Currency Crisis Contagion, Capital Flows, and Sovereign Ratings: Empirical Studies of Emerging Markets

by

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To my parents and grandparents

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Declaration

Chapter 2 of this thesis was presented at the 6th Annual Young Economist Conference in Copenhagen, Denmark. Capital flow forecasts of chapter 3 and chapter 4 were used as simulation exercises for the Development Economics Prospect Group (DECPG) of the World Bank.

ABSTRACT

CURRENCY CRISIS CONTAGION, CAPITAL FLOWS, AND SOVEREIGN RATINGS: EMPIRICAL STUDIES OF EMERGING MARKETS

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Followed by the introduction, we begin the thesis by focusing on providing a quantitative indicator of the currency crisis contagion during the 1997-98 East Asian crisis. The severity of contagion is measured using a state-space model and a technical apparatus known as the Kalman filter. The results show that the contagion level is exceptionally high during the peak of the Asian crisis from June 1997 to January 1998. Further econometric tests were carried out to identify whether the crisis is transmitted to countries linked through trade or to countries characterized by macroeconomic similarities. The results indicate that the macroeconomic similarity dominates trade linkage

as the major crisis transmission channel. Further, the high level of domestic claims which were financed by foreign capital inflows were shown to be the most significant factor in explaining crisis contagion in 1997-98.

The next part of thesis develops and implements a method for forecasting capital flows to emerging markets. We provide capital flow forecasts to thirty-two developing countries using a vector autoregressive (VAR) framework based on the underlying fundamental factors driving capital flows. We also use our estimated models to carry out simulation exercises for the behaviour of capital flows under various economic scenarios. In the following part of thesis, using an unobserved components model and maximum likelihood Kalman filtering estimation, we separate out permanent and temporary components of capital flows. Based on these models, and using monthly data up to December 2000, forecasts of various capital flows are presented for the period January 2001 to December 2003. The results of the time series-based forecasts are then compared to those obtained using the fundamentals-based approach.

Previous simulation exercises for the behaviour of capital flows under various scenarios have pointed out the significance of sovereign ratings in determining the size of inflows to emerging markets. Therefore,

the final part of the thesis uses the state space form and the Kalman filter to illustrate that the contagion factor influenced the rating agencies' sovereign rating decisions in East Asian emerging markets in 1997-98. It also shows that agencies downgraded sovereign ratings of the five Asian emerging markets excessively, beyond which economic fundamentals would justify. This exacerbated Asian emerging markets' cost of borrowing abroad and led to the evaporation of supply of international capital to them. It is proposed that rating agencies would have an incentive to downgrade to recover their reputation from failing to predict the emergence of crisis in the first place.

Chapter 1

Introduction

During the 1990's, international financial market participants have witnessed some of the most severe market turbulence in the post war period. The 1997-98 East Asian crisis can now be ranked among the most notable crises in financial history; the unprecedented movements in exchange rates and asset prices have destroyed more than U$ 1.5 trillion[1] of financial wealth in the affected Asian countries alone.

In contrast to previous balance of payments-cum-currency crises where economic mismanagement had resulted in either large fiscal deficits or gross misalignment of exchange rates, the macroeconomic performance of Asia has been exemplary. Over the past decade, record economic growth and development were supported by strong economic fundamentals. Most countries ran either balanced or surplus fiscal accounts with little or no government debt, and high private sector savings funded exceptional rates of investment. Even as investment surpassed savings, driving current account deficits wide, the fact that growth was investment rather than consumption driven provided a large degree of comfort. Similarly, monetary policy appeared to be coping well, with reported inflation rates under

[1]Source from Deutsche Bank, Gobal Markets Research, November 1999

control.

Much of official and academic opinion has tended to lay the responsibility for the crisis on fundamental economic and financial problems. Some of the most frequently mentioned explanations include (i) the high leverage in corporate balance sheets, (ii) the importance of foreign capital in financing Asian growth, (iii) the weak banking sector as financial intermediation, and (iv) the exchange rate mismanagement and investment flows. However, one question still remains unanswered. If these were the only explanations for the emergence of crisis, why did it occur so suddenly and almost simultaneously in so many countries? Was there some unobservable but nevertheless strong negative sentiment growing and prevailing in the whole region as an investment target when the Thai baht collapsed in early July of 1997? Did crisis spread contagiously from one country to another? In a period of 6 weeks, four currencies were devalued. Speculation intensified allowing the Bank of Thailand to accumulate U$ 23 billion of short dollar forward liabilities, and on 2nd of July, 1997, the Bank of Thailand abandoned its currency peg. The fall in the baht immediately raised doubts over other currencies. The Philippine peso was floated on 11th of July, and the Malaysian ringgit was next to come under pressure with Bank Negara forced to abandon its interest rate defence after only one week. The Indonesian rupiah followed soon, although the official intervention band was not discarded until the 14th of August. Up to this point, all ASEAN currencies had fallen by around 20% against the US dollar.

If this was simply a competitiveness issue, the exchange rate misalignment had been redressed. However, currencies failed to stabilize despite the introduction of IMF support packages. The crisis eventually spread to Korea and Korean won was devalued in November 17th, 1997.

Krugman (1998), drawing on earlier work by, in particular, McKinnon and Pill (1996), argues that traditional currency models fall short of an adequate explanation of the Asian crisis and proposes an alternative moral hazard model of banking sector instability. The moral hazard problem, generated when the liabilities of financial institutions are underwritten by implicit government guarantees which is likely to be an important distortion in the financial system, is at the core of the crisis. Since the costs of banking losses are not fully borne by the institution, this creates an incentive to increase lending beyond actuarially prudent levels. Banking sectors become increasingly unstable and vulnerable to collapse if the guarantee is doubted. However, the ongoing financial support from governments to major banking groups in Europe shows moral hazard is hardly unique to Asia, and this alone cannot justify the scale of the subsequent currency collapse.

In our view, fundamental problems and financial system insolvencies were blown into debilitating systemic regional problems by herding behaviour when foreign financial institutions pushed excessive capital flows into emerging markets and by hysterical panic when they then pulled out in excessive amounts. In the months preceding the crisis, speculative attacks were driven in large part

by leveraged market participants - hedge funds, proprietary trading desks - and international financial institutions. It is unlikely that such funds were betting on inflation causing a major real exchange rate appreciation at some distant future time, particularly given the impressive low inflation track record over the past two decades. A more plausible strategy was that central banks were considered unable to afford a sustained interest rate defence of the currency. This creates an unstable equilibrium because the greater the speculative attack, the higher the cost of defence encouraging even more speculation.

During the period of greatest uncertainty with currencies depreciating and interest rates rising, credit risk escalated to the point that the returns to holding almost any exposure were perceived as being negative in the near term. In addition, the expected domestic economic contraction that was necessary to generate a current account surplus and finance bank recapitalisation reduced the expected yield on equity. A classic liquidity squeeze emerged in which foreign creditors recognized that there were insufficient foreign exchange reserves to cover short term debt, and creditors "ran" the currencies. Capital flight triggered a raft of credit downgradings, and rating downgrades triggered loan repayments. Currency dynamics after the initial devaluating were influenced by contagion. By raising the risk premium on foreign investment, this led to further capital outflows from the region. Total private capital flows to five Asian[2] emerging markets most hit by the crisis fell from an inflow of U$ 97 billion in 1996 to an estimated outflow of U$

[2]These countries include Thailand, Philippines, Malaysia, Indonesia and Korea.

12 billion in early 1998, a U$ 109 billion reversal. The shift in capital flows into the region in only one year was equivalent to more than 10% of aggregate GDP.

Devaluation may have created a competitive gain, but this was minor to the increase in cost of capital. The cost of capital doubled from 1997 to 1998, and the cost of equity increased dramatically as well, ranging from 40% for Malaysia to 70% for Philippines[3].

In this connection, the overall aim of this thesis is to understand the financial dynamics of emerging market economies vis-a-vis the rest of the world. We begin by raising the questions "Was the 1997-98 East Asian crisis due to herding behaviour of investors? Did crisis spread contagiously from one country to another?" Our null hypothesis is that fundamental problems and financial system insolvncies wee magnified by psychological contagion or negative sentiment over the whole region, and may have pushed emerging markets into a spiral of turbulence. In chapter 2, an unobserved variable, "contagion", is isolated from the index of exchange market pressures using the state space form and a technical apparatus known as the Kalman filter. We show that the contagion factor played an important role in causing a series of crises in East Asian emerging markets. We extend our studies to examine whether crises spread to countries linked by the trade, or to countries that shared similarities in their macroeconomic fundamentals. Our analysis shows that crisis spreads from one country to others who are characterized by similar high levels of domestic credit and total foreign liability

[3]Source from Deutsche Bank, Global Markets Research, November 1999.

which had been financed by the strong inflow of foreign capitals in previous years.

Having pointed out the importance of foreign capital in the financial dynamics of Asian economies, chapters 3 and 4 forecast capital flows into 32 emerging markets using the pull vs. push or fundamentals-based approach, and purely time series-based approach respectively. Capital flows to emerging markets are driven by domestic pull factors that attract foreign capital. These include the consumer price index, the level of domestic credit, the short-term debt to reserves ratio, the level of industrial production, the domestic short-term interest rate, credit ratings, the reserves to import ratio and the domestic stock market index. Global or "push" factors also affect the flow of capital into the region. Hence, the fundamentals-based approach to capital flow forecasting (chapter 3) considers both domestic pull factors and global push factors as determinants of flows into the region. The global factors taken into account in the model included global factors such as the strength of US output growth, US short-term and long-term interest rates, the Emerging Markets Bond Index (EMBI), the US swap rate and the US high yield spread (as proxies for a measure of risk aversion). The time series-based approach to capital flow forecasting (chapter 4) analyses the times series characteristics of flows using an unobservable components model, and projects future inflows based on these characteristics. The results of the two different forecasts are then compared.

Capital flow forecast under various low case scenarios in the fundamentals

based approach has revealed that the negative shocks to real global factors, notably the level of US industrial production, had a significant impact on capital flows to emerging markets. This can be attributed to the fact that many developing countries depend on the US a prime export destination, and also because they often import parts and intermediate goods which are processed and assembled to be re-exported to the US. Also, the study reveals the importance of sovereign rating as a factor determining the size of capital inflows to the region. In almost all of the developing countries included in this research, the increases in capital inflow were closely related to the improvements in credit ratings.

