ECONSTOR
*Make Your Publications Visible.*

A Service of

ZBW Leibniz-Informationszentrum Wirtschaft
Leibniz Information Centre for Economics

Francis, Bill; Hasan, Iftekhar; Hunter, Delroy

**Working Paper**

# Emerging market liberalization and the impact on uncovered interest rate parity

Working Paper, No. 2002-16

**Provided in Cooperation with:**
Federal Reserve Bank of Atlanta

*Suggested Citation:* Francis, Bill; Hasan, Iftekhar; Hunter, Delroy (2002) : Emerging market liberalization and the impact on uncovered interest rate parity, Working Paper, No. 2002-16, Federal Reserve Bank of Atlanta, Atlanta, GA

This Version is available at:
https://hdl.handle.net/10419/100927

**Standard-Nutzungsbedingungen:**

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

**Terms of use:**

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*

WWW.ECONSTOR.EU

Mitglied der Leibniz-Gemeinschaft

FEDERAL
RESERVE
BANK
*of* ATLANTA

**Emerging Market Liberalization and the Impact on Uncovered Interest Rate Parity**

Bill Francis, Iftekhar Hasan, and Delroy Hunter

Working Paper 2002-16
August 2002

# Working Paper Series

Federal Reserve Bank of Atlanta
Working Paper 2002-16
August 2002

# Emerging Market Liberalization and the Impact on Uncovered Interest Rate Parity

Bill Francis, University of South Florida

Iftekhar Hasan, Rennselaer Polytechnic Institute and
Federal Reserve Bank of Atlanta Visiting Scholar

Delroy Hunter, University of South Florida

**Abstract:** In this paper we make use of the uncovered interest rate parity (UIRP) relationship to examine the extent that the liberalization of emerging financial markets has resulted in the integration of developing countries' currency markets into the international capital market. Previous tests of the impact of liberalization on the integration of emerging markets capital markets into world financial markets are confined to equity markets, ignoring currency markets that arguably are more important in determining the success of financial liberalization. We find that, in general, deviation from UIRP in the emerging markets is systematic in nature and that a significant part of emerging market currency excess returns is attributable to time-varying risk premium. Importantly we also find that these countries' currency deposits provide U.S. (equity) investors the benefits of international diversification. Our results also show that for some markets, liberalization improved (worsened) investors' perception of growth opportunity while reducing (increasing) investors' perception of the probability of financial distress. Finally, while several countries benefited from liberalization and have become more integrated into the world capital market, the experience is country specific.

JEL classification: F21, F31, F36

Key words: capital market integration, uncovered interest rate parity (UIRP), financial liberalization, GARCH model

---

The authors gratefully acknowledge the Federal Reserve Bank of Atlanta for research support in the later stages of this project. They also thank Gayle Delong, Jerry Dwyer, Jim Lothian, and Michael Melvin for helpful comments and the University of Rome, Bentley College, the University of Southern Florida, and participants at the Tor Vergata, Italy, Conference on Banking and Finance for helpful suggestions. The views expressed here are the authors' and not necessarily those of the Federal Reserve Bank of Atlanta or the Federal Reserve System. Any remaining errors are the authors' responsibility.

Please address questions regarding content to Iftekhar Hasan, Finance Department, Lally School of Management, Rennselaer Polytechnic Institute, 110 8th Street, Troy, New York 12180, 518-276-2525, fax 518-276-2387, hasan@rpi.edu, or Bill Francis, Finance Department, University of South Florida, 4202 E. Folwer Avenue, BSN 3403, Tampa, Florida 33620-5500, 813-974-6319, fax 813-974-3030, Bfrancis@coba.usf.edu.

The full text of Federal Reserve Bank of Atlanta working papers, including revised versions, is available on the Atlanta Fed's Web site at http://www.frbatlanta.org. Click on the "Publications" link and then "Working Papers." To receive notification about new papers, please use the on-line publications order form, or contact the Public Affairs Department, Federal Reserve Bank of Atlanta, 1000 Peachtree Street, N.E., Atlanta, Georgia 30309-4470, 404-498-8020.

**Emerging Market Liberalization and the Impact on Uncovered Interest Rate Parity**

A large number of studies has examined the impact of liberalization on the integration of emerging markets (see, e.g., Bekaert (1995), Bekaert and Harvey (1995), Korajczyk (1996), and Hunter (2002)). Although providing important insights regarding the success or lack thereof of the integration policies of these countries, these studies have in general focused only on integration of equity markets, neglecting other financial markets. This focus on equity markets suggests that researchers are implicitly making the assumption that integration of equity markets implies integration of other financial markets. It is usual for researchers simply to assume that currency markets are integrated. For instance, both Dumas and Solnik (1995) and De Santis and Gerard (1998) assume that currency and equity markets are internationally integrated and impose the same price of world equity market risk on portfolios of equities and foreign currency deposits.

A fundamental relationship in international finance is interest rate parity. It states that when the domestic interest rate is less than the foreign interest rate the domestic currency is expected to appreciate by an amount approximately equal to the interest rate differential. An implication of this known as the uncovered interest rate parity (UIRP), is that the return on an uncovered foreign currency deposit should be equal to the return on an equivalent domestic deposit regardless of the national market within which the foreign deposit is located. A violation of this relationship indicates that capital markets are not integrated (see, e.g., Frankel (1992,1993) and Montiel (1993)).

In this paper we investigate if the liberalization of emerging markets has led to the integration of their currency markets into the world capital market. We take the perspective of a U.S. investor and examine the extent to which the liberalization of emerging financial markets impacted the deviation from UIRP. Many studies of UIRP (these focus primarily on the developed markets) find that, in general, UIRP does not hold (see Engel (1996) for a survey). One of the more prominent explanations for this failure is the existence of a time-varying risk premium as a compensation for the speculative position in the foreign currency.[1] We argue below that, if deviation from UIRP is due to a risk premium, then a fortiori these deviations will exist in the emerging markets in the pre-liberalization period. On the other hand, if financial market liberalization has been successful in integrating developing countries' currency markets into the international capital market, then in the post-liberalization period U.S. investors will not require a risk premium in the returns on currency deposits in the emerging markets. Hence, there should be no systematic component to the deviation from UIRP. Given our objective, we necessarily focus on the time-varying risk premium explanation of deviations from UIRP and are in general silent about other possible explanations.

We focus on the integration of emerging currency markets into the world capital market for several reasons. First, Frankel (1992,1993), Montiel (1993), De Brouwer (1997), and others, stress the importance of the integration of currency markets for the integration of emerging financial markets into the world capital market. As noted by Frankel (1992,1993), only interest rate parity tests can be interpreted unambiguously as tests of integration of a country's financial markets. In other words, the design of unequivocal tests of capital market integration based on equity markets has proven elusive (e.g., Montiel (1993)). Thus, given that the impact of capital

[1] Other explanations include, inefficient currency forward markets, rational learning about potential changes in

market liberalization on the degree of integration of emerging markets currency markets is yet to be determined, claims of financial market integration following capital market liberalization may be premature (see, e.g., Bekaert, Harvey and Lumsdaine (2001)). Second, as we show in Table 1, the liberalization of the emerging financial markets was designed to affect other areas of the capital markets (see, e.g., Bekaert and Harvey (1998), Beim and Calomiris (2001), Bekaert et al. (2002)). Thus examining the impact of liberalization on other financial markets is important to ascertain the success of these policies.

The importance of this study is further supported by the intense debate over the appropriate response of the governing authorities to emerging market currency crises. One frequently advocated response is the reintroduction of capital controls.[2] However, Kaminsky and Schmukler (2001) document the vacillation in policy regarding capital controls in six important emerging markets and raise doubts about their efficacy. An alternative policy tool at the disposal of governments responding to currency crises is the implementation of fixed exchange rates (e.g., Malaysia after the Asian crisis). The scope for a successful "interest rate defense" of a fixed exchange rate depends on the extent of the deviation from interest rate parity (e.g., Flood and Rose (2001)).

An additional benefit of this study is that, given the investment interest in the emerging markets, investigating the behavior of excess returns on currency deposits provides an interesting complement to the studies that have focused on the diversification benefits of investing in equities (e.g., Bailey and Stulz (1990), Harvey (1995), and others)). Interestingly, Malliaropulos

---

currency regimes, speculative bubbles, and the "peso" problem causing bias in the forward rate (e.g., Engel (1996)).

[2] For example, the World Bank's former chief economist Joseph Stiglitz (*Int'l Herald Tribune* April 10-11, 1999, p. 6), Paul Krugman (*Fortune*, September 7, 1998, 74-80), and others, have suggested that emerging markets should reimpose restrictions on capital flows. See http://www.stern.nyu.edu/~nroubini/asia/capcontrols.htm for information on the debate about capital controls.

(1997) finds that expected excess returns of foreign currency deposits are less volatile than that of equities and that the addition of dollar deposits to an international equity portfolio can provide additional diversification benefits to non-U.S. investors. Similarly, Bansal and Dahlquist (2000) find that adding emerging market currency returns to those from developed markets results in higher Sharpe ratios.

As stated previously, most of the work on interest rate parity has focused on the industrialized markets. However, we believe that deviations from UIRP in emerging markets are likely to be larger and more persistent than in industrialized markets. Recent work by Flood and Rose (2001) and Bansal and Dahlquist (2000) find that UIRP is different across developed and emerging markets. Flood and Rose do not find support for UIRP and indicate that the foreign exchange premium is larger for emerging markets than for developed markets. In contrast, Bansal and Dahlquist find that although UIRP does not hold for most countries, it tends to hold more frequently in low-income and emerging markets than developed economies.

Interestingly, Bansal and Dahlquist also find that when there is deviation from UIRP for lower-income industrialized economies it is not caused by the existence of a risk premium. They note that country-specific attributes such as the level and volatility of inflation rate, income level, and country ratings are important in explaining foreign currency excess returns. Industrialized markets typically have lower and less volatile inflation and interest rates, more stable exchange rates, and higher income levels than emerging economies. Given these differences, we expect that emerging markets will have significantly larger currency excess returns than industrialized economies, even if these excess returns are not compensation for risk.

Furthermore, theoretical work by Aliber (1973) finds that deviation from interest rate parity is a function of both currency and political risks. The latter relate to the uncertainty that in

the future a foreign government will impose restrictions on capital flows (see, also, Dooley and Isard (1980)). In light of a long history of vacillation in the policy towards capital flows (see, e.g., Beim and Calomiris (2001)) and the above-mentioned debate about the appropriate response to recent currency crises, this risk should be greater in the developing economies and should give rise to significant deviations from UIRP, especially in the pre-liberalization period.[3]

Our analysis proceeds in two stages. In the first stage we examine if UIRP holds for our sample of emerging markets. In the second stage, for those markets where UIRP does not hold, we investigate whether liberalization reduces the risk premium in excess currency returns. If emerging market liberalization leads to the integration of emerging financial markets (Bekaert and Harvey (2000) and Bekaert, Harvey and Lumsdaine (2001)), then we expect to find no significant risk premium in the post-liberalization period.

We use a multifactor conditional asset pricing model to examine the extent to which emerging market currency excess returns can be explained by systematic risk factors and therefore can be attributed to time-varying risk premia. This approach is similar in spirit to several studies that have examined the risk-premium explanation of deviations from interest rate parity (see, e.g., Kaminsky and Peruga (1990), McCurdy and Morgan (1991), Chiang (1991), Korajczyk and Viallet (1992), Malliaropulos (1997), and Morley and Pentecost (1998)). An important difference between these papers and ours is that we focus on emerging markets whereas these earlier studies use data from industrialized countries. More important, we investigate changes in the risk premium as a result of market liberalization.

We find that, in general, deviation from UIRP in emerging markets is systematic in nature and that a significant part of emerging market currency excess returns is attributable to

[3] This would be consistent with the fact that emerging market equity returns provide investors with a compensation

time-varying risk premium. Importantly we also find that these countries' currency deposits provide U.S. (equity) investors the benefits of international diversification. Additionally, our results show that for some markets, liberalization improved (worsened) investors' perception of growth opportunity while reducing (increasing) investors' perception of the probability of financial distress. Finally, while several countries benefited from liberalization and have become more integrated into the world capital market, the experience is country specific.

The remainder of the paper has five sections. Section 2 describes the channels through which liberalization impacts risk premium in currency excess returns. Section 3 describes the methodology. In section 4 we present summary statistics of the data and preliminary evidence on the extent to which UIRP holds. Section 5 contains the main empirical results. Section 6 summarizes and suggests further research.

## 2. Risk Premium and Liberalization

Market liberalization can impact UIRP through two basic channels, the exchange rate and/or nominal interest rates (and the correlation between both, especially as correlation is affected by changes in the rate of inflation). Emerging market liberalization was driven by "…fundamental structural changes…" including the elimination of exchange controls, stabilization of exchange rates, control of inflation, removal of restrictions on capital inflows and outflows, removal of interest rate restrictions, and sovereign debt reduction coupled with the use of private debt and equity (e.g., Mullin (1993)). Taken together, these changes are expected to have a direct and significant effect on U.S. investors' perception of the need for a risk premium

---

for bearing political risk (see, e.g., Bailey and Chang (1995)).

in the returns on currency deposits in the emerging markets. Liberalization should therefore impact the deviation from UIRP.

There are several means by which liberalization can affect interest rate parity via the currency channel. First, countries such as Argentina, Colombia, Jordan, Mexico, and Taiwan included the reduction of exchange controls and/or freely floating currencies as an important component of financial market liberalization (see, e.g., Kim and Singal (2000), Bekaert and Harvey (1998) and Bekaert (1995)). Others such as Mexico and Thailand have been forced to abandon fixed exchange rate regimes in the post-liberalization period. Arguably, either path to floating foreign exchange rates has contributed to more volatile currencies. If excess returns on emerging market currencies is compensation for systematic risks, and if a component of this risk premium is for exposure to the (low) probability of a currency crash, then with the increasing frequency and intensity of currency crises in the post-liberalization period this compensation might have increased, rather than declined, over time. Hence, liberalization might have increased the deviation from UIRP.

However, even in the absence of currency crises in the emerging markets we would expect that the extent to which UIRP holds changes over time as liberalization takes effect. Specifically, as restrictions are reduced (and are so perceived by foreign investors) the financial markets of the emerging economies will move more closely with the international capital markets, reducing the potential for earning excess returns on foreign currency deposits.[4]

Further, the post-liberalization increase in private physical investments (Henry (2000)) and higher economic growth rates (Bekaert et al. (2000)) experienced by the emerging markets

[4] This is similar to the argument that increasing integration of emerging equity markets will reduce the benefits of diversification. It is also consistent with the argument that the potential for future capital controls is reduced as the

can stabilize and strengthen currencies. In the absence of a commensurate decline in interest rates, this would lead to an increase in the excess returns (and hence, deviations from UIRP) on emerging market currency deposits.

With regard to the potential impact of liberalization on interest rates, evidence presented by Henry (2000), Bekaert and Harvey (2000), Kim and Singal (2000), and others, indicates that there has been a reduction in the cost of capital subsequent to liberalization. However, Chari and Henry (2001) point out that this reduction may be related solely to an increase in risk sharing in the formerly restricted emerging markets and not to a reduction in the risk-free component of the cost of capital. If liberalization followed a period of artificially low interest rates and liberalization was accompanied by domestic financial deregulation and/or increased freedom of emerging market residents to invest abroad, then domestic interest rates may increase (Henry (2000), Basak (1996)). On the other hand, if market liberalization followed a period of relatively scarce capital and high interest rates in the emerging market, then with unrestricted inflows there is expected to be a decline in interest rates. Hence, the net impact of liberalization on emerging market interest rates and in turn the impact of interest rates on UIRP is an empirical question.

## 3. Methodology

Previous studies that use an asset pricing model to examine if deviation from UIRP is due to systematic risk factors (see, e.g., Bansal and Dahlquist (2000), Malliaropulos (1997), McCurdy and Morgan (1991)) have in general met with limited success in explaining currency excess returns as compensation for systematic risk. A possible explanation for this lack of success is that most of these models are single-factor models. This possibility arises because in

---

emerging markets increasingly embrace open (financial and economic) market policies. This lower political risk

an international setting the single-factor asset pricing model holds only under very strict assumptions, and as such its application might have affected previous results (see, e.g., Engel (1996)).[5] To overcome this weakness of previous studies we use a multi-factor conditional asset pricing model estimated in a multivariate generalized autoregressive conditional heteroscedasticity (GARCH) framework.

The expected returns on each foreign currency deposit in excess of the U.S. returns on a similar deposit is modeled as a product of the conditional betas of the return on the foreign currency deposit (relative to each of three systematic risk factors), and the conditionally expected realization of the factors. We use factors that have been used in the literature to explain equity returns and have been argued that they are also valid for currency returns. For example, Korajczyk and Viallet (1992), among others, argue that the same pervasive factors that explain excess returns on equities should explain the variation in the risk premia in forward exchange markets. Asset pricing models employed by Dumas and Solnik (1995) and De Santis and Gerard (1998), among others, successfully use equity benchmarks to price excess returns on foreign currency deposits. Ikeda (1991) shows that a linear factor model in local currency terms (i.e., the local currency APT of Ross (1976)) does not hold internationally unless the same factor-pricing model governs both equities and exchange rates.

In our investigation of whether deviation from UIRP can be attributed to time-varying risk premium, we take the position of a domestic (U.S.) investor. Consequently, we only use domestic risk factors in our estimation. Specifically, we use the Fama-French three-factor model where the factors are the returns on the U.S. value-weighted market portfolio in excess of the

---

reduces the probability of deviations from interest rate parity (see, e.g., Dooley and Isard (1980)).

[5] The single-factor model holds under the assumptions of strict purchasing power parity, logarithmic utility functions, or zero correlation between exchange rate changes and stock returns (e.g., Adler and Dumas, (1983)).

risk-free rate ($r_{Mt}$), the returns on the "size" factor ($r_{SMBt}$) that is an arbitrage portfolio formed from going long in small stocks and short in large capitalization stocks, and the returns on the "book-to-market" portfolio ($r_{HMLt}$) that is an arbitrage portfolio formed from going long in stocks with a high book-to-market value and short in stocks with a low book-to-market value (Fama and French (1993)). The recent success of this model in pricing U.S. equities and the finding by Brennan, Wang, and Xia (2001) that the factors are correlated with investors' investment opportunity set lead us to believe that they may price returns on foreign currency deposits. Moreover, Empirical tests by McCurdy and Morgan (1991), Korajczyk and Viallet (1992), among others, find that excess returns on foreign currencies have a component that is not explained by the single- (equity) factor model.

