is portfolio equity flow to these countries. It has been suggested that these flows are usually not based on the domestic macroeconomic fundamentals of these countries and so highly speculative and volatile. Future research could investigate the volatility effects of this stream of capital flow on the stock markets of emerging countries. Also the response of investors to any macroeconomic news may be conditioned on the prevailing business cycle. Therefore the current study can be extended to investigate the relative effects of these variables under different business cycles.

Future research can solve the lack of normality problem associated with the return series by estimating a non-parametric model like the Hansen's (1982) generalized method

of moments (GMM), which is valid under mild statistical assumptions. Also, the test conducted in this study represents a joint test of the model and the hypotheses. Future studies can use the fitted values from a multivariate GARCH model to estimate a vector autoregressive (VAR) model. That will be an important extension because a VAR does not take into account ARCH effects and a univariate GARCH fails to capture multivariate dynamic interactions. So this approach will help control for both problems.

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