Noting the importance of the role credit rating agencies in determining the size of capital flows (and hence the growth in the emerging markets), chapter 5 investigates the actions taken by major credit rating agencies during and shortly after the Asian crisis. The downgrading of sovereign ratings of 5 Asian countries during the 1997-98 crisis period were, collectively, the largest and the most abrupt changes in the modern history of credit ratings. Downgrading of this size were not only unusual but were also decided late in the crisis, thereby exacerbating market price movements and increasing instability (IMF, 1998). It is our view that rating agencies, having failed to predict the emergence of crisis, became extremely conservative, and downgraded sovereign ratings beyond a level which their economic fundamentals would justify. Hence, this chapter proposes that rating agencies would downgrade other countries excessively because failing to

predict another crisis would result in a damage in their reputation which would be difficult to restore. The results of our analysis show that the psychological contagion, or the negative sentiment prevailing in the region did indeed contribute to huge downgrading of sovereign ratings of major rating agencies during the period of Asian crisis.

Finally, chapter 6 presents some concluding remarks and suggest policy implications arising from the thesis, both from the emerging markets' perspective as well as the perspective of international financial institutions.

Chapter 2

Measuring Currency Crisis Contagion and Identifying Crisis Transmission Channel

2.1 Introduction

Currency crises in the 1990s differ from those in the 1970s in a fundamental way: they tend to cluster. The domino collapse of Exchange Rate Mechanism in 1992-1993, the Tequila effect of Mexican crisis in 1994, the Asian flu of 1997 and the emerging markets and even the global turmoil that followed the August 1998 Russian crisis all illustrate the fact that currency crises spread from one country to another.

Nevertheless, until now, there has not been any positive and statistically significant empirical evidence of contagion. Why is this so? Could the problem lie in the definition of contagion? Is it possible to isolate and estimate the level of contagion, and finally identify the channel of crisis transmission? Do coun-

tries devalue their currencies in order to maintain export competitiveness against other countries that devalued, or are they forced to devalue due to speculators who, after observing a similar market crash, become skeptical about the currency stability and flee the market?

While acknowledging the importance of contagion in recent currency crises, Eichengreen, Rose and Wyplose (1996) and Glick and Rose (1999) show in their analysis that the international trade linkage dominates macroeconomic similarities as the main channel of contagion. That is, crisis spreads from one country to another because, after observing the devaluation of a currency, trade competitors also devalue their currencies in order to support their export industries. They argue that because crisis contagion is trade linked, geographical proximity plays an important role and that crises are regional. But then how can we explain the Asia-Russia and Russia-Brazil cases where the countries were not competing for the same export market and bilateral trade linkages were not as strong?

In contrast to previous balance of payments-cum-currency crises where economic misalignment had resulted in either large fiscal deficits or gross misalignment of exchange rates, the macroeconomic performance of Asia has been exemplary. Most countries ran either balanced or surplus fiscal accounts, and high private sector savings funded the exceptional rates of investment. Even as rising investment surpassed savings, driving current account deficit wider, the fact that growth was investment rather than consumption driven provided a large degree

of comfort. Similarly, monetary policy appeared to be coping well, with reported inflation rates under control.

Whereas the macro fundamentals gave little indication of a traditional balance of payments crisis, financial imbalances had created increasingly illiquid corporate and banking sectors. These imbalances developed in three stages: (i) accumulation of domestic private debt; (ii) the inflow of mainly short term foreign capital which created both maturity and currency mismatches, and (iii) weak regulation and opaque reporting practices which contributed to excessive investments in unproductive assets. Capital inflows per se do not create financial instability. But when these capital inflows are short term in nature and serve as the main source to fund high level of domestic credit, reliance on them could render the market vulnerable because short term capital is subject to rapid reversal. These capital inflows can be driven either by recipient country specific factors such as credit ratings, secondary- market prices, sovereign debt and other indicators of country performance, or external factors such as general level of economic activity in the developed world.

Liquidity crises due to sudden reversals in capital flows seem to be a common element in crisis countries. For example, the debt crisis in 1982, the Mexican crisis in 1994 and the Asian crisis in 1997-1998 show that capital inflows can come to a sudden halt and even reverse sharply. The sudden reversal is more abrupt when capital inflows are in the form of portfolio flows or short-term capital move-

ments rather than direct foreign investment. Events such as the liberalization of capital account transactions, by allowing this type of short-term capital flows, may contribute to instability of the flow of reserves and undermine the ability of a country to peg its currency. Once a country's currency is attacked, foreign investors, who are generally less informed than domestic investors, fear that another attack could occur in countries sharing similar characteristics and may begin to reduce their investments or even flee the market.

Motivated by the comments by Taylor (1999) on Glick and Rose's paper on contagion and trade, this chapter is focused on providing a quantitative indicator of currency crisis contagion in Asia. Severity of the contagion has been measured using a state-space model applying a Kalman filter approach (Harvey, 1989). The results show that the contagion level is exceptionally high during the peak of the Asian crisis from June 1997 to January 1998. Further econometric tests were carried out to identify whether the crisis is transmitted to countries linked through trade (both through bilateral trade and through trade competition in third markets) or to countries characterized by macroeconomic similarities. Variables included in the analysis of the macroeconomic similarity include the level of real effective exchange rate misalignment relative to 1990, M2/reserves, real GDP, total foreign liability, domestic stock prices, domestic credit, and claims on the private sector. Contrary to Glick and Rose (1999), the results indicate that macroeconomic similarity dominates trade linkage as the major crisis transmission

channel. Further, the high level of domestic claims were shown to be the most significant factor in explaining crisis contagion in 1997-98.

The chapter is structured as follows. Section 2.2 presents the state space model and the Kalman filter involving an unobserved variable, and describes how the model has been modified for application to estimating 'contagion'. The result of the estimation of contagion is also reported in this section. Section 2.3 discusses whether the trade linkage or the macroeconomic similarity is the dominant channel of crisis transmission, and identifies which specific variable(s) is mostly responsible for crisis transmission Section 2.4 concludes and suggests some macroeconomic policy implications.

2.2 The Model : Estimating Contagion

Waves of currency crises in the 1990s have generated much interest in contagion effects. Crisis can be transmitted through trade linkages or may be a result of similarities in macroeconomic fundamentals. Contagion may also be due to the interaction between financial sector crises and the balance of payments crises in which a loss of investor confidence may set off a vicious cycle of capital flow reversals, liquidity squeezes and currency depreciation (Valdes 1996, Goldfajn and Valdes 1997).

Despite some progress, previous researches do not provide positive and statistically significant empirical evidence of contagion. This is because theoretically,

it does not fit into the assumption that agents in the financial market are rational and that information is common knowledge. However, if there are high costs for access to information about the healthiness of an economy, then herding behavior of investors does not violate market efficiency assumptions. Empirically, the difficulty still remains in isolating contagion as a sole variable. This paper concentrates on the latter problem of presenting statistically significant evidence of contagion. An index of contagion is created. We then distinguish whether contagion is trade linked or is due to similarities in macro fundamentals, and if so, which variable(s) is(are) responsible for explaining crisis transmission.

2.2.1 Data

The data can be classified into two main groups. The first are intended to capture the dynamics of the financial sector, consisting of monthly financial data on exchange rates, money market rates, real effective exchange rates relative to 1990, total foreign liability/GDP, stock prices, domestic credit/GDP, total claims on the private sector/GDP and M2/reserves. The second group of data includes real GDP and bilateral and regional import-export statistics to reflect the real sector. The monthly data from 1994M1 to 1998M9 are from the Deutsche Bank, International Financial Statistics and Direction of Trade from the International Monetary Fund and Joint BIS-IMF-OECD-World Bank statistics.

Countries mainly affected by the 1997 Asian crises are included in this study,

namely : Indonesia, Korea, Malaysia, Philippines, Singapore and Thailand, with Thailand being the country where 1997 crisis began.

2.2.2 Estimating Contagion

The main objective of this chapter is to provide significant and measurable evidence of contagion and to identify the factors that cause crises transmission. An index of contagion is created, and we distinguish whether crises are transmitted due to the trade linkage or due to similar characteristics in macroeconomic fundamentals. Further, the macro variable mostly responsible for crisis contagion is identified.

2.2.3 Measuring the Probability of Devaluation

Measuring the probability of devaluation and in particular, proxying private agents' beliefs can be a difficult task. The most effective approach would be to observe option prices since these are highly accurate in reflecting market perceptions (Campa and Chang, 1996). The problem is that such markets either do not exist or are at a very early stage of development for emerging markets.

Therefore, in order to capture the idea of devaluation probability, the actual exchange market pressure(EMP) proposed by Girton and Roper (1977) is used. This measure is a weighted average of changes in nominal exchange rate of a country, the changes in interest rate and negative of changes in international

reserves.

$$EMP_{it} = \alpha\%\Delta e_{it} + \beta\%\Delta i_{it} + \gamma\%\Delta r_{it} \tag{2.1}$$

e_{it}, i_{it}, r_{it} are exchange rate, interest rate and foreign reserves for country i at time t. The weights α, β and γ are set in order to equalize the volatilities of three components to preclude any one of them from dominating the index. The intuition for using this index is that when a country faces pressure on its currency, the government has the option to devalue or raise interest rates or run down reserves. Such exchange market pressure also captures speculative attacks that were unsuccessful in causing devaluation.

Figure 2.1 shows the EMPs of countries hit by the Asian crisis. Larger values represent higher devaluation probability. Negative values indicate investors' expectation of currency appreciation rather than depreciation. High exchange market pressures in some countries prior to 1997 Asian crisis indicate that these countries had been exposed to the danger of crisis but that attacks were unsuccessful.