It is a well-known fact that many of the emerging markets have experienced at one time or another debt crisis. As a result U.S. investor might require a risk premium for the exposure to this risk. The SMB factor, which is generally regarded as a financial distress factor (Fama and French (1993)), should be able to capture this if in fact U.S. investors demand such a premium. It should be noted that, because of the frequency and severity of emerging market currency crises in the post-liberalization period, U.S. investors might extract a larger premium relative to the period before liberalization. Additionally, Liew and Vassalou (2002) find that both HML and SMB are positively related to future GDP, suggesting that these factors forecast future growth opportunities. Hence, these factors may capture any risk premium that U.S. investors charge for the uncertainty of local business and political conditions that could reduce the probability of repatriating their investments in the foreign country.

To capture the time-varying risk premia of excess returns on currency deposits both the betas and the factors are allowed to vary over time. The model to be estimated has the following specification:

$$E_{t-1}(r_{it}) = \beta_{iMt-1}E_{t-1}(r_{Mt}) + \beta_{iSMBt-1}E_{t-1}(r_{SMBt}) + \beta_{iHMLt-1}E_{t-1}(r_{HMLt}). \quad (1)$$

In this model $E_{t-1}(r_{it})$ is the conditionally expected return (conditioned on information up to $t$-1) on the $i$th currency position in excess of the return on the equivalent U.S. asset. $\beta_{t-1}$ is the conditional beta, measured as the ratio of the conditional covariance ($cov_{t-1}[\bullet]$) and the conditional variance ($var_{t-1}[\bullet]$), $\mathrm{cov}_{t-1}[r_{it}, r_{jt}] / \mathrm{var}_{t-1}[r_{jt}]$, where $j$ is equal to factor $r_M$, $r_{SMB}$, and $r_{HML}$, respectively.

To estimate the conditional factors we use a system of equations where the (rational) expectations in equation (1) are replaced by the actual realization of each factor minus its conditionally mean-zero forecast error term ($\varepsilon_t$). The conditional betas are replaced by the conditional covariance between the currency deposit excess returns and the realization of each factor, divided by the conditional variance of the factor. These are obtained from the conditional variance-covariance matrix of the multivariate GARCH process. For ease of notation we represent the covariance between currency deposit $i$ and factor $j$ as $h_{ij}$ and the variance of factor $j$ as $h_j$. The estimated system of one currency deposit ($r_i$) and three factors ($r_M$ $r_{SMB}$ $r_{HML}$) is as follows:

$$r_{it} = \left(\frac{h_{iMt}}{h_{Mt}}\right)(r_{Mt} - \varepsilon_{Mt}) + \left(\frac{h_{iSMBt}}{h_{SMBt}}\right)(r_{SMBt} - \varepsilon_{SMBt}) + \left(\frac{h_{iHMLt}}{h_{HMLt}}\right)(r_{HMLt} - \varepsilon_{HMLt}) + \varepsilon_{it} \quad (2)$$

$$r_{Mt} = E_{t-1}(r_{Mt}) + \varepsilon_{Mt} = a_0 + a_1 z_{1t-1} + \ldots + a_4 z_{4t-1} + \varepsilon_{Mt} \quad (3)$$

$$r_{SMBt} = E_{t-1}(r_{SMBt}) + \varepsilon_{SMBt} = b_0 + b_1 z_{1t-1} + \ldots + b_4 z_{4t-1} + \varepsilon_{SMBt} \quad (4)$$

$$r_{HMLt} = E_{t-1}(r_{HMLt}) + \varepsilon_{HMLt} = c_0 + c_1 z_{1t-1} + \ldots + c_4 z_{4t-1} + \varepsilon_{HMLt} \quad (5)$$

$$E_{t-1}(\mathbf{e}) = (\varepsilon_i, \varepsilon_M, \varepsilon_{SMB}, \varepsilon_{HML})' \sim N(\mathbf{0}, \boldsymbol{H}_t)$$

$$\mathbf{H}_t = \mathbf{C}'\mathbf{C} + \mathbf{A}_1'\mathbf{e}_{t-1}\mathbf{e}_{t-1}'\mathbf{A}_1 + \mathbf{B}_1'\mathbf{H}_{t-1}\mathbf{B}_1 \quad (6)$$

In equation (2), the realized excess return on the currency deposit is estimated as a product of the conditional betas and the expected returns on the factors. In equations (3) to (5), a vector of instruments is used to predict the factors. These include a constant, the change in the U.S. default premium measured as the yield differential between Moody's Baa and AAA corporate bonds (ΔDEFAULT), the U.S. term premium (TERM) measured as the difference in yield between the 10-year Treasury note and the three-month Treasury bill, the risk-free rate (RFREE) measured as the return on the one-month Treasury bill, and the U.S. market portfolio. Each instrument is lagged one period relative to the factor returns.

Asset pricing theories do not specify how conditional second moments should be modeled and in the present paper we do not attempt to specify an equilibrium economic model of the covariance matrix. Instead, we draw on the considerable evidence in the literature that asset prices in general, and exchange rates in particular, are characterized by ARCH effects (see, e.g., Bollerslev, Chou, and Kroner (1992)). Further, several previous examinations of UIRP have used a GARCH framework (see, e.g., the survey by Engel (1996)). Hence, the variance-covariance matrix is parameterized using the GARCH (1,1) specification of the *diagonal BEKK* model (Engle and Kroner (1995)). This is achieved as follows. Form a system containing the realized returns on the currency deposit and the realization of the three factors and estimate equations (2) to (5). Let $\mathbf{e}_t$ represent a 4×1 vector containing the residuals from these equations and assume that they are conditionally mean-zero and normally distributed; i.e., $\mathbf{e}_{t-1} \sim \mathbf{N}(\mathbf{0}, \mathbf{H}_t)$. Then equation (6) models the 4×4 variance-covariance matrix of the system $\mathbf{H}_t$ as a function of a

constant, lagged error terms, and lagged variance-covariance terms. In this paper we specify $\mathbf{A}_1$, $\mathbf{B}_1$ as diagonal matrices. Hence, there is no "volatility spillover" among the respective variance and covariance processes. That is, each process is dependent on its own lagged values. This is reasonable given that at the monthly interval there is usually only very limited cross-variable interaction. De Santis and Gerard (1997, 1998), and others, have successfully used this specification, to generate the requisite dynamics of the variance-covariance matrix. $\mathbf{C}$ is a 4×4 upper-triangle matrix of constants; hence, positive definiteness of $\mathbf{H}_t$ is guaranteed.

Because normality is not frequently observed in financial markets data the estimation uses a quasi-maximum likelihood (QML) approach (e.g., Bollerslev and Wooldridge (1992)), where the log-likelihood function from the conditional normal specification is maximized, but the variance-covariance matrix of coefficients is made robust to the error distribution. This allows for regular statistical inferences. An additional advantage of the QML estimation is that hypotheses tests based on the Wald test are also robust to the non-normality.

## 4. The Data

We use country level data to test if a time series of excess currency returns can be explained by systematic risks. We study Chile, Colombia, Mexico, India, Korea, Pakistan, Malaysia, Thailand, and Turkey using monthly data over the period 1980 to 2000. We use bank deposit rates and inter-bank rates when information on deposit rates is not available. These rates are obtained from the International Financial Statistics (IFS) of the International Monetary Fund (IMF).

Testing whether financial liberalization affects UIRP requires establishing the date of each country's capital market liberalization. Liberalization dates for the nine countries examined

in this study are obtained from Bekaert and Campbell (2000) and are reported in column 1 of Panel A in Table 1. As is shown, the capital market liberalization for each of the countries in our sample occurred in the late 1980's and early 1990's. Although others (see, e.g., Henry (2000), and Kim and Singal (2000)) have, in general, confirmed these dates several caveats are in order. First the act of liberalization for most of the countries did not occur at a specific point in time, but rather over a period of time. Second, although limited in nature, most of these countries capital markets were open in one form or another prior to the formal liberalization date. Third, the investment restrictions that were in place were not binding for most of these countries (see, e.g., Kaminsky and Schmukler (2001) for some interesting examples). The importance of these caveats is that the impact of liberalization on the deviation from UIRP for the current sample may be confounded.

Table 2, Panel A, presents summary statistics for the excess currency returns series for both the pre- and post-liberalization sub-periods. Panel B reports the autocorrelation for the pre-liberalization period, while Panel C contains the autocorrelation statistics for the post liberalization period.

Column 3 of Panel A contains the mean excess returns (percent per month). For each country two numbers are reported. The top number represents the average excess currency return for the pre-liberalization period while the number below corresponds to the post-liberalization period. Several noteworthy features are apparent. First, for each country the pre-liberalization period is characterized by negative excess currency returns and ranges from a high of -1.114 for Mexico to a low of -0.068 for Korea. That is, on average these countries experienced large enough depreciations and/or had relatively low interest rates such that U.S. investors would have suffered a net loss had they invested in the currencies of these emerging markets. The finding

that over this period Korea had the smallest average deviation from UIRP is not surprising given that over this period Korea had the most developed capital market of the countries examined in this study. For the post-liberalization period the results are dramatically different with five out of the nine countries displaying positive excess returns and for the others the absolute magnitude of the negative values have declined. This implies that either the emerging market currencies have become more stable and appreciated relative to the U.S. dollar in the post-liberalization period, or their interest rates have increased over time relative to equivalent rates in the U.S. An examination of the data lends more support to the latter as most countries experienced significant depreciation up to the end of the sample. This was accompanied by increasing interest rates in several cases, perhaps in pursuit of an "interest rate defense" of the local currency (e.g., Flood and Rose (2001)).

Column 3 also shows that several currencies of several countries (Colombia, India, Mexico, Malaysia, Pakistan, and Turkey) have mean excess returns significantly different from zero in one period or another, at least at the 10% level. Interestingly only in the cases of Colombia, India, and Pakistan can we conclude that average excess currency returns are different in the pre- and post-liberalization periods. Care must be exercised in interpreting these numbers however, given that they represent averages of series that are time varying and are characterized by both large negative and positive values (columns 4, 5). Thus, in any one period there might be significant deviation from UIRP, even if it holds on average over the long term. If markets are integrated, then UIRP should hold on a period-by-period basis, and any systematic deviation would be of concern to the investor. Further, even if there is no difference in average excess returns between the two sub-periods it would be incorrect to conclude that capital market liberalization does not impact deviations from UIRP because the impact is not necessarily in the

magnitude of the excess returns but rather in the compensation for risk that investors extract from this excess return.

The standard deviations for excess currency returns are reported in column 6. As is the case for the mean excess returns the first number for each country corresponds to the pre-liberalization period with the second number corresponding to the post-liberalization period. Similar to the results for emerging market equity returns (see for e.g., Bekaert and Harvey (1995, 2000), Henry (2000)) emerging market currency returns are characterized by high volatility with standard deviations from approximately 12% annually to 77%. Column 6 also displays additional interesting results. For two of the Latin American countries (Chile and Mexico) there is a sharp decline in the volatility of the excess currency returns going from the first sub-period to the second. The reverse holds for Colombia. In comparison, for the Asian countries, with the exception of India, there is a marked increase in the standard deviation in the post-liberalization period. Turkey also demonstrates this increase in volatility in the post-liberalization period. This increase in volatility is probably due to the Asian currency crisis that occurred in 1997.

The final two columns of Table 2 contain skewness and kurtosis statistics. Similar to the standard deviation results going from the pre- to the post-liberalization period, there is a decline in both statistics for Chile and Mexico but an increase for Colombia, while there is an increase for the Asian countries and Turkey. As is customary for emerging market asset returns, Panel B and Panel C show that the excess currency returns are characterized by autocorrelation. There are no apparent differences across regions and across sub-periods.

Taken together the results presented so far indicate that emerging equity markets are characterized by deviations from URIP, and more important for the current study, the deviation seems to be significantly impacted by capital market liberalization. And as indicated only for the

cases of Colombia, India, and Pakistan are the differences in mean excess currency returns statistically significant across the pre- and post-liberalization periods. However, by looking at averages the impact of capital market liberalization on deviations from UIRP is not fully discernible. Figure 1*a* through 1*i* plot the excess currency returns for each of the eight countries for both pre- and post-liberalization. Inspection of these figures indicates that this is in fact the case. For each country the figures display a distinct and important difference in the excess currency returns for both periods.

The Latin American countries show a relatively large increase in both the magnitude and variation of excess currency returns in the post-liberalization period compared to the pre-liberalization period. This finding is surprising given that, a priori, we expected that liberalization of the capital markets would lead to a decline in the mean and volatility of the excess currency returns.

For the Asian countries the behavior of excess currency returns is demonstrably different from that displayed by Chile, Colombia, and Mexico. Specifically, Figures 1*d* to 1*h* show that in general the excess currency returns are much more dynamic in the first sub-period than in the second. It should be noted however, that this general pattern changes around the Asian financial crisis. As is expected, for each country there is a substantial increase in the variability of the excess returns at the onset of the financial crisis. This variability then tapers off over the next six to 18 months depending on the particular country.

Figure 1*i* displays Turkey's excess currency returns for both the pre- and post-liberalization sub-periods. Similar patterns to those of the Asian countries are displayed. This similarity in the movement of excess currency returns across the pre- and post-liberalization

periods is probably a geographical effect given Turkey's relatively close proximity to the Asian countries.

In summary, Figures 1*a* through 1*i* provide strong evidence that excess currency returns are time varying in nature, are frequently significantly different from zero and are different across the pre- and post-liberalization sub-periods. This evidence together with the results presented in Table 2 indicates that UIRP does not hold and that deviations from UIRP is significantly affected by liberalization of a country's capital market. Next we examine whether the excess currency returns (deviation from UIRP) is due to non-diversifiable risk.

## 5. Empirical Results

Ferson and Harvey (1993), and others, show that conditionally expected returns are driven by both time-varying betas and risk factors. We therefore specify the asset pricing model to capture these characteristics of the data. Table 3 reports summary statistics of the instruments used to capture this time variation of the risk factors. These data are used extensively in asset pricing tests (see, e.g., Fama and French (1993), and Eckbo et al. (2000)) and the summary statistics are presented here for completeness.

Table 4 provides evidence as to the predictability of the risk factors and therefore if they are time varying. The usefulness of this is that if they are time varying, the currency excess returns can be expressed as a function of both a time-varying beta and time-varying factor. As is shown in Table 4, the results indicate that our information instruments have substantial predictive ability for each country and across both sub-periods. It is worth noting that the

predictability of the factors is not predominantly driven by any single instrument as overall all instruments contribute to the time variation of the factors.[6]

Results pertaining as to whether or not deviation from UIRP, as measured by excess currency returns, has a systematic risk component and if this has changed as a result of liberalization are reported in Table 5. These results are presented in three groupings. Each grouping reports the sample average of the time-varying betas for each of the three risk factors for both the pre- and post-liberalization periods. It must be noted that the traditional method of presenting coefficient estimates is not applicable here given that the coefficient for each factor is allowed to vary on a period-by-period basis. Additionally, we report the minimum and maximum of the coefficients, their standard deviations (and an indication of their statistical significance), and the *p*-value for the difference in the means of the betas across the two sub-periods.

The final statistic that is reported in Table 5 is the model's average pricing error. This measure is an un-standardized residual from the excess currency returns equation (equation 2) and represents the portion of the currency excess returns (deviations from UIRP) not explained by the model. The importance of this measure is that when compared with the average excess currency returns (in Table 2) it provides an indication of how well the excess return is explained by the conditional asset pricing model. For example, in the case of Chile (second column) the average excess return is 0.197% and the error is 0.013%. This indicates that the model has "explained" 0.184% of the excess returns. Stated differently, given the riskiness of Chile's

[6] Note that the factors display varying levels of predictability across the different countries because although a common set of instruments is used in each country model the full "information set" for each model contains the particular country's currency excess returns and its contribution to the variance-covariance matrix of the system.

excess returns, relative to the three risk factors, the sample average conditionally expected return is 0.184% while the realized average excess return is 0.197%.

The results indicate that in almost all cases we can reject the null hypothesis that the betas are not significantly different from zero. This indicates that a part of the currency excess returns is compensation for bearing systematic risk. Except in the case of India, there is a statistical and in most cases an economical difference in the average market beta across the pre- and post-liberalization periods. We interpret the market beta in the usual manner and contend that a negative market beta indicates that the country's currency returns provide the U.S. investor with the benefits of diversification. The average size (SMB) beta (except for Malaysia) and the HML beta (except for Thailand) are also significantly different across sub-periods. These findings provide strong support for the notion that deviation from UIRP is systematic in nature and that liberalization of capital markets significantly impacts the nature of the risk premium. Next we present a closer examination of each of the countries studied.

**Chile**

The average value of the market beta in the pre-liberalization period is –0.035 while for the post-liberalization period it becomes positive with a value of 0.069. This is an increase in absolute value of about 100%. The negative beta in the first period suggests that currency deposits in Chile provides benefits of international portfolio diversification to U.S. equity investors. As is shown in Table 5, a difference in means test is significant at the 1% level. The increase in the market beta is evident in Figure 2. The first sub-period, although displaying some variation, is relatively stable except for a major spike around July 1982 that is probably due to either the Latin American debt crisis and/or the fact that Chile also floated its currency around

this time period. It should be noted that this spike Following capital market liberalization it shows a gradual increase in the first 18 months, fluctuates between 0.08 and 0.16 over the next two years then tapers off to approximately 0.01 for the remainder of the period.

Similar results are also displayed by the size and value betas. Interestingly, while the size beta is generally positive throughout the post-liberalization period it shows a steady decrease in magnitude even though its variation increases. In contrast, the value beta increases sharply in size and volatility though it is generally negative. The positive size beta suggests that following liberalization investors require a large but declining risk premium for financial distress as proxied by SMB. The negative value beta leads to a lower expected excess return in both the pre- and post-liberalization periods and suggests that investors view the Chilean economy as having superior growth opportunities. This reflects the experience of the Chilean economy over much of the 1980s and 1990s (Altig and Humpage (1999)).

The significant positive market and size betas in the second sub-period indicate that Chile's currency market is not integrated in the world capital market, as in that case U.S. investors should not require a positive and significant risk premium. However, from the graphs of the betas it is clear that the results are driven primarily by the period before 1996. That is, consistent with the equity market results of Bekaert and Harvey (1995), Chile appeared to be becoming less integrated in the first three years after liberalization. This trend seems to be reversed starting in 1996. The latter supports Bekaert et al. (2002) that integration is frequently effective only after three or so years after the official liberalization.

## Colombia

In the pre-liberalization period the average value of the market beta is 0.009, while for the post-liberalization period it is 0.013. The *t*-test in Table 5 indicates that they are significantly different at the 1% level. Though both betas are economically small, what is of more significance is the upward trend in the post-liberalization period that is evident in Figure 3. This follows a steep drop in the market beta in early 1994. The cause of this is not clear as in the first half of the year there were some new restrictions imposed on both local and foreign investors and firms (see, e.g., Bekaert and Harvey (1998)).

While the size beta is generally positive throughout the pre-liberalization period it becomes negative after liberalization with increased volatility. The negative beta suggests that U.S. investors' fear of financial distress from investing in Colombia had declined significantly in this period of reform. In contrast, the value beta increases sharply in size to become positive throughout most of the sample period although towards the end of the period it is trending downwards, suggesting that investors view the Colombian economy as about to experience growth perhaps as a result of the earlier reforms.

Considering the increase in the market and value betas and the positive risk premium related to the lack of growth opportunities in the post-liberalization period, we conclude that Colombia is not internationally integrated.

## Mexico

The results for Mexico are broadly similar to those of Chile. In the pre-liberalization period the market beta is negative. In the second sub-period it is positive with an inverted "U" shape (Figure 4), indicating that in the first few years after liberalization the currency market

became less integrated (see, e.g., Bekaert and Harvey (1995)) but is becoming more integrated in the latter years. The beta fluctuates significantly around the 1994 peso crash and increases around the time of the Brazilian currency crisis of the fourth quarter 1998. These results suggest that in the first sub-period the currency market provided U. S. investors with diversification benefits, while in the second sub-period, investors perceived a loss of diversification benefits and therefore required positive compensation.

The SMB beta has an average value of 0.029 in the first sub-period and increases to 0.146 in the post-liberalization period. Although the difference in coefficients is statistically significant, in looking at Figure 4 it appears that this difference is primarily driven by the impact of the Latin American currency crises. This result is consistent with the finding by Hunter (2002) that U.S. investors in Latin American depositary receipts (ADRs) require larger compensation for holding these assets following the peso crash. The value beta has an average of 0.127 in the first sub-period and -0.182 in the post liberalization period, suggesting that in the pre-liberalization period there is a paucity of growth opportunities, while in the post-liberalization period there is a substantial increase in growth opportunities. This may be because Mexico became the largest Latin American recipient of U.S. foreign portfolio investments after liberalization and their joining the North American Free Trade Agreement (NAFTA) in 1994.

Overall, the results indicate that the Mexican currency market is not internationally integrated as investors continue to demand a positive risk premium for exposure to market and financial distress risks. Furthermore, there is clear evidence that segmentation increases around currency crises. The latter is consistent with the findings of Hunter (2002) that currency crises increases equity market segmentation.

## India

The average coefficient for the market beta is 0.013 and 0.049 in the pre- and post-liberalization periods. In contrast to the Latin American markets, the *t*-test indicates that statistically there is no difference across the sub-periods. This similarity across regimes is evident in Figure 5, with notable exceptions around October 1995, April 1996 and the period of the Asian crisis.

The average size coefficient is 0.124 in the pre-liberalization period and decreases to –0.064 in the post liberalization period. For the value beta the coefficient decreases in magnitude from –0.136 to –0.26. In contrast to the market beta, both the size and value betas are statistically different across the two sub-periods. The reduction in coefficients is also apparent in Figure 5. It should be noted that not only is there a reduction in the average size of the coefficients, but there is also a marked decline in their volatility across both sub-periods. These results suggest that the liberalization of capital markets leads to a reduction in the compensation required by investors, an indication that India is becoming more integrated in the 1990s.

## Korea

There is an economically significant increase in the mean excess currency returns moving from the pre- to the post-liberalization periods, even though the latter is influenced largely by the Asian crisis. This is accompanied by a dramatic increase in the average market beta from 0.012 to 0.198 and in the default (SMB) risk beta from –0.038 to 0.081. These results indicate that following liberalization investors required an increase in the risk premiums for both market and default risks. On the other hand, the beta associated with the HML factor, which is a

proxy for future growth opportunities, becomes substantially more negative. This suggests that in contrast to size and market risks, investors require less compensation following liberalization.

These changes in the pre- and post-liberalization periods are also apparent in Figure 6. Overall, these results suggest that for Korea, excess currency returns are time varying and are characterized by significant differences across the two sub-periods. Further, the results also show that the deviation from UIRP is systematic in nature and though it is significantly affected by capital market liberalization the deviation is not eliminated by liberalization.

We conclude, therefore, that Korea has not become integrated in the post-liberalization period, even though an inspection of the betas suggest that in the period after June 1996 it is becoming more integrated notwithstanding the impact of the Asian crisis. The results for Korea are surprising given that Korea is one of the most developed emerging markets. It is a very liquid market, has relatively high market capitalization, and lists over 30 country funds with a fairly long history (Bekaert and Harvey (1995)). Our results are clearly different from those of Bekaert and Harvey who find that Korea is integrated. This difference points to the problem of drawing conclusions solely on the basis of tests of integration of equity markets.

**Malaysia**

The results for Malaysia indicate that excess currency returns are significantly affected by capital market liberalization. The average of the market beta has gone from positive to negative, the mean financial distress (SMB) beta has become more negative, and the mean growth opportunity (HML) beta has become positive. However, only the market and HML coefficients are statistically different across the two sub-periods, suggesting that the perception of the probability of default has not changed significantly across the sub-periods. The negative market

and SMB betas mean that U.S. investors considered Malaysia a significant source of benefits of international diversification and are willing to give up some risk premium in exchange for these benefits. It is clear, however, that they perceive a loss of growth opportunities as a result of the Asian crisis.

An inspection of Figure 7 shows that the most significant deviation from UIRP in the post-liberalization period occurred during the Asian crisis. In fact, excluding the Asian crisis there appears to be no significant difference in the currency excess returns in the second sub-period relative to the first. That is, the deviation seems to be within a ± 5% band from the start of the sample up to the Asian crisis. However, further statistical analyses suggest that the mean excess return of the second sub-period excluding the crisis is positive and economically different from the average for the pre-liberalization period. There are similar differences between the market and HML betas. For instance, closer inspection of the graphs indicate that the range of the HML beta in the second sub-period leading up to the crisis is ± 0.60, compared to –0.15 to +0.05 in the pre-liberalization period.

Overall, these results indicate that, independent of the Asian currency crisis, liberalization has significantly impacted the deviation from UIRP and the component that is required as compensation for bearing risk. It appears as if the Asian crisis interrupted a strong convergence to integration. A close inspection of the graphs of the excess returns and betas clearly indicates that in the nearly 18 months after the crisis the currency excess returns are on average zero.

**Pakistan**

The average coefficient on all three risk factors has increased in magnitude from the first sub-period to the second. These results suggest that on average deviation from UIRP is more

systematic in the post-liberalization period relative to the first period. The increased importance of a non-diversifiable component in deviation from UIRP in the post-liberalization period is also apparent on inspection of Figure 8. Figure 8 shows that for all three risk factors the average coefficients are much larger and are characterized by much wider variations. Additionally, it is also apparent that investors demand a higher compensation for both market and size risk in the post-liberalization period and a reduction in compensation for HML risk. This is consistent with the notion that liberalization increases future growth opportunities (see, e.g., Henry (2000) and Bekaert and Harvey (2000)), while at the same time increasing default risk as evidenced by the Asian and Russian financial crisis.

However, it does appear that Pakistan is becoming more integrated after 1996 as the risk premium required for exposure to market and financial distress risks begin to decline after peaking in 1995 and the HML beta is tapering off to the pre-liberalization average.

**Thailand**

The model estimates show that on average there is a relatively large increase (decrease), both economically and statistically in the average coefficient of the market (size) risk factor. These results are consistent with the notion that deviation from UIRP is due to systematic risk and that this relationship is significantly affected by the liberalization of capital markets. In contrast, the average coefficient on the risk factor proxying for future growth opportunities remains virtually unchanged.

Inspection of Figure 9 reveals some characteristics of the coefficients that are not apparent by the average value reported in Table 5. First it is clear that the increase in the size of the average market beta going from the pre- to the post-liberalization period reported in Table 5

is directly related to the Asian financial crisis.[7] Excluding the crisis period there is a decline in the mean post-liberalization coefficient from 0.121 to 0.097. However, the latter average beta is also statistically significantly different (at less than the 1% level) from the pre-liberalization mean beta (0.059). Similarly, excluding the crisis, the average size beta increases from 0.025 to 0.049, which is statistically different from the pre-liberalization average of 0.088.

The mean of the HML coefficients is also impacted by the Asian crisis. The results reported in Table 5 indicate that the average coefficient is the same across both sub-periods. This is somewhat misleading because of the inclusion of the crisis. The average HML beta in the post-liberalization period before the crisis is -0.130, which is significantly different from the pre-liberalization average (-0.088). Incidentally, the mean pre-crisis excess return in the second sub-period is 0.317, which is significantly different from the pre-liberalization mean at the 0.07 level.

Taken together these results suggest that in general deviations from UIRP are due to systematic risks and that the compensation required for bearing these risks is significantly affected by capital market liberalization. Given that the market and size betas are significant and positive and the increase in the market beta when we exclude the crisis, we conclude that Thailand is not integrated. However, the large negative HML beta and the pre-crisis decline in the mean SMB beta in the post-liberalization period are good indicators of a trend towards integration.

[7] The Asian crisis also led to a change of currency regime from fixed to floating. Thus the impact of the crisis may also be reflecting this change in currency regimes. However, it should be noted that this occurred 10 years after the liberalization, thus it is unlikely that our findings are due to this.

## Turkey

The model estimates for Turkey indicate a dramatic change in the average of the coefficients between the pre- and post-liberalization periods for both market and size risks. Specifically the coefficients change from positive to negative following liberalization. The negative coefficients in the post-liberalization period suggest that on average investors required less (negative) compensation for systematic risk attributed to the market and financial distress. This implies that in comparison to the first sub-period there are perceived diversification benefits from investing in Turkey and a substantial reduction in compensation for financial distress. The latter finding may be due to an increase in Turkey's fiscal responsibility as it seeks to gain acceptance into the Euro zone. Unlike the market and size beta the value beta is negative in the first sub-period suggesting that, on average, during this period investors perceived Turkey as having good future growth opportunities. Following liberalization, although still negative, the average beta is now smaller in absolute magnitude. This is a bit surprising given Turkey's bid to become part of the European Monetary Union (EMU). Perhaps, it is due to the austerity of the economic programs being instituted in order to qualify.

Inspection of Figure 10 indicates results that are in general consistent with those reported in Table 5. They show that there is a dramatic decline in both the size and fluctuation of the market and size coefficients (except for the spike around the first half of 1994). In contrast, for the value beta there is a reduction in the size of the coefficient. However, this is accompanied by an increase in its volatility. Surprisingly, it appears that the compensation required by investors is not substantially affected by the Asian crisis. In fact it appears as if there may be a reduction in the magnitude and variation in the mean of all three coefficients following the Asian crisis.

This may be because investors are now regarding Turkey as becoming more aligned to Europe, given its effort to join the EMU.

It appears that Turkey has benefited substantially from liberalization. The reduction in the excess currency returns as a result of the negative market and size betas in the second sub-period suggests that it has become integrated.

## 6. Conclusion

In this paper we use monthly data to establish that emerging markets typically experience significant deviations from UIRP. We then examine whether these deviations are characterized by time-varying risk premiums and the extent to which this component of excess returns is affected by the liberalization of the country's capital market. We hypothesize that if the emerging market became integrated following capital market liberalization, then U.S. investors will not require a positive and significant risk premium for exposure to risks from investing in these countries' currencies.

Estimation results indicate that deviations from UIRP are indeed characterized by a time-varying component that is compensation for non-diversifiable risks. The results also show that the deviations from UIRP are significantly affected by the liberalization of capital markets. Interestingly, we find that the impact is regional in nature. Specifically, we find that following liberalization of the capital markets of the Latin American countries analyzed, the systematic component of deviations from UIRP increased. On the other hand, for the Asian countries examined and Turkey, apart from the financial crisis that occurred in 1997, there is a general decline in excess currency returns and the component that is compensation for non-diversifiable risk. Further, we also show that the impact of liberalization on the systematic component of

currency excess returns is also significant even if we exclude the currency crisis. However, it is clear that currency crises increase emerging market segmentation. Future studies should examine the underlying forces that resulted in the contrasting effects of liberalization on UIRP across Latin American and Asian countries.

## References


Adler, M., and B. Dumas, 1983, International Portfolio Choice and Corporation Finance: A Synthesis, *Journal of Finance* 38, 925-985.

Aliber, R., 1973, "The Interest-Rate Parity Theorem: A Reinterpretation," *Journal of Political Economy* 81, 1451-59.

Altig, D.E., and O. F. Humpage, 1999, "Dollarization and Monetary Sovereignty: The Case of Argentina," *Federal Reserve Bank of Cleveland*, September 15.

Bailey, W., and R. M. Stulz, 1990, "Benefits of International Diversification: The Case of the Pacific Basin Stock Markets," *Journal of Portfolio Management*, 57-61.

Bansal, R., and D. Magnus, 2000, "The forward premium puzzle: different tales from developed and emerging economies," *Journal Of International Economics*, 51, 115-144.

Basak, S. 1996, "An Intertemporal Model of International Capital Market Segmentation," *Journal of Financial Quantitative Analysis* 31, 161-188.

Beim, D. O., and C. W. Calomiris, 2001, *Emerging Financial Markets,* McGraw Hill Irwin, NY.

Bekaert, G., 1995, "Market Integration and Investment Barriers in Emerging Equity Markets," *World Bank Economic Review* 9, 75-108.

Bekaert, G., and C. R. Harvey, 1995, Time-Varying World Market Integration, *Journal of Finance* 50, 403-444.

Bekaert, G., and C. Harvey, 1998 "Capital Flows and the Behavior of Emerging Market Equity Returns," NBER working paper # 6669.

Bekaert, G., and C. R. Harvey, 2000, "Foreign Speculators in Emerging Equity Markets," *Journal of Finance,* 55, 565-613.

Bekaert, G., C. Harvey, and R. Lumsdaine, 2002, "Dating The Integration of World Equity Markets," forthcoming *Journal of Financial Economics.*

Bollerslev, T., R. Y. Chou, and K. F. Kroner, 1992, "ARCH Modeling in Finance: A Review of Theory and Empirical Evidence," *Journal of Econometrics*, 52 5-59.

Bollerslev, T. and J. M. Wooldridge, 1992, "Quasi-maximum Likelihood Estimation and Inference in Dynamic Models With Time-Varying Covariances," *Econometric Reviews*, 11, 143-179.

Brennan, M., A. Wang, and Y. Xia, 2001, "Intertemporal Capital Asset Pricing and the Fama-French Three-Factor Model," UCLA Working Paper.

Buckberg, E., 1995, “Emerging Stock Markets and International Asset Pricing,” *World Bank Economic Review,* 9, 51-74.

Chari, A., and P. Henry, 2001, "Stock Market Liberalizations and the Repricing of Systematic Risk," Stanford University, Working paper.

Chiang, T. C., 1991, “International Asset Pricing and Equity Market Risk,” *Journal of International Money and Finance* 10 (3), 349-364.

De Brouwer, G., 1997, “Interest Parity Conditions as Indicators of Financial Integration in East Asia,” *Pacific Economic Papers* 268.

De Santis, G., and B. Gerard, 1998, “How Big is the Premium For Currency Risk?,” *Journal of Financial Economics* 49, 375-412.

Dooley, M., P. Isard, 1980, “ Capital Controls, Political Risk, and Deviations from Interest-Rate Parity,” *Journal of Political Economy* 88, 370-384.

Dumas, D., and M. Solnik, 1995, “The World Price of Foreign Exchange Risk,” *Journal of Finance,* 50, 445-479.

Engel, C., 1996, “The forward discount anomaly and the risk premium: A survey of recent evidence,” *Journal of Empirical Finance* 3, 123-192.

Engle, R. F., and K. F. Kroner, 1995, “Multivariate Simultaneous Generalized ARCH,” *Econometric Theory* 11, 122-150.

Fama, E., and K. French, 1993, “Common Risk Factors in the Returns on Stocks and Bonds,” *Journal of Financial Economics* 53, 427-465.

Ferson, W. E., and C. R. Harvey, 1993, “The Risk and Predictability of International Equity Returns,” *Review of Financial Studies* 6, 527-566.

Flood, R., and A. Rose, 2001, “Uncovered Interest Parity in Crisis: The Interest Rate Defense in 1990s,” University of California Berkley, working paper.

Frankel, J., 1992, “Measuring International Capital Mobility: A Review,” *American Economic Association Papers and Proceedings* 82, 197-202.

Frankel, J., 1993, “Quantifying International Capital Mobility in the 1980s,” J. Frankel, ed., *On Exchange Rates*, chapter 2.

Harvey, C. R., 1995, “The Risk Exposure of Emerging Equity Markets,” *World Bank Economic Review,* 9, 19-50.

Henry, P., "Do Stock Market Liberalizations Cause Investment Booms?" *Journal of Financial Economics*, 58, 2000, pp. 301-334.

Hunter, D. M., 2002, "The Evolution of Stock Market Integration in the Post-Liberalization Period: A Look at Latin America," working paper, University of South Florida.

Ikeda, S., "Arbitrage Asset Pricing Under Exchange Risk," *Journal of Finance*, (46), 1991, 447-455.

Kaminsky, G., and R. Peruga, 1990, "Can a Time-Varying Risk Premium Explain Excess Returns in the Forward Market for Foreign Exchange," *Journal of International Economics* 28 (1,2), 47-70.

Kaminsky, G., and S. Schmukler, 2001, "Short- and Long-Run Integration: Do Capital Controls Matter?" working paper, World Bank.

Kim, E., and V. Singal, 2000, "Stock Market Openings: Experience of Emerging Economies," *Journal of Business*, 73, 25-66.