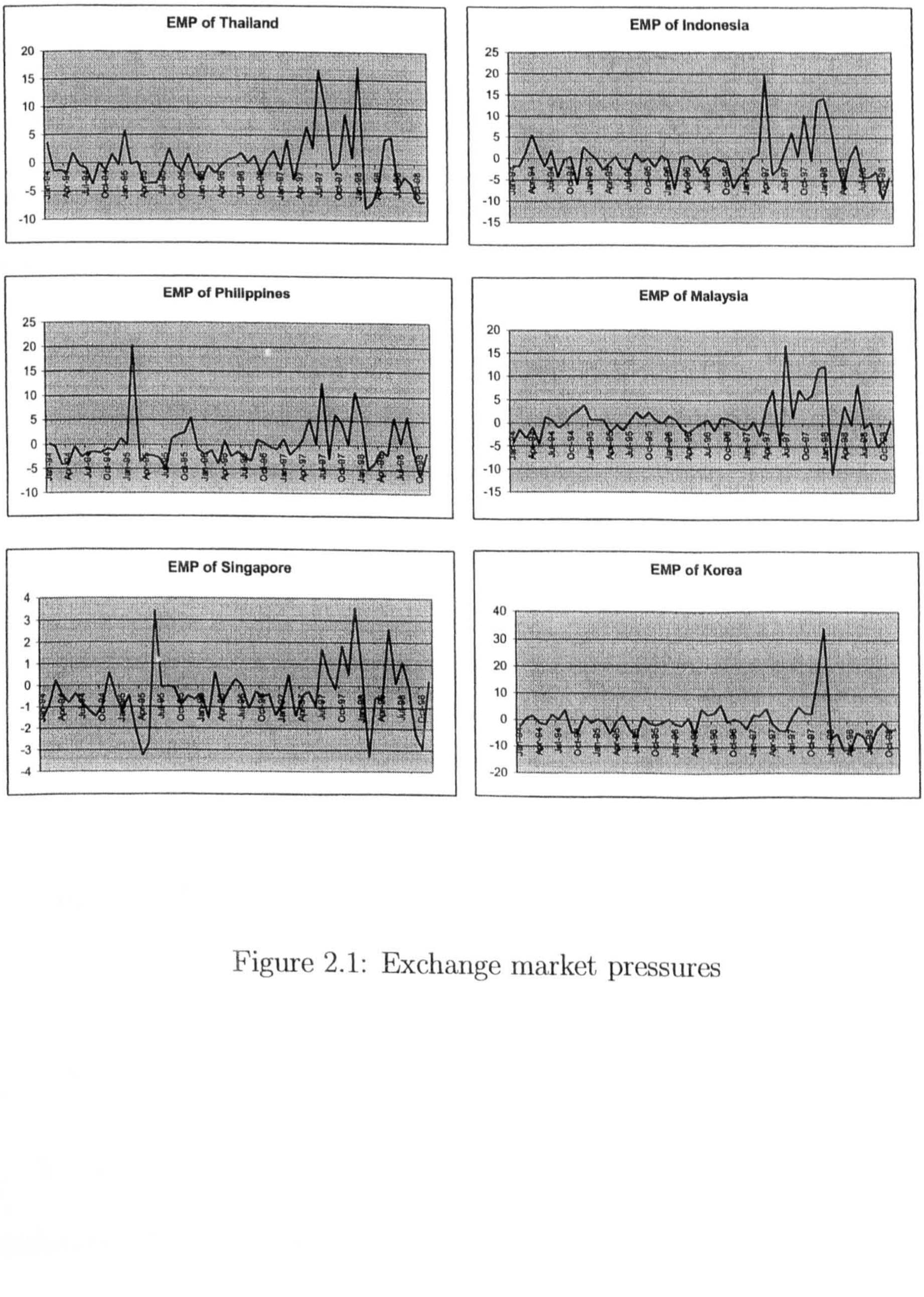

Figure 2.1: Exchange market pressures

2.2.4 Application of the State-Space Form in Estimation of Contagion

Currency crisis contagion can be examined by employing the state-space form and unobserved components model suggested by Kalman (1960) and Harvey (1989). A state space model consists of two equations: a measurement equation that describes the relationship between observed variables and unobserved state variables, and the transition equation that demonstrates the evolution of the unobserved variable.

Measurement equation :

$$Y_{it} = X_{i,t-1}A' + H \cdot B_t + \epsilon_{it} \qquad \epsilon_{it} \sim iid\, N(0, R) \qquad (2.2)$$

Transition equation :

$$B_t = \widetilde{u} + F \cdot B_{t-1} + v_t \qquad v_t \sim iid\ N(0, Q) \qquad (2.3)$$

$$E(\epsilon_{it} \quad \cdot v_t) = 0 \qquad (2.4)$$

Y_{it} is a n×1 vector of variable observed at time t, B_t is a k×1 vector of unobserved state variables that evolves in autoregressive form. H is a n×1 matrix

that links the observed Y_{it} with unobserved B_t, $\widetilde{u}$ is k×1 vector of constants, v_t is k×1. A is a matrix of parameters. If Y_{it} is to represent the exchange market pressure of country i at time t, equation (2.2) can be interpreted as exchange market pressure as the sum of a country specific factor $X_{i,t-1}$, an unobserved and slowly decaying temporary contagion B_t, and purely temporary, zero persistent ε_{it}. Contagion, in turn evolves in autoregressive[1] form.

The Kalman filter, a recursive procedure for computing an optimal estimate of the unobserved state vector B_t, is then applied. In this way, it is possible to estimate the unobserved component and provide a minimum mean squared error estimate of B_t given the appropriate information set[2]. The unknown parameters in the state space form can be estimated by maximum likelihood Kalman filtering methods (Harvey, 1989), and can be used to predict and update the unobserved state variable B_t at the end of each period.

2.2.5 Modelling the Transmission of Currency Crisis

The modelling of currency crisis contagion used in this paper is a modified version of basic state space model and Kalman filter. Let Y_{it} be the exchange market pressure of 6 countries (i=1..6) under study and $\widetilde{\beta}_t$ be the unobserved contagion factor common in all 6 countries.

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[1]It is not limited to AR(1), but can be AR(n) as long as n is finite.
[2]Information set includes the parameters $\widetilde{u}, A, F, R$ and Q.

$$Y_{it} = (X_{i,t-1} \cdot A') + (\gamma_i \cdot \widetilde{\beta}_t) + \varepsilon_{it} \qquad i = 1,2,3,4,5,6 \quad (2.5)$$

$$\widetilde{\beta}_t - \delta = \phi_1(\widetilde{\beta}_{t-1} - \delta) + \phi_2(\widetilde{\beta}_{t-2} - \delta) + \omega_t \qquad \omega_t \sim iidN(0,1) \quad (2.6)$$

$$\varepsilon_{it} = \psi_{i1}\, \varepsilon_{i,t-1} + \psi_{i2}\, \varepsilon_{i,t-2} + \epsilon_{it} \qquad \epsilon_{it} \sim iidN(0,\sigma_i^2) \quad (2.7)$$

σ_ω^2 is set to 1 to normalize the common component. The the roots of $(1 - \phi_1 L - \phi_2 L^2)$=0 and $(1 - \psi_1 L - \psi_2 L^2)$=0, $i = 1..6$ lie outside the unit circle, and the shocks are assumed to be independent, i.e. $E(\varepsilon_{it} \cdot v_t) = 0$. The common component, $\widetilde{\beta}_t$ enters each equation of Y_{it} with different weights, γ_i, $i = 1..6$. For each of the 6 series, $(X_{i,t-1} \cdot A') + \varepsilon_{it}$ represents individual, country specific macroeconomic variables.

The first population moment for the ith indicator Y_{it} consists of two components.

$$E(Y_{it}) = (X_{i,t-1} \cdot A') + (\gamma_i \cdot \delta) \qquad (2.8)$$

However, from the corresponding sample first moment $\overline{Y_i}$, one can not separately identify $X_{i,t-1} \cdot A'$ and $\gamma_i \delta$. This causes a problem in deriving the maximum

likelihood estimator. Such an identification problem can be avoided by demeaning, that is subtracting the mean value from original value.

Let $y_{it} = Y_{it} - \overline{Y_i} = \gamma_i(\widetilde{\beta}_t - \delta) + \varepsilon_{it}$ and define $\beta_t = \widetilde{\beta}_t - \delta$ and $\varkappa_{it} = X_{it} - \overline{X_i}$, hence we have

$$y_{it} = A_i \varkappa_{it} + \gamma_i \beta_t + \varepsilon_{it} \tag{2.9}$$

$$\beta_t = (\phi_1 \cdot \beta_{t-1}) + (\phi_2 \cdot \beta_{t-2}) + \omega_t \qquad \omega_t \sim iidN(0,1) \tag{2.10}$$

$$\varepsilon_{it} = \psi_{i1}\, \varepsilon_{i,t-1} + \psi_{i2}\, \varepsilon_{i,t-2} + \epsilon_{it} \qquad \epsilon_{it} \sim iidN(0, \sigma_i^2) \tag{2.11}$$

The above model in deviation from means is written in the state space form and the Kalman filter is available for maximum likelihood estimation of the model based on the prediction error decomposition, as well as for inference on β_t.

Measurement Equation :

$$\underset{(n \times 1)}{\begin{bmatrix} Y_{1t} \\ Y_{2t} \\ \vdots \\ Y_{nt} \end{bmatrix}} = \underset{(n \times 1)}{\begin{bmatrix} A_1 x_{1t} \\ A_2 x_{2t} \\ \vdots \\ A_n x_{nt} \end{bmatrix}} + \underset{(n \times s)}{\begin{bmatrix} \gamma_1 & 0 & 1 & 0 & \cdots & 0 \\ \gamma_2 & 0 & 0 & 0 & 1 & 0 \\ \vdots & & & & & \\ \gamma_n & 0 & \cdots & & & 1 \end{bmatrix}} * \underset{(s \times 1)}{\begin{bmatrix} \beta_t \\ \beta_{t-1} \\ \varepsilon_{1t} \\ \vdots \\ \varepsilon_{n,t-1} \end{bmatrix}} + \underset{(sx1)^3}{\begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \vdots \\ \varepsilon_{nt} \end{bmatrix}}$$

[3] In this case, n=6 and s=14.

Transition Equation :

$$\underset{(s\times 1)}{\begin{bmatrix} \beta_t \\ \beta_{t-1} \\ \varepsilon_{1t} \\ \vdots \\ \varepsilon_{n,t-1} \end{bmatrix}} = \underset{(s\times s)}{\begin{bmatrix} \phi_1 & \phi_2 & 0 & 0 & \cdots & 0 \\ 1 & 0 & 0 & 0 & \cdots & 0 \\ 0 & 0 & \psi_{11} & \psi_{12} & & \vdots \\ \vdots & & & \ddots & & \\ 0 & 0 & \cdots & & & 0 \end{bmatrix}} * \underset{(s\times 1)}{\begin{bmatrix} \beta_{t-1} \\ \beta_{t-2} \\ \varepsilon_{1,t-1} \\ \vdots \\ \varepsilon_{n,t-2} \end{bmatrix}} + \underset{(s\times 1)}{\begin{bmatrix} \omega_t \\ 0 \\ \epsilon_{1t} \\ \vdots \\ 0 \end{bmatrix}}$$

Once the estimates of parameters using maximum likelihood estimation method are calculated, one can run the Kalman filter to get $\beta_{t|t}$, the contagion at time t, given information up to time t.