Korajczyk, R. A., 1996, "A Measure of Stock Market Integration for Developed and Emerging Markets," *World Bank Economic Review,* 19, 267-289.

Korajczyk, R. A. and C. J. Viallet, 1992, "Equity Risk Premia and the Pricing of Foreign Exchange Risk," *Journal of International Economics* 33, 199-219.

Liew, J., and M. Vassalou, 2002, "Can Book-to-Market, Size, and Momentum be Risk Factors that Predict Economic Growth?," *Journal of Financial Economics*, forthcoming.

Malliaropulos, D., 1997, "A Multivariate GARCH Model of Risk Premia in Foreign Exchange Markets," *Economic Modelling* 14(1), 61-79.

McCurdy T.H., and I.G. Morgan, 1991, "Tests for a Systematic Risk Component in Deviations from Uncovered Interest Rate Parity," Review of Economic Studies 58, 587-602.

Montiel, P., 1998, "The Long-Run Equilibrium Exchange Rate: Conceptual Issues and Empirical Research," World Bank, Washington, DC.

Morley, B., and E.J. Pentecost, 1998, "Asset Pricing and Foreign Exchange Risk: Econometric Evidence for the G-7," *Journal of International Money and Finance* 17 (2), 317-329.

Mullin, J., 1993, "Emerging Equity Markets in the Global Economy," *Federal Reserve Bank of New York Quarterly Review*, 54-83.

Ross, S. A., 1976, "The Arbitrage Theory of Capital Asset Pricing," *Journal of Economic Theory*, 13, 341-360.

## Table 1 Changes to Interest and Exchange Rate Regimes in Liberalized Emerging Markets

This table documents some of the changes to interest rate and exchange rate regimes around the official liberalization of various emerging markets.

| Country | Lib. Date | **Interest Rates** | **Exchange Rates** |
|---|---|---|---|
| **Argentina** | November 1989 | Deregulation of deposit rates in 1987 but some loan rates still regulated. | Exchange and capital controls eliminated in 1991; |
| **Brazil** | | Loan (Deposit) rates fully liberalized in 1988 (1989). | Controls on capital outflows (inflows) increased (decreased) in 1990s. Interbank foreign exchange market allowed March 1990. |
| **Chile** | January 1992 | | Minimum holding period for investments dropped to one year, peso revalued 5% in January 1992; change in the reference currency for the peso in July 1992; peso pegged to three currencies. |
| **Colombia** | February 1991 | Domestic firms could borrow from foreign sources and domestic sources lend to foreigners operating locally starting in 1991. | Deregulation of the peso in October 1991 lead to free float and reduced controls; September 1993 pesos no longer needed to be converted to U.S. dollars before conversion to other currencies; use of dollar allowed for domestic transactions; |
| **Mexico** | May 1989 | Deposit (loan) rates decontrolled 1988-1989 (1988). | Reduction of controls on foreign portfolio flows in 1989; restrictions on foreign direct flows rationalized in 1989; unification of dual exchange rate system in November 1991. |
| **India** | November 1992 | Simplification of regulated interest rates in 1992; rate controls on CDs and commercial paper lifted in 1993; other interest rate liberalizations in 1994, 1995. | Easing of restrictions on direct and portfolio flows in 1991; dual rate system introduced March 1992; eased tax restrictions in September 1992 to attract inflows; rates unified in 1993-1994. |
| **Korea** | January 1992 | Process of interest rate deregulation started in the 1990s completed by 1995. | Market average exchange rate system introduced March 1990. |
| **Malaysia** | Dec 1988 | Interest rate controls reintroduced in mid 1980s lifted by 1991. | Deregulation of foreign direct and portfolio flows by mid 1980s. |
| **Pakistan** | February 1991 | Interest rates freed in 1995. | Rupee made convertible in July 1994. |
| **Thailand** | September 1 987 | Abolished all ceilings on deposit rates in 1990; removed loan rate ceilings in 1992. | |
| **Turkey** | July 1989 | Deposit rate ceilings eliminated n 1988. | Capital flows liberalized in 1989. |

Source:


Beim, D. O. and C. W. Calomiris, 2001, *Emerging Financial Markets,* McGraw Hill Irwin, NY.

Bekaert, G., 1995, "Market Integration and Investment Barriers in Emerging Equity Markets," *World Bank Economic Review*, Table 8.

Bekaert, G., and C. Harvey, 1998 "Capital Flows and the Behavior of Emerging Market Equity Returns," NBER working paper # 6669.

Bekaert, G., C. Harvey, and R. Lumsdaine, 2002, "Dating the Integration of World Equity Markets," forthcoming *Journal of Financial Economics*.

## Table 2 Summary Statistics of Currency Excess Returns

Currency excess returns are computed as follows. At the beginning of the month a U.S. dollar is converted to local currency at the spot exchange rate against the U.S. dollar and deposited in the country of reference. At the end of the month the local currency proceeds are converted to U.S. dollars at the end-of-month spot exchange rate. The return on this currency deposit is then compared to the one-month return on the matching U.S. dollar deposit in the U.S. to compute the currency excess return. Hence, all returns are in U.S. dollar terms and are monthly percentage returns. Q(*x*) is the Ljung-Box Q statistic (*p*-value) from a test for autocorrelation up to lag *x*. The data used in this study begin in December 1979 (except for Colombia [January 1986, 177 obs.], Mexico [December 1981, 226 obs.]), and ends in September 2000 (except for India [May 1998, 222 obs.]), for a total of 250 monthly returns. The first five (5) months of each sub-period is lost through lagging to initiate the GARCH process, leaving 240 observations for each country. The number on top represents the pre- and the one below, the post-liberalization period.

**Panel A**

| Country | Liberalization Date | # of obs | Mean (%) | Min | Max | Std Dev | Skewness | Excess Kurtosis |
|---|---|---|---|---|---|---|---|---|
| **Chile** | January 1992 | 140 | -0.153 | -19.26 | 9.073 | 3.479 | -3.092 | 14.09 |
| | | 100 | 0.197 | -5.112 | 5.278 | 2.036 | 0.237 | 0.065 |
| **Colombia** | February 1991 | 61 | **-0.206** | -1.053 | 0.549 | 0.322 | 0.429 | 0.849 |
| | | 111 | 0.485[a] | -6.681 | 15.14 | 2.676 | 6.944 | 60.37 |
| **Mexico** | May 1989 | 90 | -1.114 | -47.09 | 13.27 | 6.402 | -5.023 | 32.92 |
| | | 126 | 0.027 | -29.90 | 17.10 | 4.437 | -3.130 | 21.61 |
| **India** | November 1992 | 150 | **-0.666** | -17.07 | 5.394 | 2.069 | -3.348 | 26.59 |
| | | 62 | -0.129[a] | -5.751 | 6.044 | 1.659 | -0.616 | 6.677 |
| **Korea** | January 1992 | 140 | -0.068 | -3.667 | 2.835 | 0.935 | 0.148 | 1.497 |
| | | 100 | 0.112 | -30.79 | 19.01 | 4.854 | -2.254 | 19.81 |
| **Malaysia** | December 1988 | 103 | **-0.353** | -3.898 | 2.475 | 1.340 | -0.213 | 0.067 |
| | | 137 | -0.141 | -14.71 | 25.01 | 3.325 | 2.269 | 27.78 |
| **Pakistan** | February 1991 | 130 | **-0.751** | -5.262 | 1.684 | 1.195 | -1.801 | 4.024 |
| | | 110 | -0.285[a] | -10.78 | 0.976 | 1.922 | -3.971 | 15.86 |
| **Thailand** | September 1987 | 88 | -0.096 | -14.90 | 2.939 | 2.013 | -5.649 | 38.07 |
| | | 152 | 0.005 | -18.44 | 23.12 | 3.572 | 0.173 | 18.74 |
| **Turkey** | July 1989 | 111 | **-0.959** | -8.032 | 3.596 | 2.405 | -0.709 | 0.300 |
| | | 129 | -0.337 | -30.68 | 14.85 | 4.021 | -3.370 | 27.18 |

## Panel B

### Pre-Liberalization Auto-correlations of Currency Excess Returns

| | **Chile** | **Colombia** | **Mexico** | **India** | **Korea** | **Malaysia** | **Pakistan** | **Thailand** | **Turkey** |
|---|---|---|---|---|---|---|---|---|---|
| *r* (1) | 0.033 | 0.667 | -0.065 | 0.028 | 0.277 | 0.147 | 0.360 | 0.010 | 0.030 |
| *r* (2) | 0.133 | 0.487 | -0.018 | 0.039 | 0.270 | 0.014 | 0.228 | 0.113 | 0.087 |
| *r* (3) | 0.151 | 0.323 | -0.005 | 0.060 | 0.239 | 0.012 | 0.099 | 0.119 | 0.148 |
| Q(3) | 6.176 | 46.16 | 0.444. | 0.933 | 30.65 | 2.400 | 26.30 | 2.613 | 3.645 |
| (*p*-value) | (0.103) | (0.000) | (0.931) | (0.817) | (0.000) | (0.494) | (0.000) | (0.455) | (0.302) |
| Q(12) | 20.04 | 68.18 | 20.95 | 11.62 | 84.99 | 19.45 | 38.16 | 5.852 | 12.37 |
| (*p*-value) | (0.066) | (0.000) | (0.051) | (0.477) | (0.000) | (0.078) | (0.000) | (0.923) | (0.417) |

## Panel C

### Post-Liberalization Auto-correlations of Currency Excess Returns

| | **Chile** | **Colombia** | **Mexico** | **India** | **Korea** | **Malaysia** | **Pakistan** | **Thailand** | **Turkey** |
|---|---|---|---|---|---|---|---|---|---|
| *r* (1) | 0.084 | 0.121 | -0.042 | 0.034 | 0.256 | 0.113 | 0.352 | 0.035 | 0.063 |
| *r* (2) | 0.166 | 0.143 | 0.001 | 0.180 | 0.253 | 0.006 | 0.225 | 0.118 | 0.115 |
| *r* (3) | 0.147 | 0.294 | 0.014 | 0.107 | 0.211 | 0.042 | 0.096 | 0.130 | 0.171 |
| Q(3) | 6.110 | 13.95 | 0.264 | 3.081 | 18.82 | 2.095 | 21.76 | 5.145 | 6.362 |
| (p-value) | (0.106) | (0.003) | (0.967) | (0.379) | (0.000) | (0.553) | (0.000) | (0.161) | (0.095) |
| Q(12) | 16.34 | 45.23 | 28.99 | 17.30 | 56.26 | 17.87 | 33.92 | 7.767 | 20.50 |
| (p-value) | (0.176) | (0.000) | (0.004) | (0.138) | (0.000) | (0.120) | (0.001) | (0.803) | (0.058) |

**Bold** (shaded) indicates excess currency returns that are significantly different from zero at the 5% (10%) levels.
[a] Indicates difference in excess currency returns across pre- and post-liberalization periods.

## Table 3 Summary Statistics of the Risk Factors and Information Variables

The risk factors are the Fama-French factors, the U.S. market (USMKT), SMB, and HML. The instruments are a constant, the change in the U.S. default premium (ΔDEFAULT), measured as the yield differential between Moody's Baa and AAA corporate bonds, the U.S. term premium (TERM), measured as the difference in yield between the10-year Treasury note and the three-month Treasury bill, the riskfree rate (RFREE), the return on the one-month Treasury bill, and the U.S. market portfolio (USMKT). Each instrument is lagged one period relative to the factor returns. Q(*x*) is the Ljung-Box Q statistic (*p*-value) from a test for autocorrelation up to lag *x*. The number on top represents the pre-liberalization (145 obs.) and the one below, the post-liberalization (105 obs.) period. Since different markets had different liberalization date this split in the sample represents roughly the average market.

| **Variable** | **Mean** | **Std Dev** | **Autocorrelation** | | | **Ljung-Box (*p*-value)** | |
|---|---|---|---|---|---|---|---|
| | | | *r* (1) | *r* (2) | *r* (3) | LB: Q(3) | LB:Q(12) |
| **USMKT** | 0.661 | 4.855 | 0.084 | -0.057 | -0.069 | (0.523) | (0.354) |
| | 0.589 | 5.073 | 0.111 | -0.076 | -0.094 | (0.400) | (0.180) |
| **SMB** | 0.010 | 2.392 | 0.172[a] | 0.112 | -0.024 | (0.096) | (0.393) |
| | 0.179 | 2.443 | 0.096 | 0.068 | -0.049 | (0.624) | (0.910) |
| **HML** | 0.238 | 2.661 | 0.193[a] | 0.067 | 0.082 | (0.066) | (0.420) |
| | 0.584 | 2.912 | 0.157 | 0.021 | 0.059 | (0.376) | (0.518) |
| **ΔDEFAULT*** | -0.003 | 0.160 | 0.171 | -0.269 | -0.205 | (0.000) | (0.000) |
| | -0.002 | 0.184 | 0.161 | -0.290 | -0.211 | (0.001) | (0.000) |
| **TERM*** | 1.749 | 1.424 | 0.909 | 0.766 | 0.663 | (0.000) | (0.000) |
| | 1.915 | 1.552 | 0.898 | 0.738 | 0.626 | (0.000) | (0.000) |
| **RFREE** | 0.686 | 0.229 | 0.897 | 0.808 | 0.744 | (0.000) | (0.000) |
| | 0.723 | 0.253 | 0.893 | 0.794 | 0.725 | (0.000) | (0.000) |

[a] Indicate significance at the 5% level. The standard error of the first order autocorrelation in the firsr period is approximately 0.0814 and 0.0976 in the second sub-period. * These are annualized yields. All others represent monthly measures.

## Table 4 Predictability of the Factors

The estimated model is: $r_{it} = a_{i0} + a_{i1}z_{1t-1} + \ldots + a_{i4}z_{4t-1} + \varepsilon_{it}$ for $i$ = Market, SMB, and HML, respectively, from equations (4) to (6). The vector of instruments **Z** includes a constant, the change in the U.S. default premium measured as the yield differential between Moody's Baa and AAA corporate bonds (ΔDEFAULT), the U.S. term premium (TERM) measured as the difference in yield between the10-year Treasury note and the three-month Treasury bill, the riskfree rate (RFREE) measured as the return on the one-month Treasury bill, and the U.S. market portfolio (USMKT). All instruments are lagged one month relative to the factors. Standard errors are in parentheses and are based on a QML estimation robust to non-normality of the residuals. LB($x$) is the Ljung-Box chi-squared statistic for testing the null hypothesis of zero autocorrelation up to the $x$th lag. The first column for each market represents the pre-liberalization and the second the post-liberalization period.

| | **Chile** | **Chile** | **Colo.** | **Colo.** | **Mexico** | **Mexico** | **India** | **India** | **Korea** | **Korea** |
|---|---|---|---|---|---|---|---|---|---|---|
| **MARKET** | | | | | | | | | | |
| Constant | 2.221 | -1.861 | 5.646 | -3.584 | 1.913 | -0.449 | 1.565 | **7.106** | 1.436 | -1.940 |
| | (1.838) | (2.349) | (7.495) | (2.260) | (2.423) | (2.114) | (1.849) | (2.833) | (1.707) | (2.570) |
| ΔDEFAULT{1} ×100 | **0.044** | **0.1360** | 0.034 | **0.125** | 0.018 | **0.111** | 0.041 | **0.242** | **0.041** | **0.144** |
| | (0.020) | (0.049) | (0.069) | (0.046) | (0.038) | (0.036) | (0.021) | (0.099) | (0.018) | (0.038) |
| TERM{1} | 0.126 | 0.090 | -0.638 | 0.422 | 0.168 | 0.218 | 0.279 | -1.784 | 0.240 | 0.160 |
| | (0.314) | (0.429) | (1.418) | (0.403) | (0.475) | (0.409) | (0.313) | (0.458) | (0.285) | (0.473) |
| RFREE{1} | -2.584 | 7.404 | -8.376 | **10.68** | -1.633 | 2.863 | -2.619 | -5.354 | -2.011 | 7.188 |
| | (1.975) | (4.194) | (9.712) | (3.907) | (3.326) | (4.073) | (2.347) | (5.555) | (1.881) | (4.452) |
| USMKT{1} | 0.056 | -0.025 | 0.011 | -0.135 | -0.102 | -0.024 | 0.092 | -0.291 | **0.057** | -0.021 |
| | (0.082) | (0.102) | (0.125) | (0.107) | (0.162) | (0.080) | (0.068) | (0.102) | (0.073) | (0.090) |
| **SMB** | | | | | | | | | | |
| Constant | **-1.486** | -0.629 | **4.395** | **-4.714** | **-1.959** | **-2.603** | -0.319 | -2.202 | **-1.529** | -0.646 |
| | (0.753) | (2.551) | (2.200) | (2.314) | (0.958) | (1.474) | (1.417) | (1.516) | (0.686) | (2.121) |
| ΔDEFAULT{1} ×100 | -0.009 | 0.088 | -0.013 | **0.105** | -0.014 | **0.824** | -0.009 | **0.118** | -0.005 | **0.089** |
| | (0.013) | (0.050) | (0.023) | (0.040) | (0.019) | (0.363) | (0.010) | (0.040) | (0.012) | (0.045) |
| TERM{1} | (0.065) | 0.396 | -0.794 | **1.021** | 0.350 | 0.048 | 0.077 | **0.893** | 0.186 | 0.435 |
| | (0.152) | (0.427) | (0.446) | (0.383) | (0.210) | (0.027) | (0.165) | (0.309) | (0.137) | (0.407) |
| RFREE{1} | 1.443 | -1.917 | **-8.083** | 6.062 | 0.881 | 1.436 | 0.077 | -0.224 | 1.278 | -1.967 |
| | (0.847) | (4.583) | (2.896) | (4.619) | (1.369) | (2.003) | (1.705) | (2.807) | (0.765) | (3.824) |
| USMKT {1} | **0.233** | 0.127 | **0.219** | **0.208** | **0.226** | **0.281** | **0.273** | 0.151 | **0.204** | 0.144 |
| | (0.044) | (0.106) | (0.064) | (0.103) | (0.059) | (0.103) | (0.064) | (0.107) | (0.055) | (0.080) |
| **HML** | | | | | | | | | | |
| Constant | **-2.852** | -0.693 | -3.513 | 2.286 | -1.629 | 2.536 | **-1.971** | 1.365 | **-2.326** | -0.805 |
| | (0.828) | (1.819) | (3.168) | (1.793) | (0.989) | (1.424) | (0.851) | (2.014) | (0.730) | (2.049) |
| ΔDEFAULT{1} ×100 | **-0.035** | **-0.154** | -0.031 | **-0.182** | -0.024 | **-0.091** | -0.026 | -0.078 | **-0.035** | **-0.153** |
| | (0.011) | (0.052) | (0.036) | (0.058) | (0.020) | (0.037) | (0.017) | (0.076) | (0.014) | (0.048) |
| TERM{1} | 0.236 | 0.186 | 0.930 | -0.076 | 0.156 | **-1.016** | 0.135) | -0.356 | 0.081 | 0.206 |
| | (0.177) | (0.346) | (0.497) | (0.291) | (0.246) | (0.309) | (0.203) | (0.386) | (0.156) | (0.364) |
| RFREE{1} | **3.769** | 1.501 | 3.731 | -4.908 | **2.544** | **-4.458** | **3.271** | -1.662 | **3.345** | 1.753 |
| | (0.909) | (3.356) | (4.524) | (3.529) | (1.343) | (2.014) | (1.095) | (4.032) | (0.879) | (3.822) |
| USMKT {1} | -0.006 | 0.059 | 0.026 | 0.101 | 0.041 | 0.027 | -0.088 | 0.206 | 0.008 | 0.069 |
| | (0.050) | (0.084) | (0.077) | (0.074) | (0.097) | (0.062) | (0.048) | (0.117) | (0.045) | (0.063) |
| Log-likelihood | -855.00 | -587.53 | -207.10 | -690.16 | -608.76 | -825.04 | -865.15 | -272.71 | -673.36 | -660.69 |

**Bold** numbers indicate significance at the 5% level. Shaded numbers indicate significance at the 10% level.

## Table 4 Cont'd Predictability of the Factors

The estimated model is: $r_{it} = a_{i0} + a_{i1}z_{1t-1} + \ldots + a_{i4}z_{4t-1} + \varepsilon_{it}$ for $i$ = Market, SMB, and HML, respectively, from equations (4) to (6). The vector of instruments **Z** includes a constant, the change in the U.S. default premium measured as the yield differential between Moody's Baa and AAA corporate bonds (ΔDEFAULT), the U.S. term premium (TERM) measured as the difference in yield between the10-year Treasury note and the three-month Treasury bill, the riskfree rate (RFREE) measured as the return on the one-month Treasury bill, and the U.S. market portfolio (USMKT). All instruments are lagged one month relative to the factors. All standard errors in Panel A are based on a QML estimation robust to non-normality of the residuals. LB($x$) is the Ljung-Box chi-squared statistic for testing the null hypothesis of zero autocorrelation up to the $x$th lag. The first column for each market represents the pre-liberalization and the second the post-liberalization period.

| | **Malaysia** | **Malaysia** | **Thailand** | **Thailand** | **Pakistan** | **Pakistan** | **Turkey** | **Turkey** |
|---|---|---|---|---|---|---|---|---|
| **USMKT Factor** | | | | | | | | |
| Constant | 2.961 | -1.840 | 5.049 | 1.405 | 1.929 | -2.320 | 3.388 | -0.062 |
| | (2.369) | (2.093) | (2.739) | (1.823) | (1.831) | (2.022) | (2.086) | (2.685) |
| ΔDEFAULT{1} ×100 | **0.048** | **0.093** | **0.046** | 0.093 | **0.043** | **0.143** | **0.053** | **0.075** |
| | (0.021) | (0.044) | (0.022) | (0.061) | (0.019) | (0.059) | (0.022) | (0.043) |
| TERM{1} | 0.058 | 0.599 | 0.107 | 0.155 | 0.211 | 0.202 | -0.011 | 0.152 |
| | (0.379) | (0.440) | (0.389) | (0.557) | (0.297) | (0.339) | (0.339) | (0.486) |
| RFREE{1} | -3.393 | 3.977 | **-5.680** | 0.249 | -2.469 | **8.203** | -3.822 | 1.683 |
| | (2.473) | (3.404) | (2.797) | (2.445) | (2.018) | (3.670) | (2.151) | (4.368) |
| USMKT{1} | 0.028 | -0.025 | -0.081 | **-0.197** | 0.078 | -0.119 | 0.023 | 0.023 |
| | (0.073) | (0.090) | (0.083) | (0.098) | (0.066) | (0.092) | (0.073) | (0.115) |
| **SMB Factor** | | | | | | | | |
| Constant | -1.155 | **-2.965** | **-1.434** | -0.065 | **-1.514** | **-1.937** | -1.184 | -1.553 |
| | (0.921) | (1.239) | (0.699) | (1.418) | (0.713) | (0.374) | (1.033) | (1.762) |
| ΔDEFAULT{1} ×100 | 0.000 | 0.0330 | -0.002 | -0.010 | -0.007 | **0.112** | 0.003 | 0.040 |
| | (0.012) | (0.037) | (0.010) | (0.033) | (0.011) | (0.052) | (0.008) | (0.041) |
| TERM{1} | -0.080 | **0.751** | -0.030 | 0.315 | 0.116 | **0.556** | 0.038 | 0.435 |
| | (0.130) | (0.295) | (0.149) | (0.321) | (0.124) | (0.114) | (0.153) | (0.336) |
| RFREE{1} | 1.337 | 2.193 | **1.549** | -1.607 | 1.480 | 0.955 | 1.155 | 0.676 |
| | (0.996) | (1.848) | (0.741) | (1.743) | (0.804) | (1.608) | (0.987) | (2.506) |
| USMKT{1} | **0.179** | **0.311** | **0.213** | **0.220** | **0.212** | **0.259** | **0.164** | **0.342** |
| | (0.050) | (0.062) | (0.040) | (0.105) | (0.040) | (0.093) | (0.051) | (0.077) |
| **HML Factor** | | | | | | | | |
| Constant | -1.422 | **3.503** | -1.836 | -0.266 | **-2.305** | 0.118 | -1.707 | 2.479 |
| | (1.110) | (1.115) | (1.197) | (1.602) | (0.896) | (2.196) | (1.004) | (1.266) |
| ΔDEFAULT{1} ×100 | **-0.034** | -0.057 | **-0.035** | -0.039 | **-0.030** | **-0.189** | **-0.038** | -0.039 |
| | (0.014) | (0.034) | (0.014) | (0.030) | (0.012) | (0.055) | (0.014) | (0.032) |
| TERM{1} | -0.021 | -0.355 | 0.003 | 0.185 | 0.236 | 0.220 | 0.087 | -0.077 |
| | (0.177) | (0.345) | (0.198) | (0.511) | (0.167) | (0.334) | (0.172) | (0.298) |
| RFREE{1} | **2.924** | **-6.074** | **3.464** | -1.090 | **3.258** | -0.642 | **3.000** | **-5.371** |
| | (1.089) | (1.701) | (1.260) | (1.842) | (1.077) | (4.354) | (1.016) | **(1.913)** |
| USMKT{1} | -0.016 | 0.013 | -0.037 | **0.197** | -0.035 | 0.0785 | -0.009 | -0.069 |
| | (0.061) | (0.048) | (0.075) | (0.072) | (0.048) | (0.057) | (0.057) | (0.049) |
| Log-likelihood | -546.01 | -781.15 | -472.96 | -854.33 | -674.17 | -646.90 | -656.97 | -792.50 |

**Bold** numbers indicate significance at the 5% level. Shaded numbers indicate significance at the 10% level.

## Table 5 Summary Statistics of the Excess Returns, Betas, and Pricing Errors

The estimated model equation (2): $r_{it} = \beta_{mkt}(\mathbf{z}'_{t-1}\mathbf{A}_{mkt}) + \beta_{smb}(\mathbf{z}'_{t-1}\mathbf{A}_{smb}) + \beta_{hml}(\mathbf{z}'_{t-1}\mathbf{A}_{hml}) + \varepsilon_{it}$ for *i* equal the currency excess returns. β is the conditional covariance between the currency excess returns and the respective factor divided by the conditional variance of the factor. The reported value is the mean beta over the sample period. The term in (bracket) represents the conditional returns on (time-varying realization of) the factor. The vector of instruments **Z** includes a constant, the change in the U.S. default premium measured as the yield differential between Moody's Baa and AAA corporate bonds (ΔDEFAULT), the U.S. term premium (TERM) measured as the difference in yield between the10-year Treasury note and the three-month Treasury bill, the riskfree rate (RFREE) measured as the return on the one-month Treasury bill, and the U.S. market portfolio. All instruments are lagged one month. All standard errors in Panel A are based on a QML estimation robust to non-normality of the residuals. LB(*x*) is the Ljung-Box chi-squared statistic for testing the null hypothesis of zero autocorrelation up to the *x*th lag.

| | **Chile** | **Chile** | **Col.** | **Col.** | **Mex.** | **Mex.** | **India** | **India** | **Korea** | **Korea** | **Mal.** | **Mal.** | **PK** | **PK** | **Thai** | **Thai** | **Turk** | **Turk** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Mean Betas** | | | | | | | | | | | | | | | | | | |
| **Market** | **-0.035** | **0.069** | **0.009** | **0.013** | **-0.009** | **0.230** | **0.013** | 0.049 | **0.017** | **0.198** | **0.020** | **-0.054** | **0.006** | **0.058** | **0.059** | **0.121** | **0.038** | **-0.083** |
| Std | 0.018 | 0.045 | 0.005 | 0.015 | 0.019 | 0.082 | 0.001 | 0.241 | 0.008 | 0.105 | 0.019 | 0.189 | 0.011 | 0.021 | 0.003 | 0.139 | 0.018 | 0.127 |
| Min | -0.174 | -0.017 | -0.013 | -0.027 | -0.028 | 0.065 | 0.012 | -0.546 | 0.001 | 0.041 | -0.009 | -1.647 | -0.048 | 0.021 | 0.049 | -0.777 | -0.007 | -0.535 |
| Max | -0.002 | 0.160 | 0.025 | 0.038 | 0.091 | 0.640 | 0.016 | 0.856 | 0.060 | 0.449 | 0.078 | 0.261 | 0.043 | 0.095 | 0.069 | 1.016 | 0.119 | 0.769 |
| T-Test* | | **0.000** | | **0.009** | | **0.000** | | 0.255 | | **0.000** | | **0.000** | | **0.000** | | **0.000** | | **0.000** |
| **SMB** | **0.107** | **0.079** | 0.016 | **-0.170** | **0.029** | **0.146** | **0.124** | -0.064 | **-0.038** | **0.081** | **-0.029** | **-0.062** | **0.045** | **0.075** | **0.088** | 0.025 | 0.006 | **-0.178** |
| Std | 0.215 | 0.060 | 0.078 | 0.084 | 0.052 | 0.260 | 0.163 | 0.448 | 0.056 | 0.051 | 0.037 | 0.260 | 0.085 | 0.052 | 0.025 | 0.217 | 0.087 | 0.394 |
| Min | -1.153 | -0.026 | -0.132 | -0.326 | -0.145 | -1.369 | -0.539 | -2.154 | -0.254 | -0.032 | -0.128 | -1.146 | -0.303 | 0.005 | 0.019 | -1.540 | -0.214 | -2.926 |
| Max | 0.748 | 0.233 | 0.310 | -0.003 | 0.292 | 1.725 | 0.782 | 1.469 | 0.121 | 0.184 | 0.056 | 1.007 | 0.277 | 0.210 | 0.130 | 0.740 | 0.315 | 0.185 |
| T-Test* | | 0.141 | | **0.000** | | **0.000** | | **0.002** | | **0.000** | | 0.151 | | **0.001** | | **0.000** | | **0.000** |
| **HML** | **-0.139** | **-0.016** | **-0.026** | **0.015** | **0.127** | **-0.182** | **-0.136** | -0.026 | **-0.018** | **-0.399** | **-0.064** | **0.067** | **-0.020** | **-0.073** | **-0.088** | **-0.088** | **-0.164** | **-0.080** |
| Std | 0.162 | 0.030 | 0.014 | 0.015 | 0.064 | 0.298 | 0.163 | 0.209 | 0.079 | 0.152 | 0.050 | 0.327 | 0.006 | 0.024 | 0.013 | 0.202 | 0.094 | 0.260 |
| Min | -1.262 | -0.099 | -0.085 | -0.032 | -0.245 | -2.230 | -1.020 | -1.147 | -0.206 | -0.682 | -0.145 | -0.724 | -0.041 | -0.122 | -0.108 | -0.537 | -0.370 | -1.058 |
| Max | 0.134 | 0.043 | 0.015 | 0.039 | 0.310 | 1.287 | 0.571 | 0.601 | 0.186 | -.073 | 0.071 | 2.046 | 0.005 | -0.011 | -0.050 | 1.444 | 0.345 | 0.715 |
| T-Test* | | **0.000** | | **0.000** | | **0.000** | | **0.000** | | **0.000** | | **0.000** | | **0.000** | | 0.986 | | **0.001** |
| Excess Return | -0.153 | 0.197 | -0.206 | 0.485 | -1.114 | 0.027 | -0.666 | -0.129 | -0.068 | 0.112 | -0.353 | -0.141 | -0.751 | -0.285 | -0.096 | 0.005 | -0.959 | -0.337 |
| Pricing Error [a] | 0.120 | 0.013 | 0.0842 | 0.1152 | -0.252 | -0.432 | -0.352 | -0.180 | -0.037 | -0.048 | -0.097 | -0.175 | -0.293 | -0.253 | 0.001 | -0.129 | -0.328 | -0.388 |
| (Std of error) | 2.930 | 2.961 | .143 | .181 | 5.904 | 5.847 | 1.999 | 1.942 | 3.314 | 3.323 | 2.640 | 2.633 | 1.639 | 1.543 | 3.024 | 3.009 | 4.634 | 4.609 |

Betas in **bold** indicate significance at least at the 5% level. *T-Test is the test of the null hypothesis that the means of the respective beta are equal before (first column) and after (second column) liberalization. Significant *p*-values (at the 1% level) are in bold. [a]Pricing Error is the unstandardized residual from equation (2). It represents the portion of the currency excess returns not explained by the factors. A comparison of the pricing errors with the mean excess returns (repeated in the table for convenience) reflects how well risk premium explains the currency excess returns.

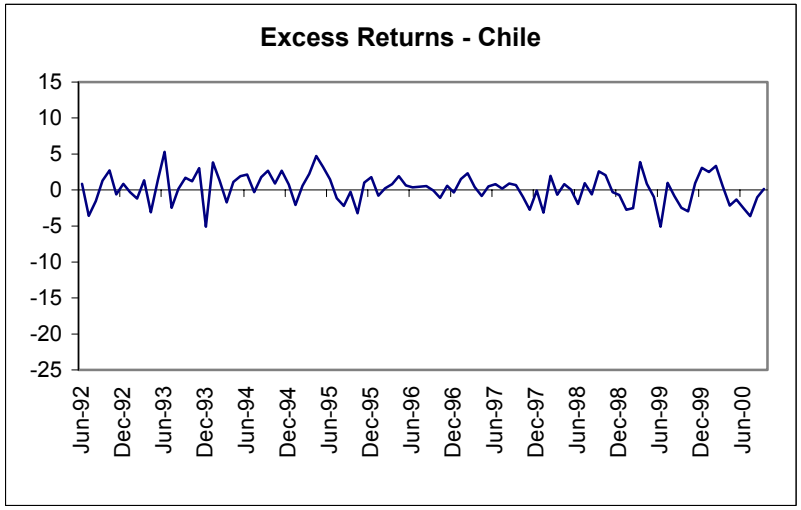
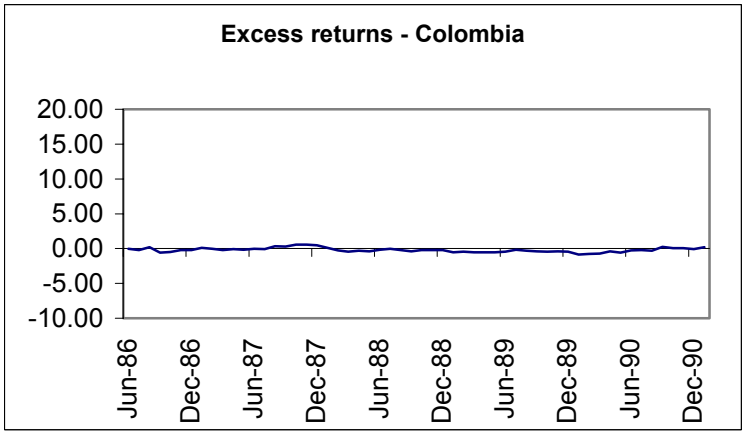



Figure 1a.



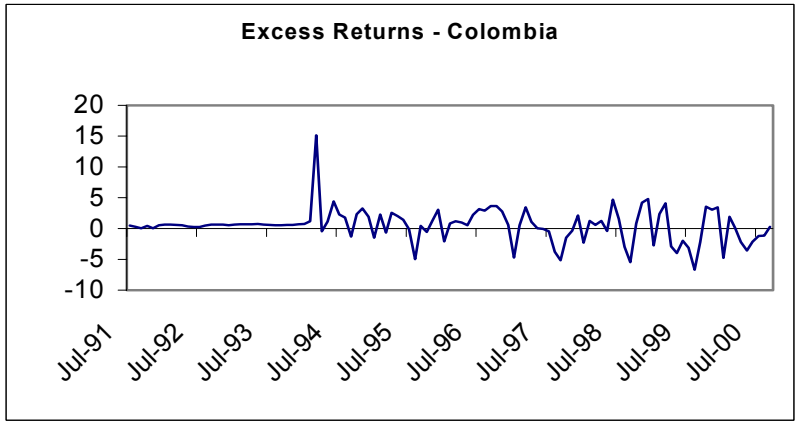
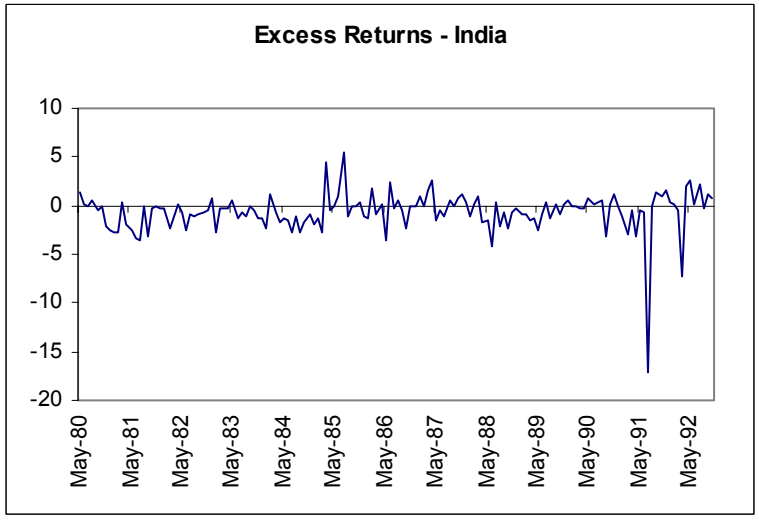




Figure 1b.