2.2.6 Empirical Results

The estimates of contagion parameters and the level of contagion are reported in the Table 2.1 and Figure 2.2. ϕ_1 and ϕ_2 are the AR(1) and AR(2) coefficients of contagion β_t. The variables ψ_{i1} and ψ_{i2} are the AR(1) and AR(2) coefficients of the shocks in the measurement equation for country i. The variable γ_i represents the coefficient of contagion variable for the country i. The results show that contagion plays an important role in exchange market pressure of currencies of all countries under study as observed by the parameter γ_i[4], ranging from 0.31 in Indonesia to 0.63 in Malaysia. Figure 2.2 shows estimated contagion level from 1994M1 to 1998M9. The contagion level is especially high during the time of crisis, June1997

[4] i=1..6, representing Korea, Indonesia, Malaysia, Singapore, Thailand and Philippines. * and ** in table 1 indicate 5% and 1% of significance respectively.

to January 1998, reaching as high as 3.213 in July-August 1997. The index remains near zero or negative during most of the periods except for a slight increase during the Mexican crisis. But at no other time is the level of contagion above 1.3 except during the Asian crisis period. Negative numbers can be interpreted as a level of immunity against currency attacks, that is, even if there were dangers of currency attack in the region, the countries had the economic strength to defend their currency against severe devaluation.

Table 2.1 Estimates and standard errors of parameters

Parameter	Estimation	Standard error	Parameter	Estimation	Standard error
ϕ_1	0.6261	0.1969	ψ_{62}	0.0821	0.1414
ϕ_2	-0.0980	0.0616	σ_1	0.7401	0.1469
ψ_{11}	0.0869	0.1323	σ_2	0.7568	0.1488
ψ_{12}	-0.0019	0.0058	σ_3	0.3259	0.1147
ψ_{21}	0.2427	0.1391	σ_4	0.5753	0.1270
ψ_{22}	-0.0147	0.0169	σ_5	0.4667	0.1187
ψ_{31}	-0.4448	0.2241	σ_6	0.6467	0.1345
ψ_{32}	0.0567	0.2505	γ_1^{**}	0.3972	0.1179
ψ_{41}	0.0463	0.1292	γ_{2**}	0.3091	0.1281
ψ_{42}	-0.0005	0.0028	γ_3^{**}	0.6276	0.1139
ψ_{51}	-0.2799	0.1687	γ_4^{*}	0.5326	0.1252
ψ_{52}	-0.0196	0.0237	γ_5^{*}	0.5872	0.1078
ψ_{61}	-0.1322	0.1416	γ_6^{*}	0.4602	0.1132
Log likelihood		-117.7594			

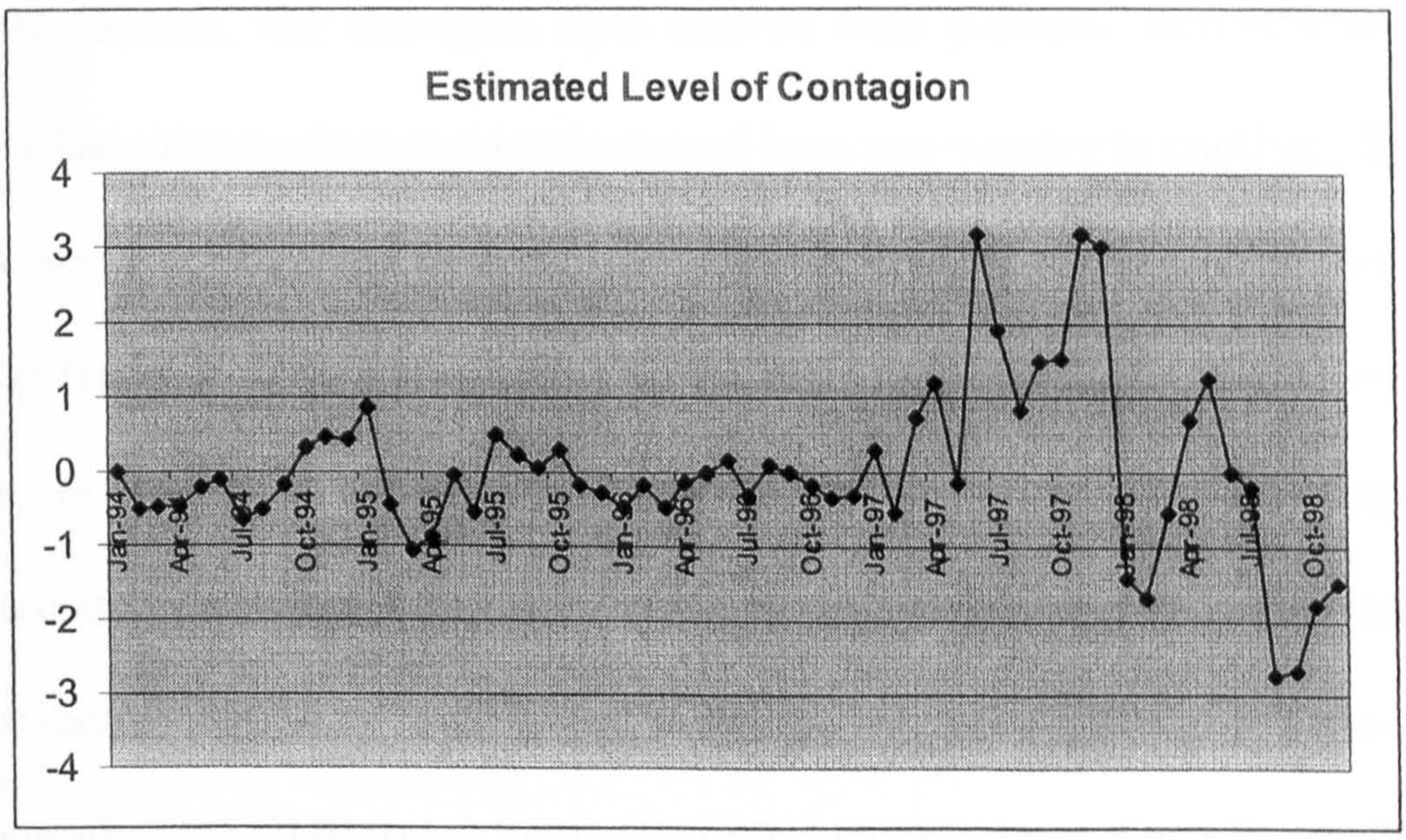


Figure 2.2: Contagion from January 1994 to November 1998

2.3 Analyzing Source of Contagion

Glick and Rose (1999) use a measure of trade linkages to indicate real integration across economies and conclude that crisis may spillover contagiously through trade links. While acknowledging geographical proximity as a characteristic of recent crisis transmission patterns, one can raise questions as to why the crisis spread from Russia to Brazil in 1998 when these countries were not competing for the same export market and bilateral trade links were not so strong. Could it be that there are other channels of contagion such that trade linkage is a proxy of these channels? Could there be some other important variables that were not included in their analysis which concluded that macroeconomic similarity was not the major channel of contagion?

In this section, the contagion level derived from previous section is used to identify what causes currency crisis to spread from one country to another. Specifically, a test is constructed to determine whether crisis is contagious to countries linked by trade or to countries that share similar macroeconomic characteristics. Further, we attempt to explain which macroeconomic variable is mostly responsible for a country's vulnerability to currency crisis. Variables used for determining macroeconomic similarity include real exchange rate misalignment relative 1990, M2/Reserves, real GDP, total foreign liability, stock prices, domestic credit and claims on the private sector.

2.3.1 Measuring the Trade Linkage

Countries affected by the Asian crisis share common characteristics in their geographical trade patterns. The following index is used to incorporate both bilateral trade linkage and the level of trade competition. Data used are from Direction of Trade Statistics of the IMF.

The degree of trade integration of the home country i with country j is measured as below (Fratzcher, 1999).

$$Trade_{ij} = \sum_{c}\sum_{d}\left(\frac{X_{jd^c}}{X_{.d^c}} \times \frac{X_{id^c}}{X_{i.}}\right) + \sum_{c}\left(\frac{Xij^c + Xji^c}{X_{i.^c} + X_{.i^c}}\right) \qquad (2.12)$$

The first term indicates the degree of competition of country j for home country i in the export market of commodity C (X^c) in the third market d. Third markets include industrialized countries (d_1: US, Europe and Japan), developing countries (d_2: Africa, Asia, Eastern Europe, Middle East and Western Hemisphere), and other regions (d_3). The larger the export market share of country j in region d, i.e.. $(\frac{X_{jdc}}{X_{.dc}})$, and the higher the share for country i of total exports to that region d, i.e ($\frac{X_{idc}}{X_{i.}}$), the more severely will country i be affected by devaluation in country j. The second term measures the degree of bilateral trade between countries i and j, suggesting that country i will be affected more by a devaluation in country j if the volume of bilateral trade is greater between them.

2.3.2 Measuring the Similarities in Macro Fundamentals

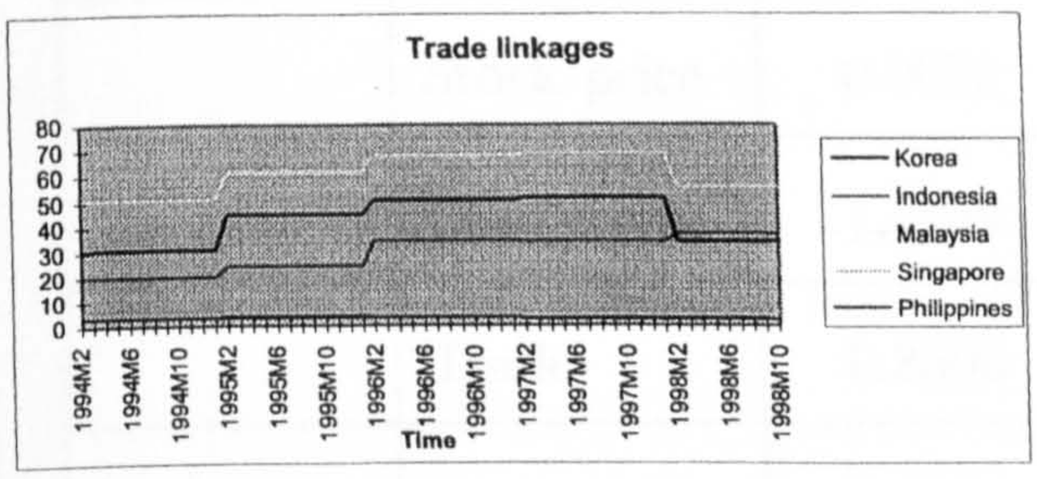
To measure similarities in macroeconomic fundamentals, a country i's macro variable (for example, REER misalignment) X_i is regressed on country j's ($j \neq i$, $j \in$ countries affected by Asian crisis) values X_j, j=1..5 and a constant. The sum of estimates of the constant and residual can be interpreted as the country specific value, and the rest as the amount due to macroeconomic similarity. That is, let X be a macro variable. This variable in regressed on the values of all other countries $j \neq i$, $j \in$ crisis country.