Figure 1c.



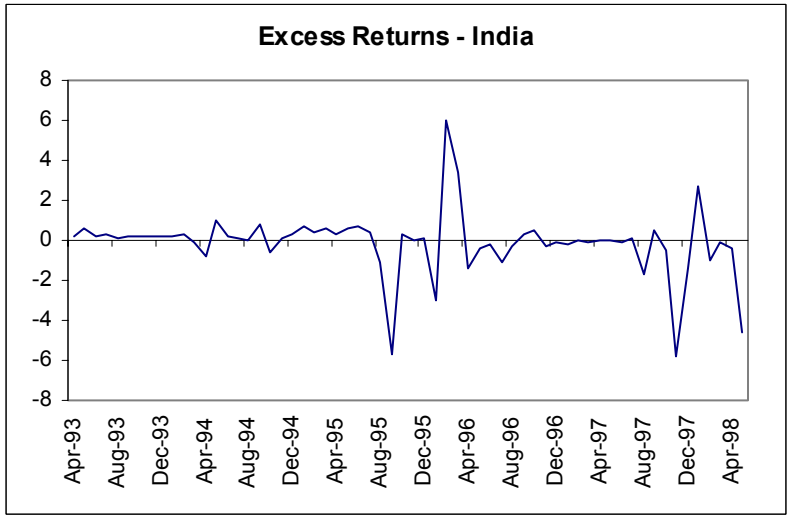
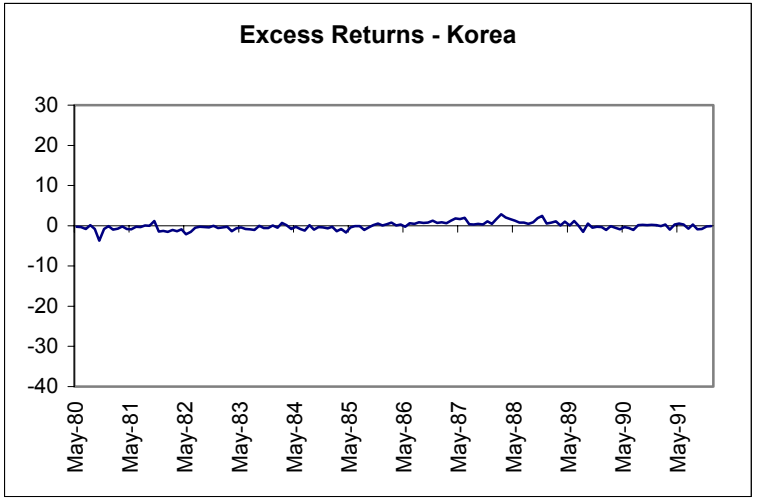




Figure 1d.



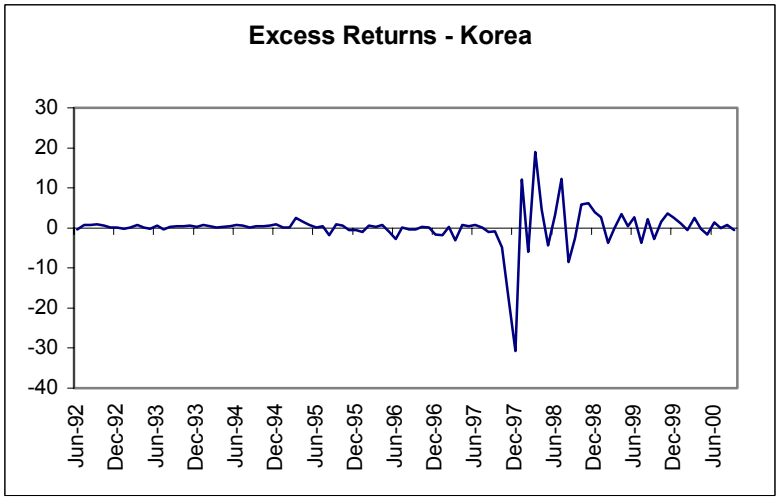
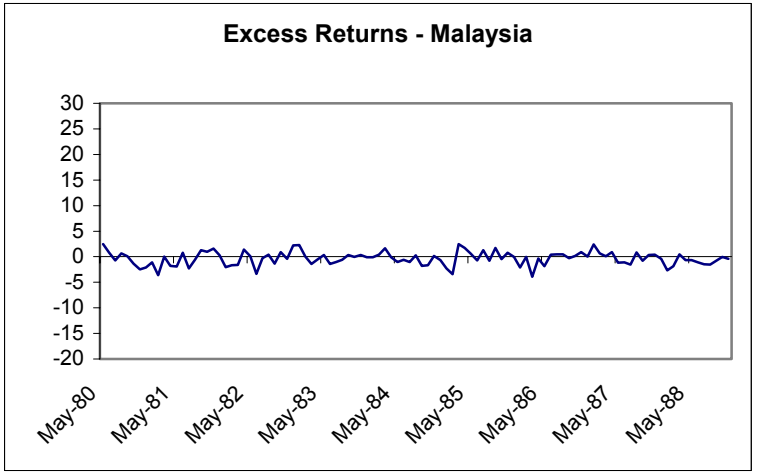




Figure 1e.



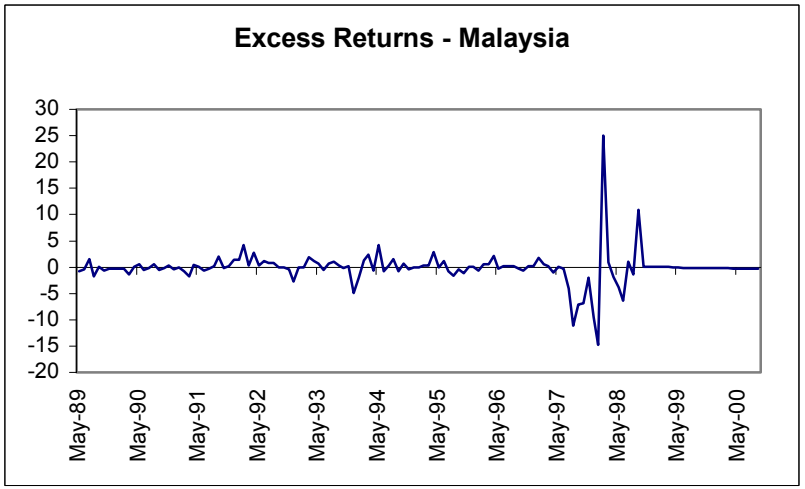
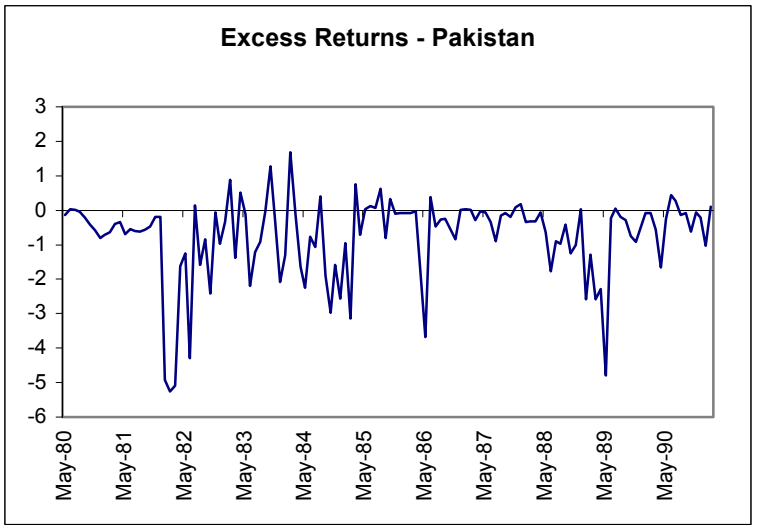




Figure 1f.



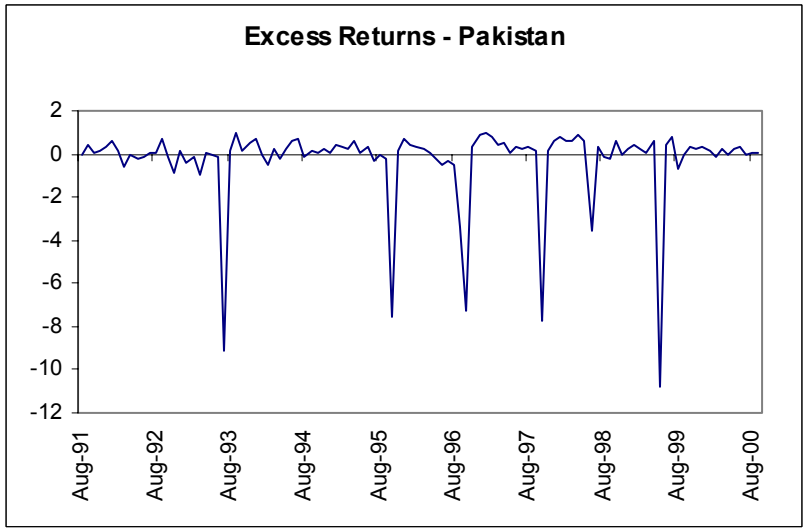
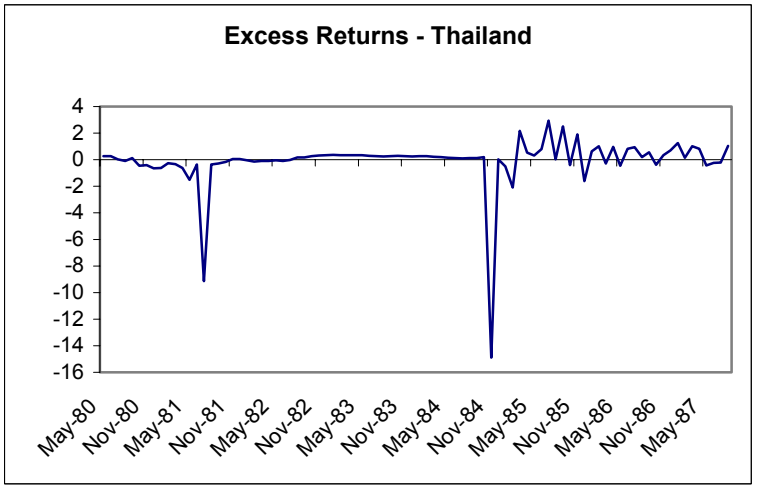




Figure 1g.



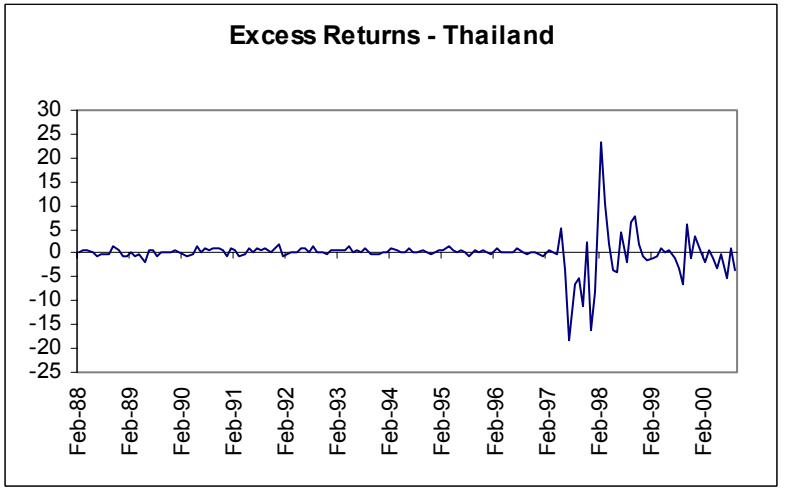
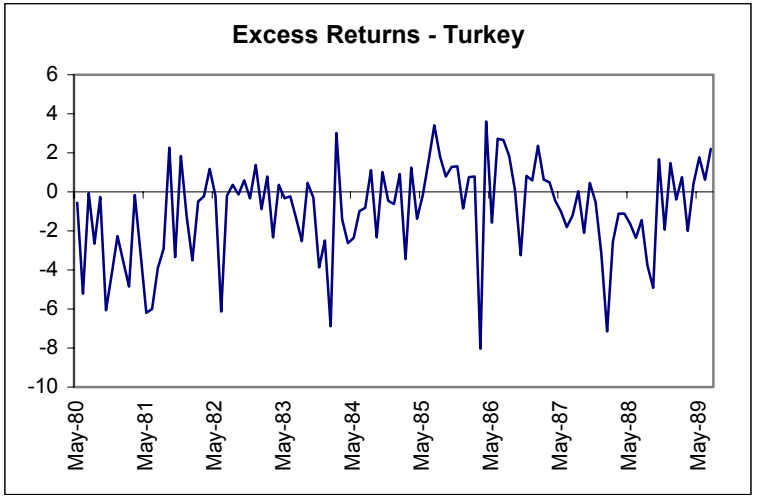




Figure 1h.


Excess Returns - Turkey
6
4
2
0
-2
-4
-6
-8
-10
May-80
May-81
May-82
May-83
May-84
May-85
May-86
May-87
May-88
May-89

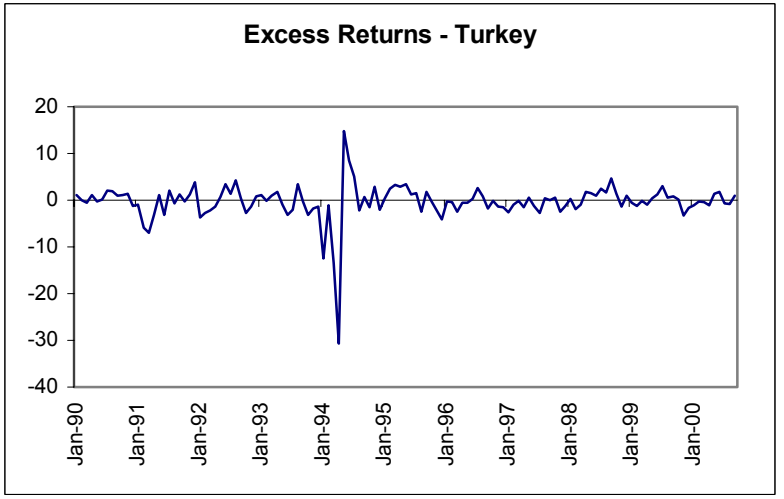
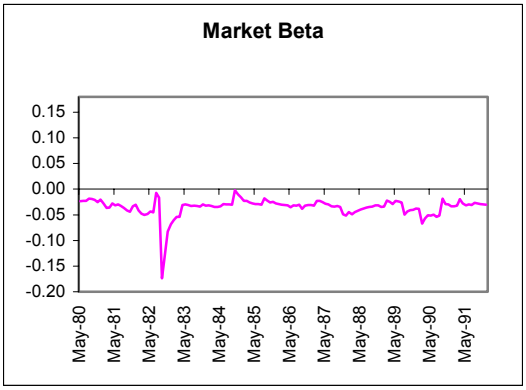
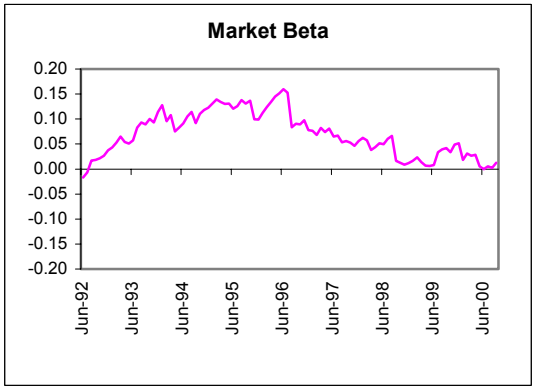
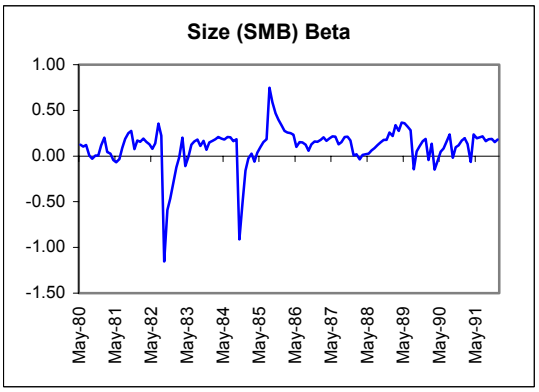
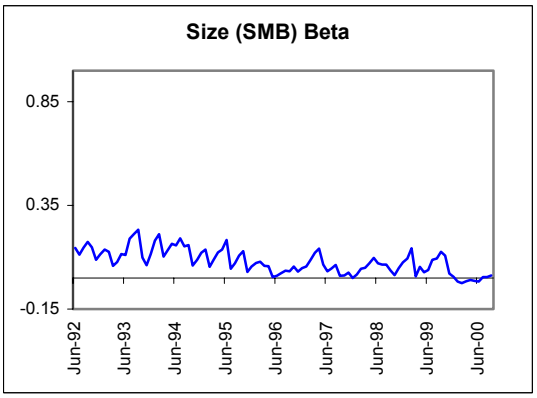

Excess Returns - Turkey
20
10
0
-10
-20
-30
-40
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00

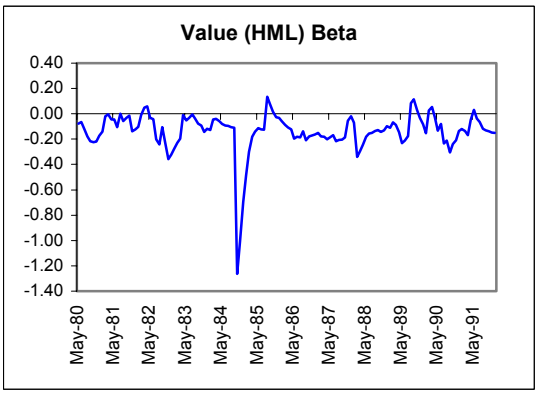
Figure 1i.



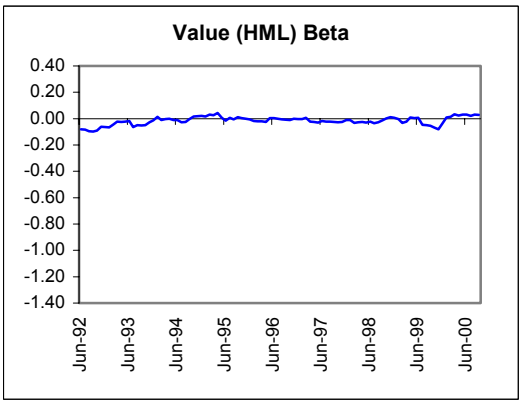




**Figure 2. Time-Varying Betas for Chile.**

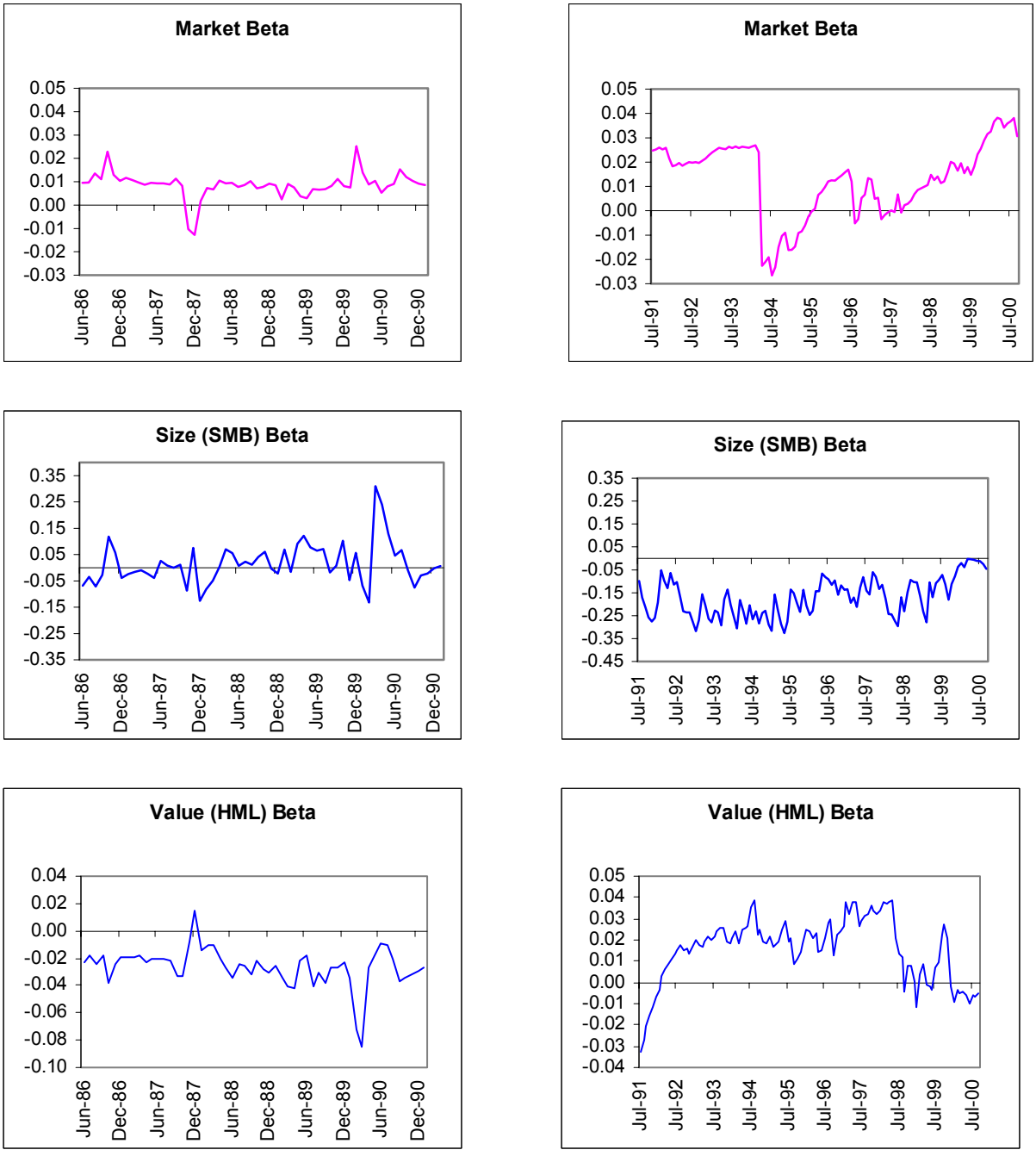
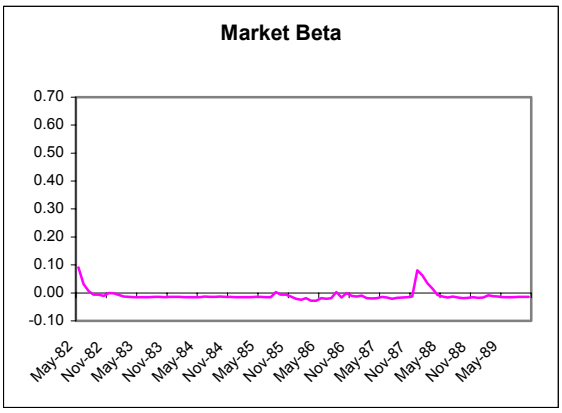
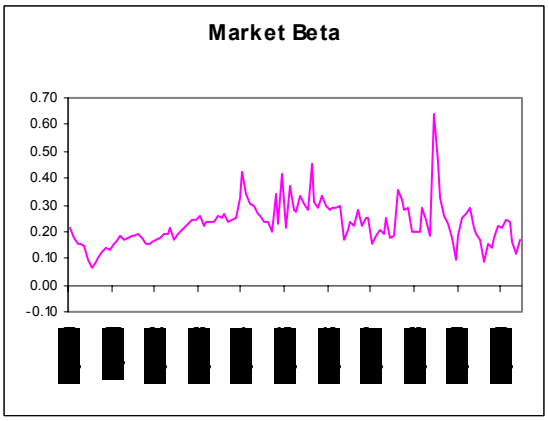
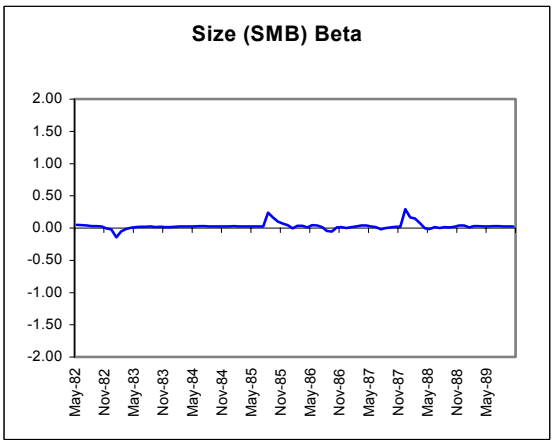
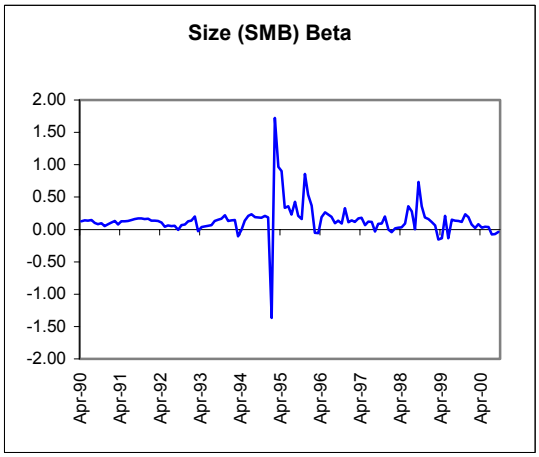


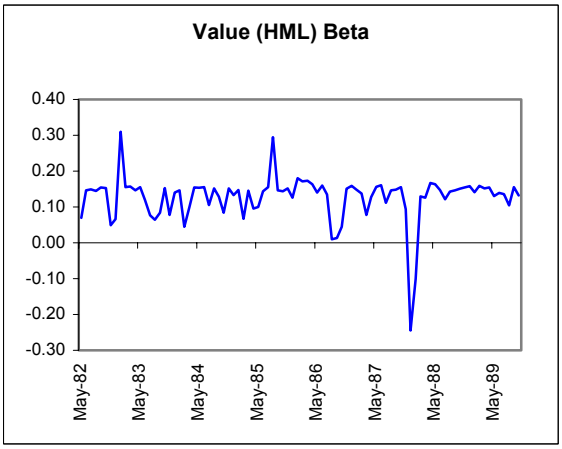

**Figure 3 Time-Varying Betas for Colombia**.



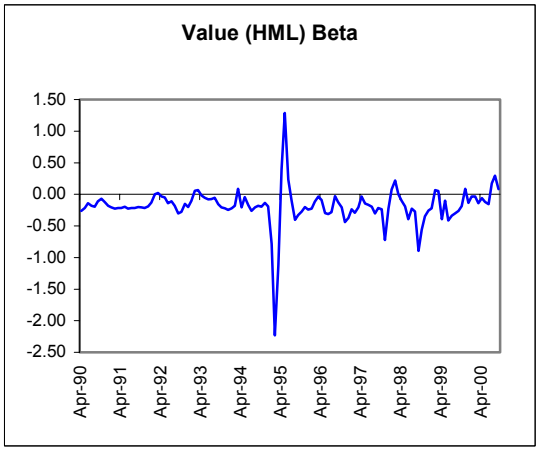
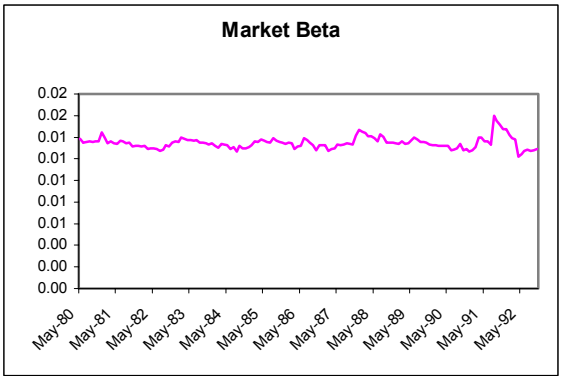
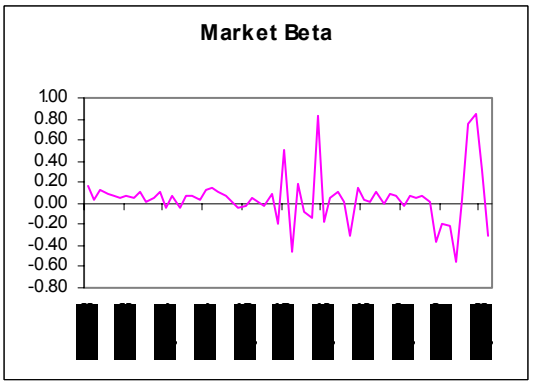
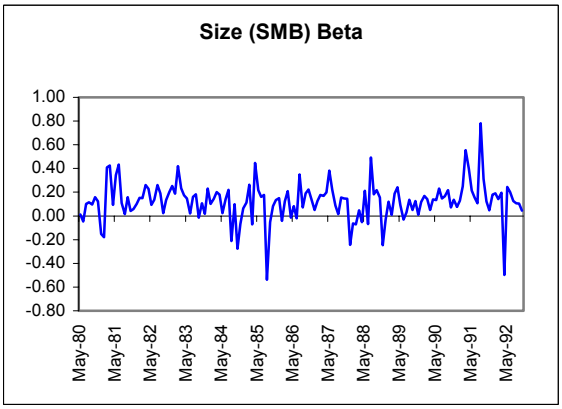
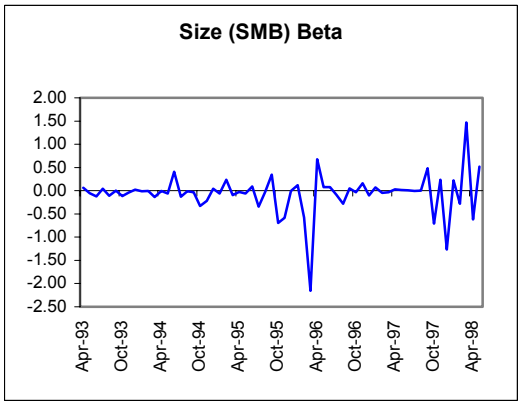