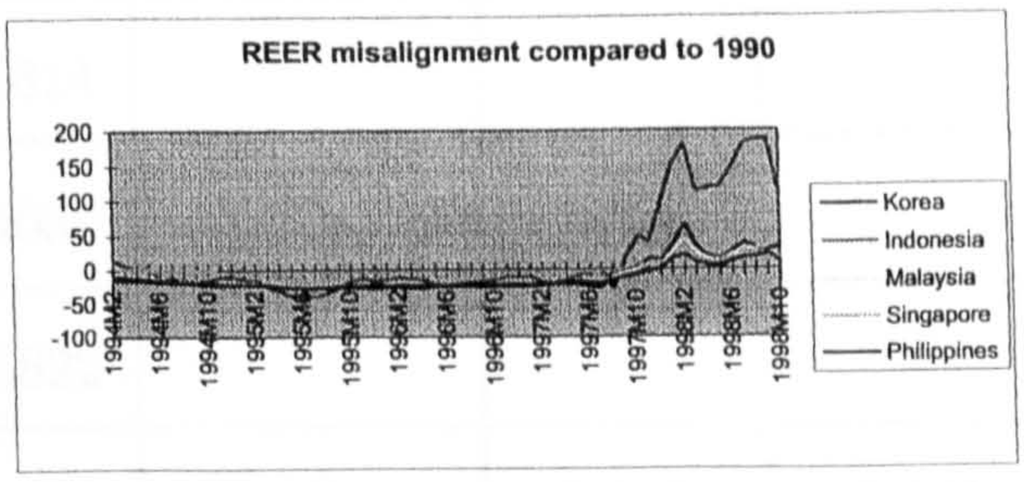
$$X_i = \beta_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \epsilon_i \qquad \epsilon_i \tilde{} iid(0,1) \qquad (2.13)$$

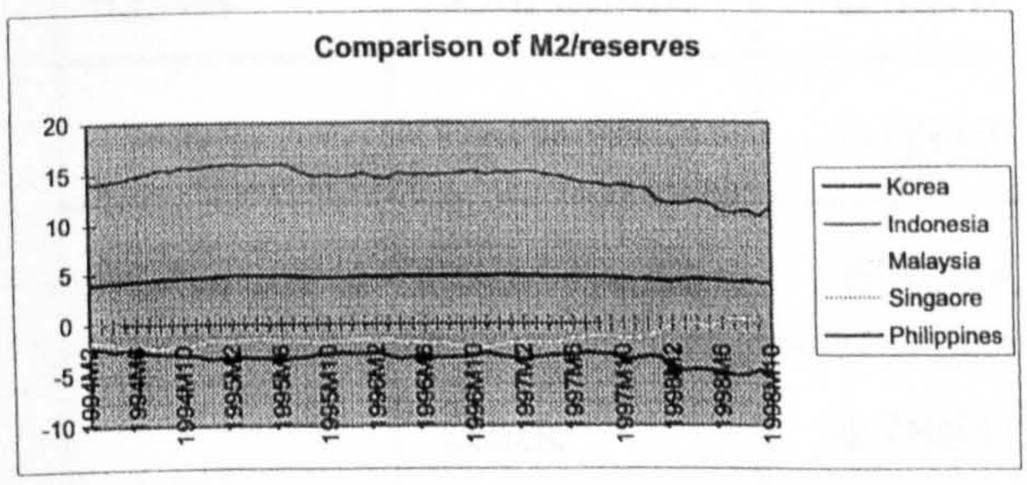
The sum of regression estimates $\widehat{\beta_1}$ and $\widehat{\epsilon}$ are the country specific value, and $X_i - (\widehat{\beta_1} + \widehat{\epsilon}) = \widehat{\beta_2} X_2 + \widehat{\beta_3} X_3 + \widehat{\beta_4} X_4 + \widehat{\beta_5} X_5$ is the proxy for similarity in macro fundamental variable X. The above identification process is carried out for all macro variables for all countries under consideration.

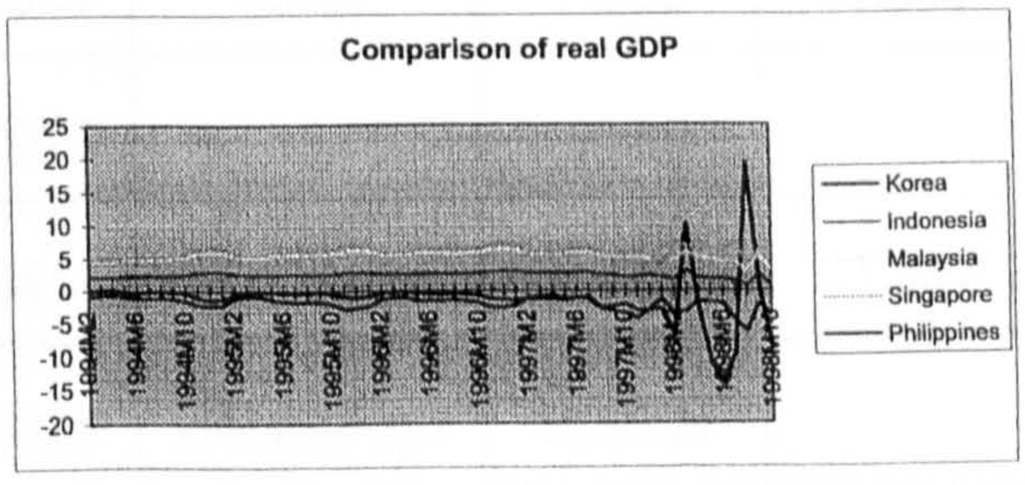
2.3.3 Empirical Results

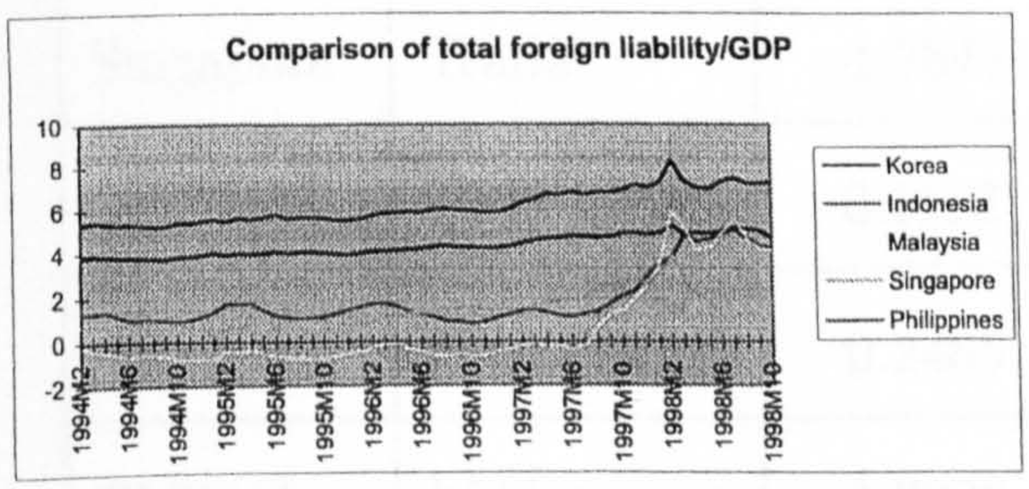
The result of multivariate regression of contagion on trade linkage and macroeconomic similarity is summarized in the Table 2.2. Estimates of coefficients, standard errors, t-values, F-statistics and measurement of fit (R^2) are reported for trade linkage and variables that contribute to transmission of crisis at the 5% significance level. Contrary to Glick and Rose's result, 1997 Asian crisis contagion does not appear to have been caused by trade linkage, but similarity in fundamentals exhibit evidence in significantly explaining contagion. Empirically, trade linkages show no significance at the usual 5% significance level for any country except Singapore, but the sign of coefficient is negative.