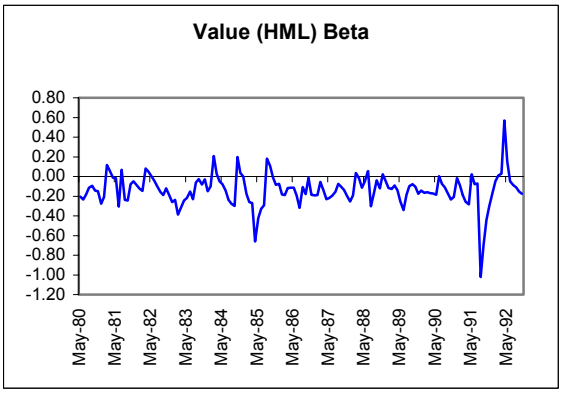

**Figure 4. Time-Varying Betas for Mexico.**



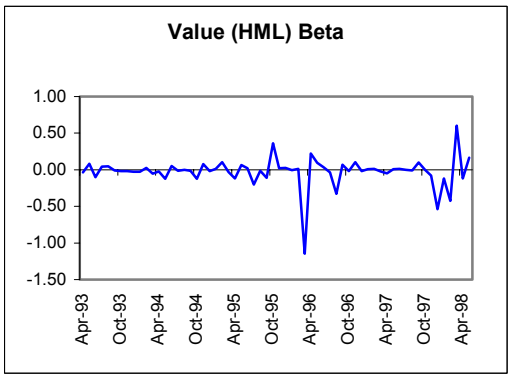




**Figure 5. Time-Varying Betas for India.**

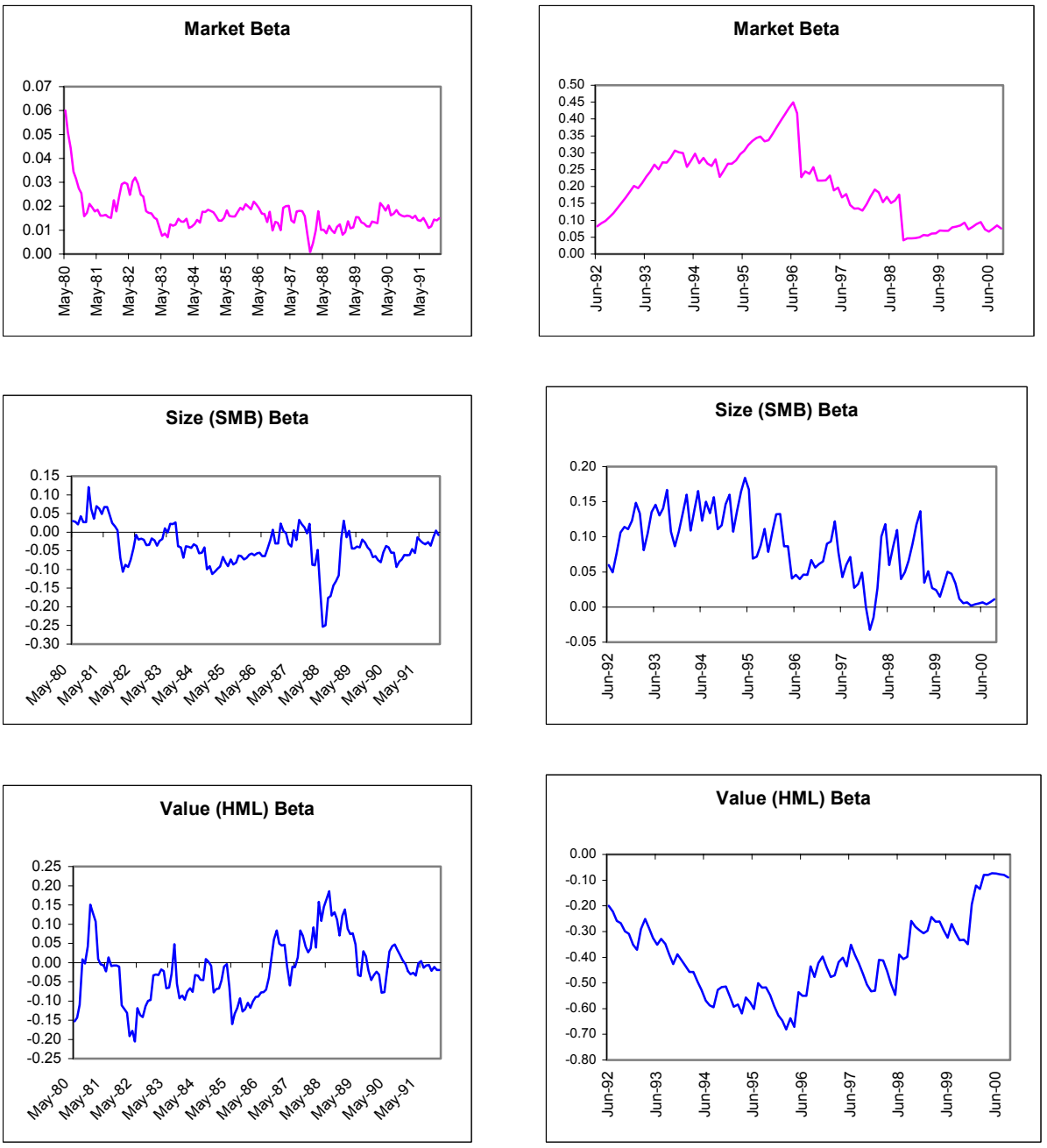



**Figure 6. Time-Varying Betas for Korea.**

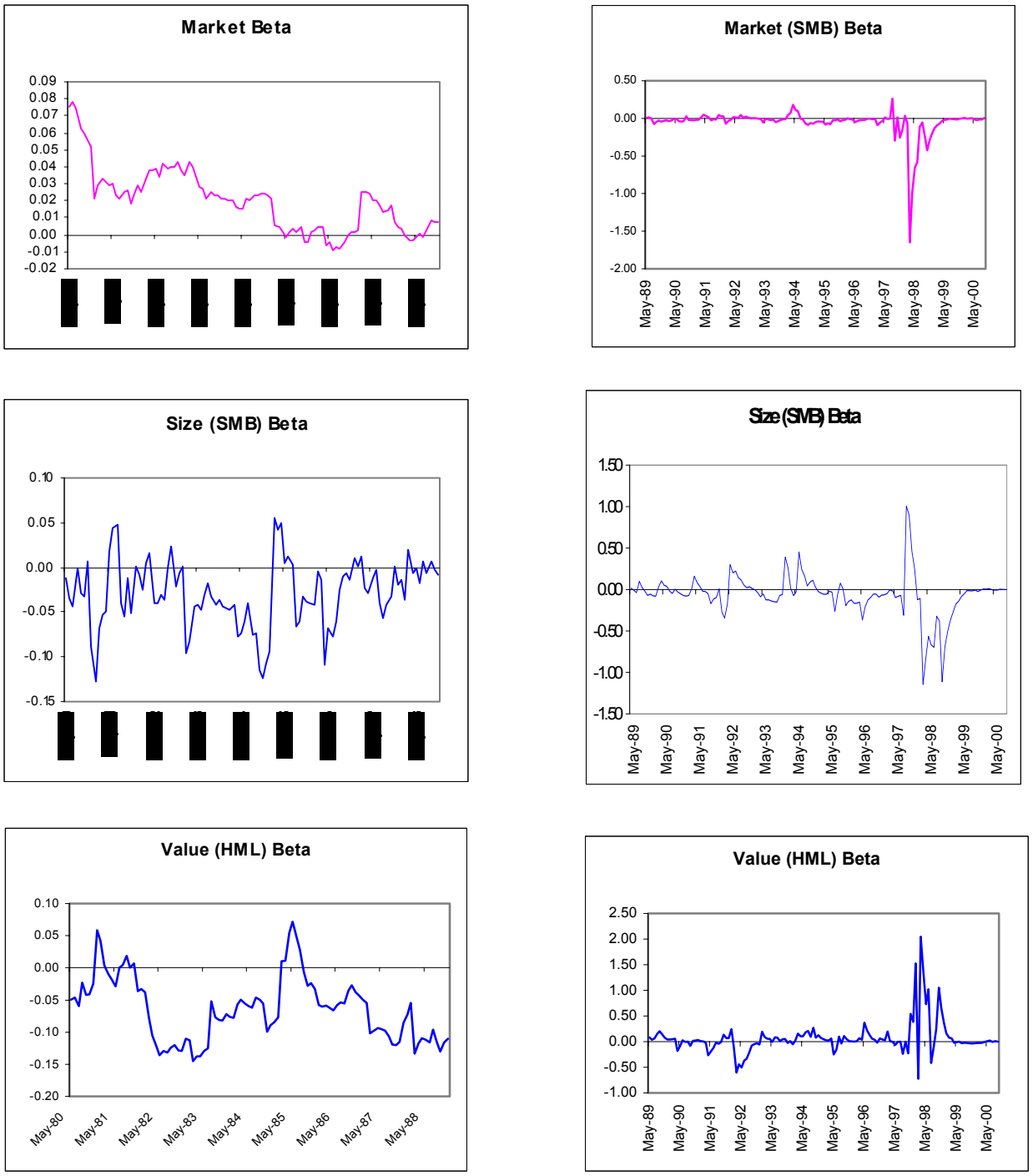
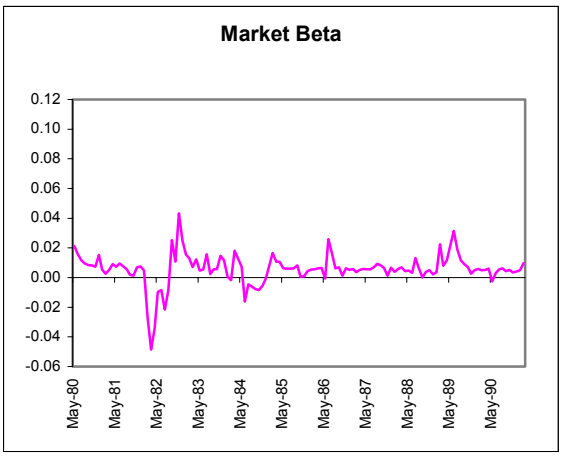
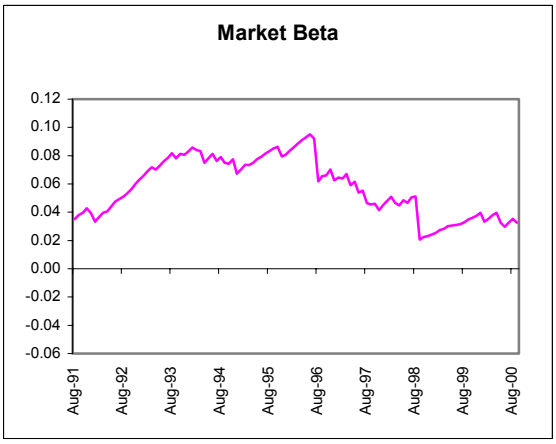
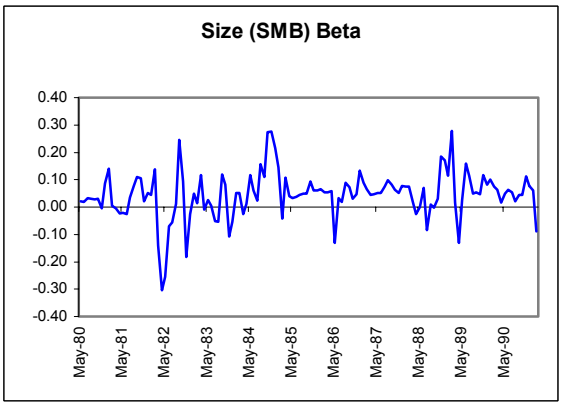
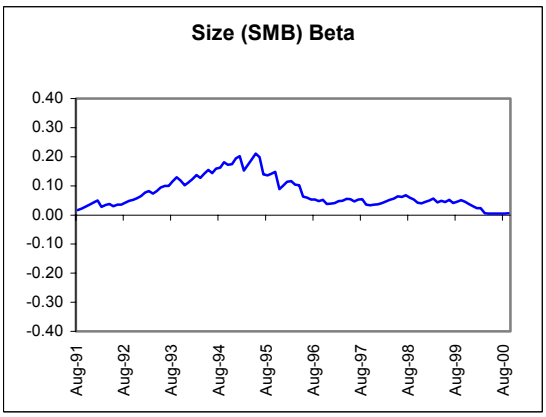


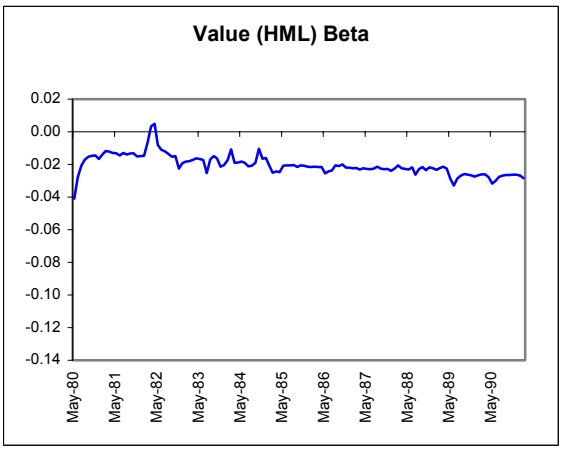

**Figure 7. Time-Varying Betas for Malaysia.**



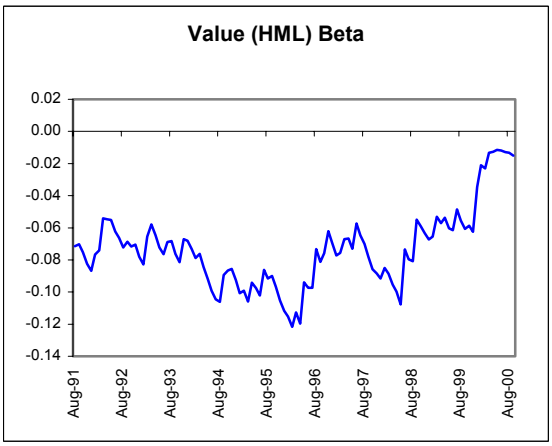
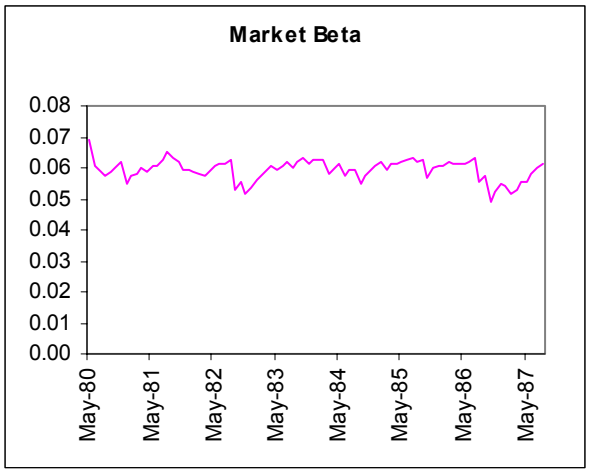
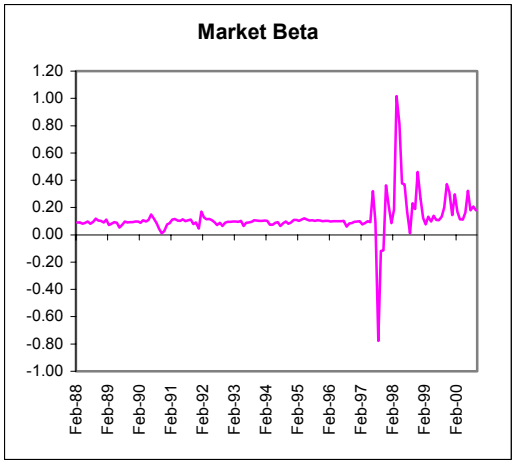
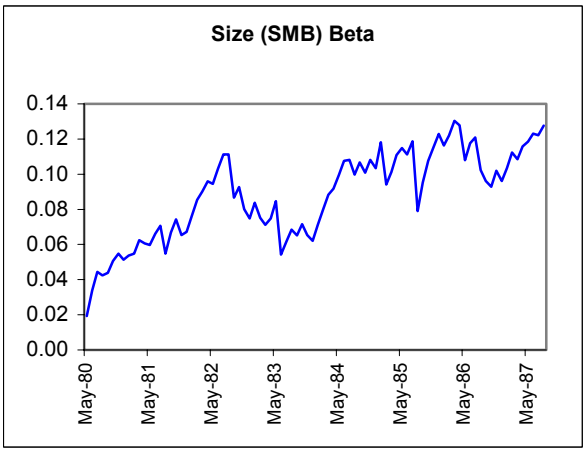
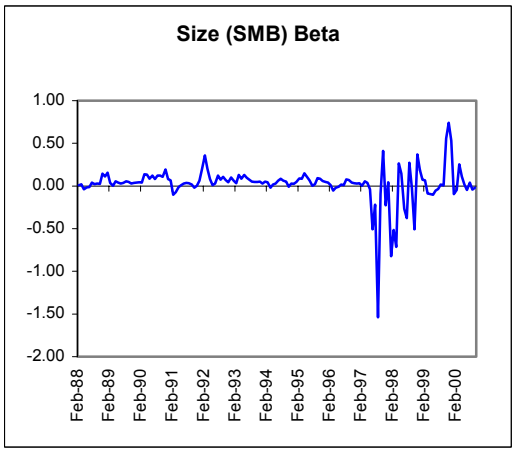



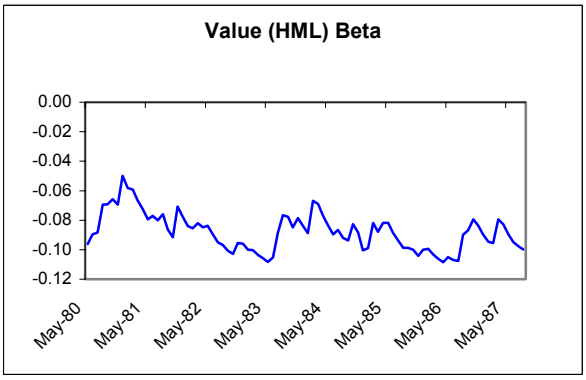

**Figure 8. Time-Varying Betas for Pakistan.**



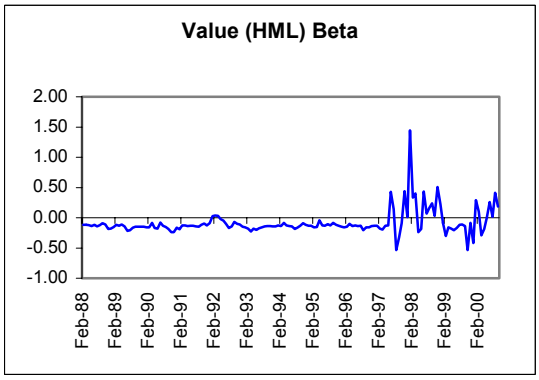
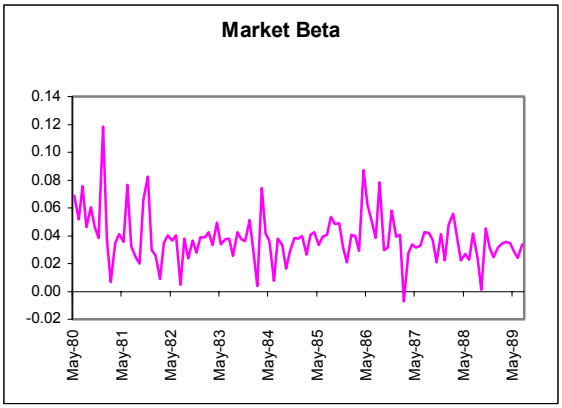
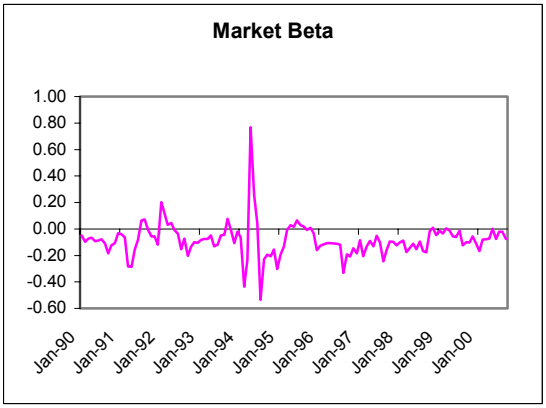
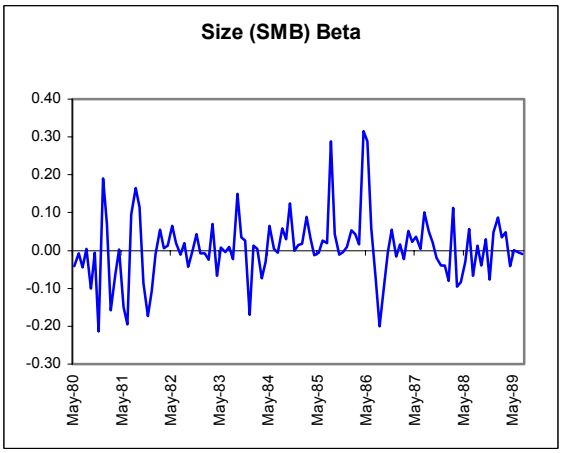
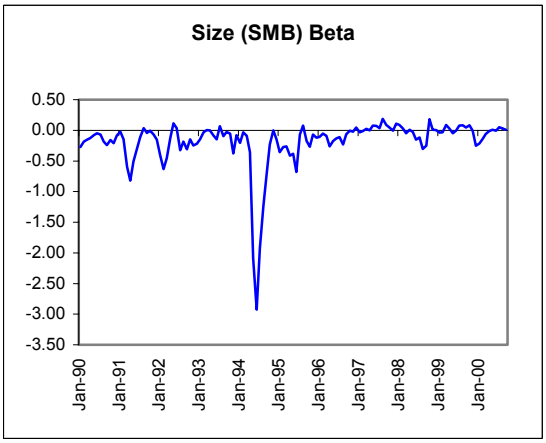



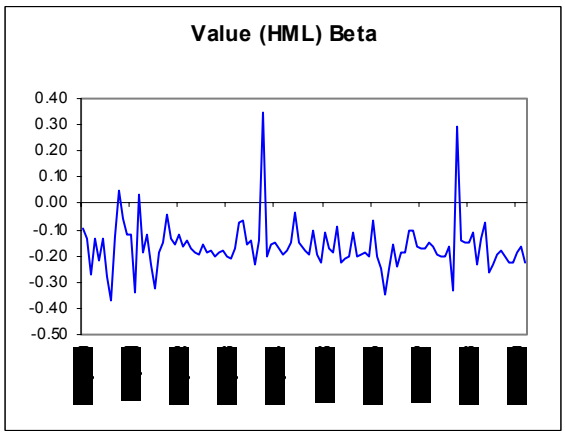

**Figure 9. Time-Varying Betas for Thailand.**



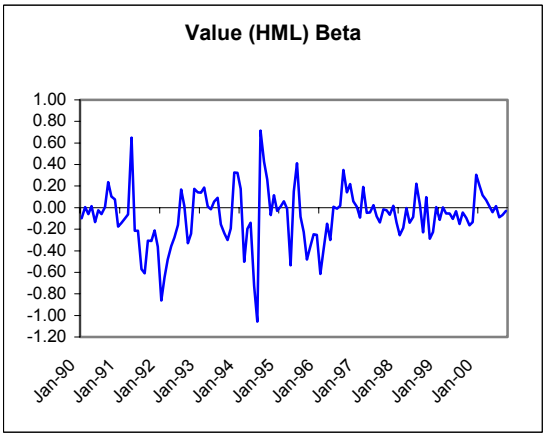




**Figure 10. Time-Varying Betas for Turkey.**