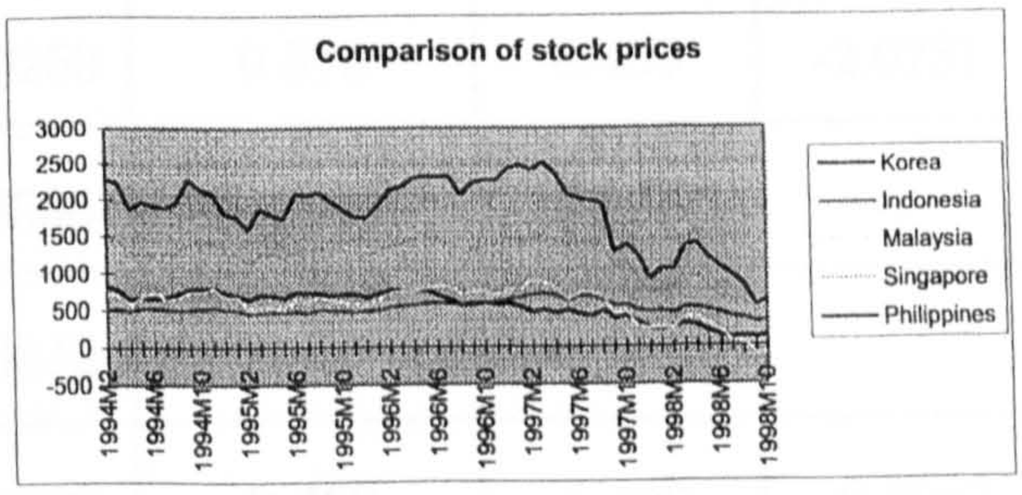


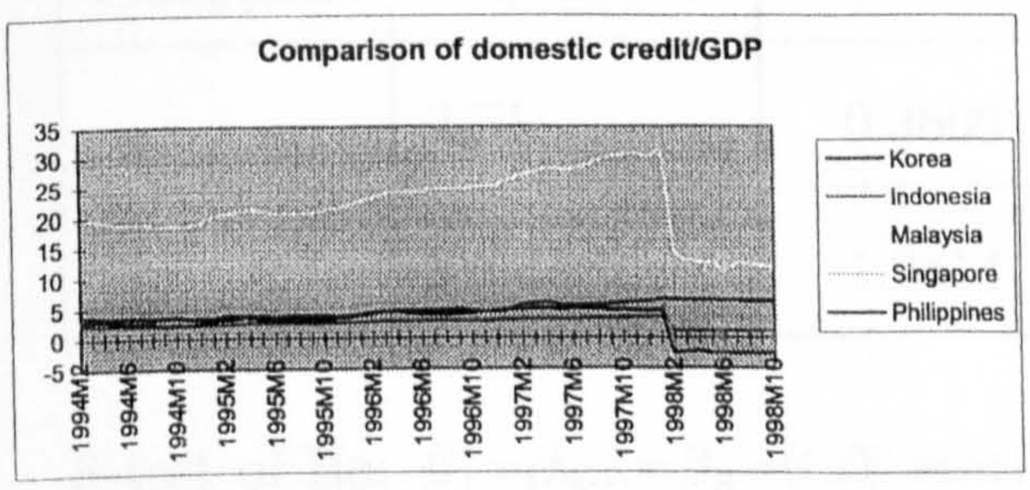












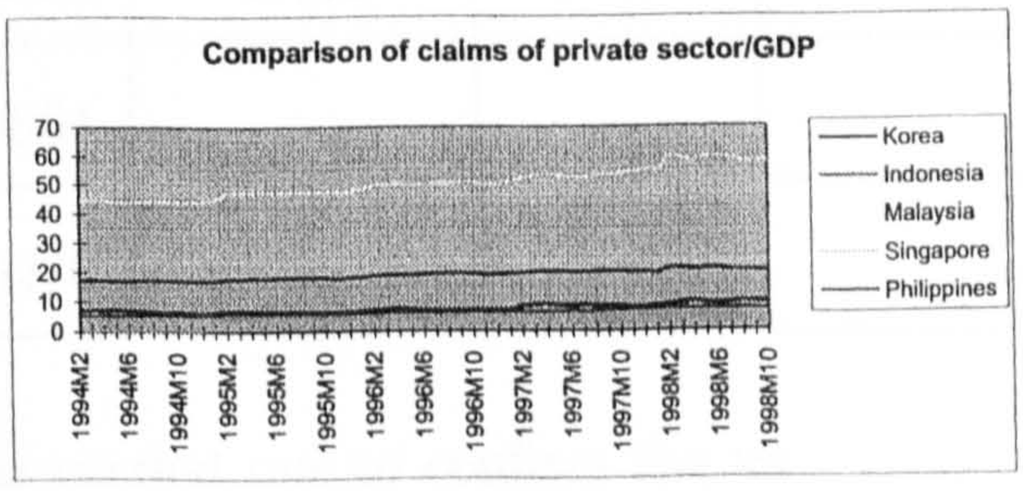


Figure 2.3: Trade links and similarities in macroeconomic fundamentals

Table 2.2 Crises transmission channels

Country	Variable	Coefficient	t-stat	R^2	F-stat(1)	F-stat(2)
Indonesia	TFL	0.1183	2.1424	0.5621	7.862	-1.097
	Stock price	0.0052	2.1814			
	Dom.credit	1.1139	5.4037			
	Trade	0.8500	1.1822			
Korea	Dom.credit	0.3870	2.6929	0.536	7.062	-0.584
	Trade	0.0382	1.0574			
Malaysia	Dom credit	0.1793	5.0444	0.500	6.133	-1.457
	Trade	4.7063/	1.0232	*Bootstrap**	15.912*	
Singapore	Trade*	-1.7847	-1.9259	0.513	6.459	-2.0781
	TFL	0.1113	2.3556	*Bootstrap**	*10.966**	
	Dom.credit	0.2465	3.0843			
Philippines	M2/reserves	1.9326	2.0009	0.469	5.406	-0.9082
	TFL	0.3606	3.6864			
	Trade	1.2414	0.9276			

F-test of Ho: $\beta_1=\beta_2...=\beta_8=0$ (F stat(1)) was carried out to confirm the validity of the regression as a whole [5]. Results indicate the F(8,49) for all countries to be above the 1% significance level of 3.02. The t-values of trade linkages of all countries except Singapore indicate that we could not reject the null hypothesis of

[5] β_1 represents the coefficient of trade linkage, and $\beta_2..\beta_8$ represent coefficient of similarity in REER misalignment, M2/reserves, real GDP, total foreign liability/GDP, stock price, domestic credit/GDDP and claim on private sector/GDP respectively.

Ho: $\beta_1 = 0$ at the 5% significance level. A F test on the coefficient of trade linkage was carried out (Ho: $\beta_1 = 0$, F stat(2)), and the result shows that one could not reject the null hypothesis, indicating that trade linkage is not a significant source of contagion. (F(1,49)=4.05 for 5%, 7.23 for 1% significance level).

A cautionary note may be added in the analysis of such studies, as the the variables in the analysis are generated, and one may face generated regressor problem (Pagan, 1984). It is possible that covariance matrix of parameter estimates may be biased, leading to In such cases, the technique of bootstrapping can be used to obtain the properties of estimators. B randomly drawn samples of m observations, which may be less than or equal to n, the total number of observation, can be drawn from the original data set, and with each such sample, the maximum score estimator can be recomputed. One can compute the mean squared deviation matrix as well as other asymptotic results. The bootstrapping results indicated that contagion was passed through trade linkgae in only 2 out of 5 countries, Singapore and Malaysia, whose test statistics (16 and 11) exceed 10% critical value of about 6.

Although the countries show different variables as the leading source of contagion, similarity in financial variables, especially the level of total foreign liability and domestic credit were common explanations for crisis transmission. This can be attributed to the rapid growth of capital flow into the region. Especially, the liberalization of the financial system and the elimination of capital account

restriction in the region have caused a hike in total foreign liability and a rapid credit expansion. Domestic credit was mostly financed by foreign capital inflows since most countries ran either balanced or surplus fiscal accounts, with reported inflation under control. High domestic credit/GDP ratio accounts for the boom and bust in the lending cycle, and indicate a growing strain in the banking system which was common in Asian crisis countries. In fact, as in Latin America in the early 1980s, the inflow of international capital in the 1990s led to a surge in domestic credit and to rocketing stock and real estate prices in many countries in East Asia (Kaminsky, 1999). The credit boom in Asia did not result in a consumption boom, but led to "excessive" investment and a deteriorating current account. This time, however, the impact of the financial sector was far more damaging than in the Latin American case because of the deepness of financial markets in Asia. Unlike Latin American countries, Asian countries had more developed capital markets; their degree of monetization was far larger[6] and firms generally had much larger debt-equity ratios.

[6]Domestic credit/GDP ratio in Asia was as five times larger than in Latin America at its peak.

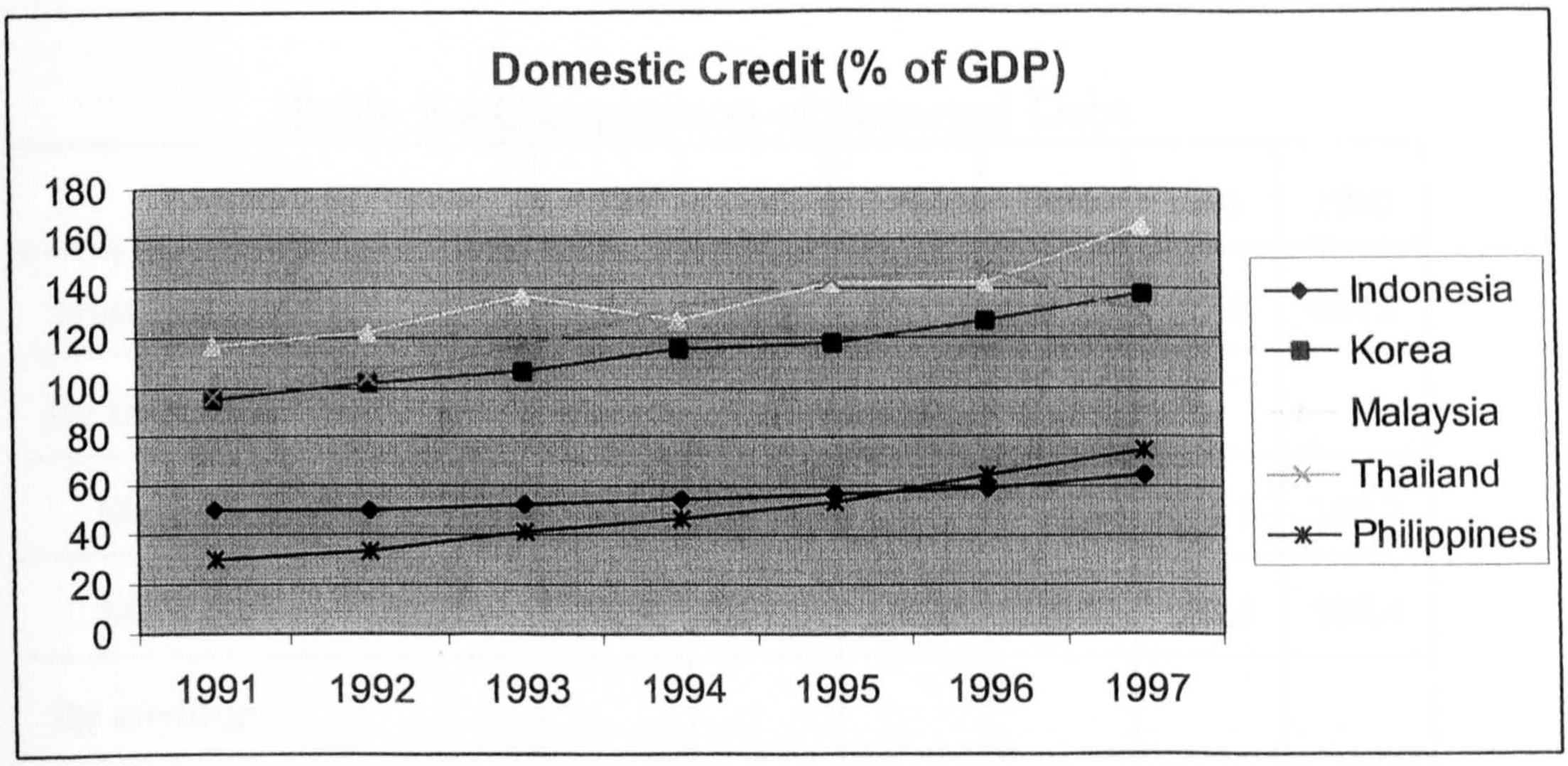


Figure 2.4:

Table 2.3 Financial System Domestic Credit (% of GDP)

	1991	1992	1993	1994	1995	1996	1997	CAGR(1991-97)
Indonesia	50.3	50.1	52.6	55.1	57.0	59.3	65.4	21.5
Korea	94.5	101.6	106.4	115.4	117.9	126.8	137.9	19.0
Malaysia	116.7	121.4	136.9	125.8	141.7	142.2	165.4	19.9
Thailand	96.3	103.7	116.3	132.0	142.8	147.7	129.4	19.1
Philippines	30.2	33.4	41.9	46.5	53.6	65.3	74.8	30.2

Source: IMF, IFS CAGR-compound annual growth rates

Table 2.4 Composition of External Debt

US$ bln	1991	1992	1993	1994	1995	1996
Total external debt	231.7	249.4	289.5	340.5	407.8	464.8
By maturities						
Short term debt	73.3	82.2	98.5	111.3	144.7	168.3
Medium-long term debt	158.4	167.3	191.0	229.2	263.0	296.4
By creditors						
IFIs	33.0	32.5	34.5	36.5	36.7	33.9
Official bilateral	54.9	61.1	68.7	82.5	86.4	80.7
Commercial banks	110.6	118.3	129.6	157.9	208.8	258.8
Other private creditors	33.2	37.4	56.7	63.6	75.9	91.4

Source: IMF, IFS Data are aggregate figures of Asian crisis countries

More important than the problem of the size of capital inflows is the nature of this capital. When in crisis, capital inflows can come to a sudden halt and even sharply reverse their course. The sudden reversal is more abrupt when capital inflows are in the form of portfolio flows or short-term capital movements rather than direct foreign investment. Sarno and Taylor(1999a) find that private portfolio flows to East Asian emerging markets are characterized by a statistically significant but very small permanent component. That is, private portfolio flows

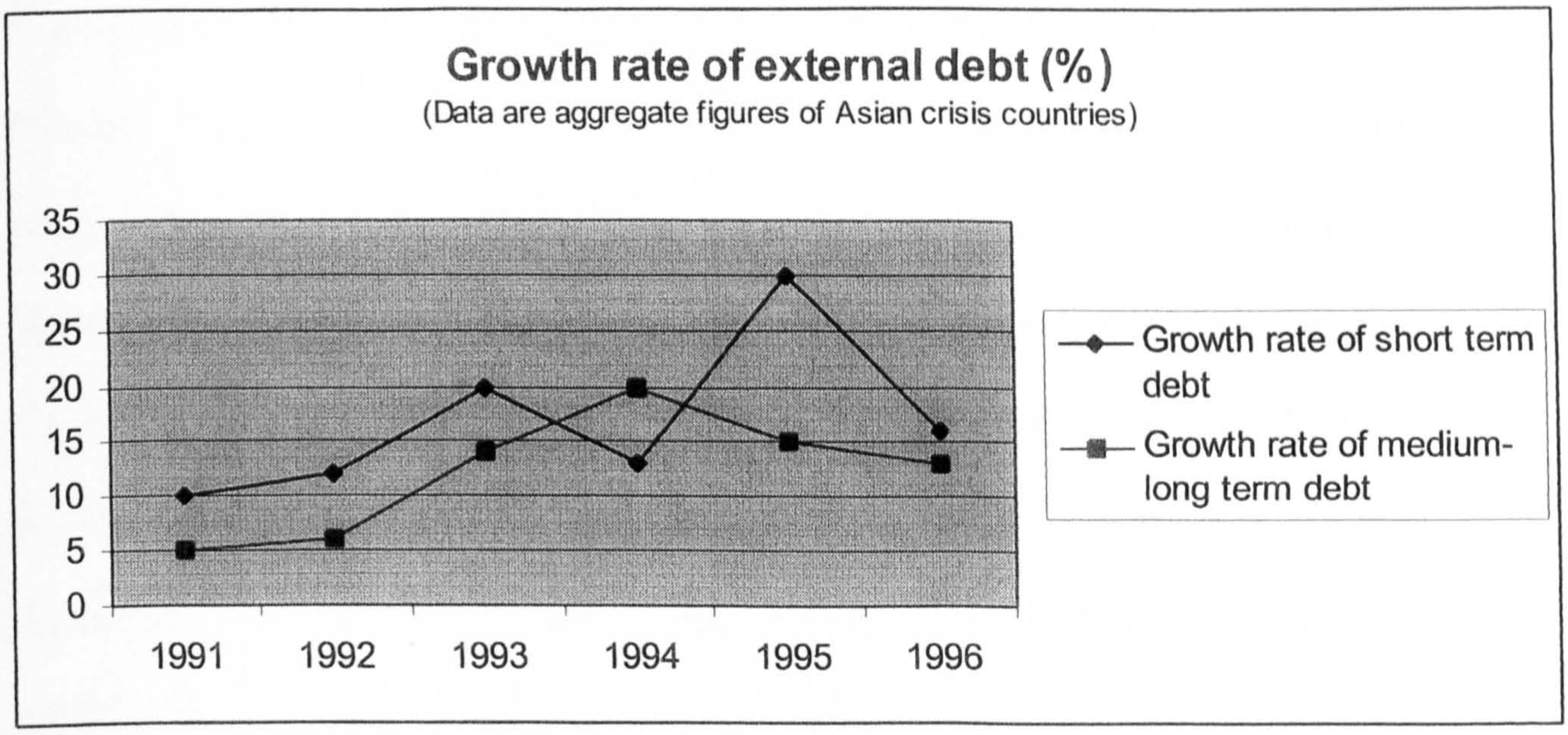


Figure 2.5:

into these countries may be regarded as largely temporary and reversible in nature, increasing the vulnerability of a country to external shocks. In fact, direct investment into above five countries accounted for less than 23% of total capital inflows in 1996. Capital inflows from 1991-97 were dominated by bank lending, portfolio capital and non-bank credit such as bond issuance, private placements, and trade credits (see table 2.4). Sarno and Taylor(1999) find that the temporary component is, however, relatively much smaller for private capital flows to Japan and Australia. Official flows also displayed a relatively large temporary component, although smaller than for private portfolio flows and varying in size across countries. Note that currency attack on the Korean won occurred somewhat later (November 1997) than in the rest of the Asian crisis countries (July-August, 1997).

The monetary authorities could have observed the effect of loss in trade competitiveness within a 3-4 month period. Therefore, if trade linkage was indeed the transmission mechanism of currency devaluation, it should have been more apparent in Korea than in any other country. However, empirical evidence suggests that rather than trade linkage, the similarity in high ratio of domestic credit/GDP is the primary explanation for crisis contagion in Korea. Singapore is the only country where the t-value of trade linkage was significant; however, the coefficient shows a negative sign.

2.4 Conclusion and Policy Implication

In this chapter, an index has been developed to measure the level of currency crisis contagion using the data of six Asian countries most severly affected by the 1997 currency crisis: Thailand, Indonesia, the Philippines, Malaysia, Singapore and Korea. A model was introduced in which an unobserved variable, 'contagion', is isolated and estimated using a state-space form and a technical apparatus known as the Kalman filter. Up until the first quarter of 1997, with the exception of the Mexican crisis period, the contagion index remained near zero or negative, demonstrating that the countries were immune against contagion. However, the index exhibits exceptionally high values during the peak of the Asian crisis (June 1997 - January 1998).

To understand the transmision mechanism of crises, a test was constructed to

investigate whether crisis was transmitted to other countries linked by trade or to countries showing similar characteristics in macroeconomic fundamentals. Contrary to Glick and Rose (1999), we find that macroeconomic similarity dominates trade linkage as a the source of contagion. A high level of domestic credit was a particularly common factor behind crises in these countries.

These results suggest a number of policy measures to prevent and safe-guard against future possible attacks. From the capital recipient country's perspective, diversifying the loan sources and avoiding excessive short-term financing could minimize negative shocks in the case of rapid capital outflow. Further emphasis should be placed on developing mature domestic financial markets which encourage firms to raise resources through equity and corporate bond issuance. Also, the 1997 Asian crisis is known as the 'twin crisis', as the combination of both currency and banking crises. Therefore, it may be essential to practice more stricter banking supervision and regulation in order to prevent excessive lending which led to the financing of excessively risky projects. In line with such efforts, international financial institutions could set up emergency funds to assist countries that practice relatively sound macroeconomic policies but face temporary liquidity shortages due to contagion. Further emphasis should be placed on the role of international financial specialists in monitoring global financial developments, and in cooperating with the country desk economists in institutions such as the IMF and the World Bank in the assesment of a country's economic performance

and outlook.

Chapter 3

Capital Flow Forecasts to Emerging Markets: A Fundamentals-based Approach

3.1 Introduction

The extreme turbulence in world financial markets in recent years has placed the role and the magnitude of foreign capital flows to developing countries under intense scrutiny once again. As markets recovered during 1999 largely due to continued growth in the US economy and the deepening of credit markets in the euro area, emerging markets rebounded from a series of crises that began in Asia in 1997. Global asset prices saw strong increases in 1999. The fundamentals in many emerging markets improved and their domestic and external financing situation continued to recover. However, beginning in early 2000, participants in mature and emerging markets have begun to manifest their loss of confidence. Signs of inflationary pressures in major currency areas emerged and the correction

of equity markets, especially in the technology sector took place. It appeared that investors became increasingly more risk averse, which led to increased volatility and a decline even in mature equity and bond markets. This in turn adversely affected emerging markets during 2000 (International Monetary Fund, 2000).

This increased market volatility has re-emphasised the importance of forecasting capital flows which had been studied by Felstein and Horioka (1980) who had extended the life cycle model and incorporated inter-country differences in saving, investment and retirement to their analysis of capital flows. A surge in capital flows to a developing country may require important compensating policies by the domestic authorities in order to offset any adverse effects or potential reversibility of capital flows in the recipient economy (World Bank, 1997. Ch.4) While a number of studies examine the history and of capital flows to developing countries, attempts to model capital flows econometrically appear to be limited. In this connection, the focus of this chapter is on three types of capital flows (bond, equity and syndicated loans) to thirty-two developing countries, and forecasting capital flows to these countries.

The chapter is organized as follows. In section 3.2, we describe the data and the forecasting methodology of the fundamentals-based approach. We take into consideration the country specific or "pull" factors that reflect domestic investment opportunities and risks, as well as global or "push" factors that mirror economic activity in developed countries which tend to affect the supply of in-

vestment funds towards emerging markets. A summary of the results of our forecasting exercise are also included in this section. Results of fundamentals-based forecasts under different scenarios are reported in section 3.3, and the final section 3.4 offers some concluding remarks.

3.2 Modelling and Forecasting Capital Flows to Emerging Markets: A Fundamentals-based Approach

3.2.1 Data

The data set used here comprises of monthly records of three types of capital flows (bond, equity and syndicated loan flows) to 32 developing countries in Latin America, Asia, Eastern Europe (including the former Soviet Union), the Middle East, and Africa. Specifically, bond flows include international bond issues by all (private, public and secondary) borrowers in the given country, excluding cancelled issues. These include eurobonds, global bonds and foreign bonds. Equity flows include international equity issues in the international capital markets by all borrowers in the given country. Publicly announced syndicated loans to all borrowers (public and private) are included in loan flows. The data are from January 1990 to December 2000 at monthly frequency. The data on this research were obtained from the data bank of the World Bank, Development Economics Prospects Group (DECPG).

The 32 countries under study include Argentina, Brazil Columbia, Ecuador,

Honduras, Jamaica, Mexico, Peru and Venezuela for Latin America; China, India, Indonesia, Korea, Malaysia, Pakistan, Philippines, Papua New Guinea, Thailand and Turkey for Asia; Bulgaria, Hungary, Lithuania, Russia and Ukraine for Eastern Europe; Algeria, Egypt, Jordan, Lebanon and Morocco for the Middle East; and Cameroon, Nigeria and South Africa for Africa. There are two sets of explanatory variables: country-specific factors and global factors. For country-specific factors we use the consumer price index, the level of domestic credit, the short-term debt to reserves ratio, the level of industrial production, the domestic short-term interest rate, credit ratings, the reserves to import ratio and the domestic stock market index. Global or "push" factors taken into account in the model included global factors such as the strength of US output growth, US short-term and long-term interest rates, the Emerging Markets Bond Index (EMBI), the US swap rate and the US high yield spread (as proxies for a measure of risk aversion). More or less variables can be used for this type of forecasting exercises. The variables incorporated in this study are those shown to have statistically significant effect on capital flows to these developing countries using the Granger causality test, and/or are frequently analyzed by institutional investors and the World Bank in forecasting capital flows.

3.2.2 Fundamentals-based (Push versus Pull Factors) Approach

We used an econometric forecasting model of emerging market capital inflows and related economic variables, using data from January 1990 up to December 2000. This model is designed to capture the dynamic interactions between capital flows and the various factors determining their global supply and local demand.

Capital flows to developing countries can be driven either by internal, country-specific factors, or external, global factors. Country-specific or "pull" factors are those reflecting domestic investment opportunities and risks, which influence a pull on overseas funds, while global or "push" factors reflect a push on investment funds toward emerging markets. Push factors are designed to capture the level of economic activity and alternative investment opportunities in developed countries.

The model was constructed first by estimating a long-run equilibrium relationship between capital flows and the various push and pull factors, and then estimating a fully dynamic system in which changes in each of the variables considered is a function of past movements in its own level, past movements in the other variables and the deviation from the long-run equilibrium. This "vector error correction" system thus captures in a highly general way the underlying interplay of economic forces and relationships driving the various variables. Well-developed econometric techniques exist for estimating systems of this kind.

By forecasting from the model and then feeding the forecasts back in, it is

possible to provide dynamic multi-step forecasts of all of the variables in the system. Alternatively, the model can be forecast subject to a set of assumptions or 'scenarios' about the assumed future course of certain variables, to examine the likely impact of, say, a downturn in US economic activity on emerging market capital flows.

The country-specific or pull factors considered include variables such as the consumer price index, the level of domestic credit, the short-term debt to reserves ratio, the level of industrial production, the domestic short-term interest rate, credit ratings, the reserves to import ratio and the level of the domestic stock market index. It was found empirically that the level of bond, equity and syndicated loan flows into a country is affected by movements in these domestic pull factors, and at the same time capital flows can have a feedback influence on these variables, through the full dynamic interaction among flows and pull factors allowed for in the model.

Global or "push" factors taken into account in the model include global factors such as the strength of US output growth, US short-term and long-term interest rates, the Emerging Markets Bond Index (EMBI[1]), the US swap rate and the US high yield bond spread (as proxies for a measure of risk aversion). Global factors influence capital inflows to emerging markets and emerging countries' macroeconomic variables. However, it is not likely that emerging countries' domestic factors would have any significant effect on global variables. Therefore, forecasts on push

[1]EMBI yield spreads are measured by JP Morgan, and the index excludes Russia.

factors were derived separately by segmenting this part of the model, and were used as exogenous variables in forecasting capital flows to emerging markets.

3.2.2.1 A Theoretic Framework

Fernandez-Arias and Montiel (1996) have developed a useful analytical framework that incorporates the effect of domestic and global factors on capital flows. They separate potential domestic causes into those operating at the project level and those which operate at the country level. Assuming capital flows may occur as transactions in different types of assets, indexed by s (s = 1,...,N), the domestic return on an asset of type s is decomposed into two components: a project expected return (G_s) and an adjustment factor depending upon the creditworthiness of the country (C_s). The project return is assumed to be a function of a vector of net flows (F) going to specific project types, while the creditworthiness factor is assumed to be a function of the vector of the end-of-period stocks of liabilities of all types, S: $S = S_{-1} + F$, where S_{-1} denotes the initial stocks of liabilities. Given that external creditors will diversify their portfolios, the opportunity cost of assets of type s, V_s, is a function of S. Fernandez-Arias and Montiel (1996) then establish an arbitrage condition–from which F may be solved for – of the form

$$G_s(g, F)C_s(c, S_{-1} + F) = V_s(v, S_{-1} + F) \tag{3.1}$$

where g, c and v represent shift factors associated, respectively, with the domestic economic environment and domestic creditworthiness (pull factors) and the financial conditions of the creditor country (push factors). G_s, C_s and V_s are assumed to be increasing functions of g, c, and v respectively. The equilibrium or "desired" value of the vector of net flows F, F* say, determined implicitly by equation 3.1 may be expressed as

$$F^* = F^*(g, c, v, S_{-1}) \tag{3.2}$$

where F* is increasing in g and c but decreasing in v and S_{-1}. Holding S_{-1} constant, totally differentiating equation 3.2, and approximating total derivatives by first differences yield:

$$\Delta F^* = F_1^* \Delta g + F_2^* \Delta c + F_3^* \Delta v \tag{3.3}$$

where subscripts denote partial derivatives. Equation 3.3 describes the pattern of changes in desired capital flows, determined by changes in the pull factors g and c and the push factors v by the initial value of S. Increases in g and c and decreases in v may induce prolonged growth in capital flows to developing countries. It states that differences in short-run and long-run capital movements might arise in accordance with the types of changes in g, c, and v : permanent changes in g, c, and v may cause long-run, permanent changes in the pattern of net flows, whereas transitory changes in these factors may generate transitory, short-term

changes in net flows, which may be reversed over time. For example, the gradual, permanent removal of capital controls and liberalization of restrictions of FDI may reduce the adjustment costs that foreign investors face in diversifying their portfolios and thus give rise to a gradual stock adjustment (flow) over time. This gradual adjustment also implies a complex dynamic pattern of net flows moving toward their long-run equilibrium value and is consistent with an estimation of capital flows.

Dynamic adjustment can be formally introduced into the Fernandez-Arias-Montiel framework by assuming a simple cost-of-adjustment model. In this model factors such as market imperfections, informational asymmetries (Stiglitz and Weiss 1981), and entry and exit costs to emerging financial markets (Daveri, 1995) are captured on the assumption that creditors face costs in adjusting their portfolios that are increasing in the size of the adjustment. The desired vector of capital flows is given by equation 3.2.

Assume that agents want to minimize the difference between desired and actual flows, subject to adjustment costs. A simple way of modelling this is to assume a simple quadratic loss function for investors:

$$L = (F - F^*)' M_1 (F - F^*) + (F - F_{-1})' M_2 (F - F_{-1}) \qquad (3.4)$$

where M_1 and M_2 are positive definite weighting matrices. From the first-

order conditions for minimizing L, we can derive a simple equation for changes in F:

$$\Delta F = (M_1 + M_2)^{-1} M_1 (F^* - F_{-1}) \tag{3.5}$$

which, rearranging and using equation 3.3, can be equivalently expressed in the error-correction form:

$$\Delta F = A_0 (F^* - F)_{-1} + A_1 \Delta g + A_2 \Delta c + A_3 \Delta v \tag{3.6}$$

where $\mathrm{A}_0 = (M_1 + M_2)^{-1} M_1$ and $A_i = (M_1 + M_2)^{-1} M_1 F_i^*, (i = 1, 2, 3)$.

According to equation 3.6 changes in current capital flows are determined partly by the difference between desired and actual capital flows in the previous period and partly by the changes in the factors determining the desired level of capital flows. Again, changes in push and pull factors can be decomposed into permanent and transitory components, with only the permanent ones affecting the long-run level of F. Transitory movements, which are also reversed over time, will generate transitory movements in F, which are also reversed over time,. For example, a temporary reduction in U.S. interest rates, which might be interpreted as a downward movement in v, will, other things being equal, generate a rise in capital flows to the developing country equal to $A_3 \Delta v$ (which is positive since F^* is decreasing in v and Δv is negative). If this change persists over time, then the

long-run level of F will be raised because of the permanent effect on F^* operating through 3.2. If on the other hand, the change in v is reversed over subsequent periods, then although ΔF will be affected over several periods, the net long-run effect on both desired and actual capital flows will be zero.

3.2.2.1 An Empirical Framework

Consider a panel of N countries, indexed by i (i=1,...,N), with portfolio flows at time t denoted f_{it} , assumed to be an integrated process of order one I(1) Also, define a vector of country-specific factors as x_{it} and a vector of global factors as w_{it} and assume that both vectors contain at least one I(1) variable and no higher order integrated cointegrating relationships of the kind:

$$f_{it} = \beta' x_{it} + \gamma' w_{it} + e_{it}, i = 1, ...N \tag{3.7}$$

where f_{it} may be either equity flows, say ef_{it}, or bond flows, say bf_{it}.

If cointegration is established in above equation, that is, the error term e_{it} is approximately stationary, then the I(1) variables in x_{it} and w_{it} may be thought of as capturing the long-run or permanent component of f_{it}, whereas e_{it} captures short-run or temporary movements of capital flows. Since e_{it} may alternatively be interpreted as the deviation from the long-run equilibrium ($e_{it} = f_{it} - \beta' x_{it} - \gamma'$ w_{it}), it may be used in an analysis of the short-run dynamics of capital flows through estimation of the error correction model (ECM):

$$\Delta f_{it} = \psi_i - \rho(\beta' x - \gamma' w)_{it} + \theta \Delta f_{it-1} + \sum_{j=0}^{p} \lambda'_{ij} \Delta x_{it-1} + \sum_{j=0}^{p} \delta'_{ij} \Delta w_{it-1} + \omega_{it}, \; i = 1, \ldots N \tag{3.8}$$

where i is a country index, ψ_i is a constant term, j(=0,...,p) denotes the number of lags and ω_{it} is approximately white noise. Equation 3.8 is a panel data generalization of the error-correction representation of cointegrated variables established by Engle and Granger (1987) and follow directly from the Granger Representation Theorem (Granger, 1983; Engle and Granger, 1987).

The adoption of an error correction system, employed in other dynamic modelling contexts in international finance, allows us to shed some light on the dynamic versus long-run determination of bond and equity flows and differentiates the present study from the earlier studies on portfolio flows determination. Equations 3.8 provide the full dynamic interaction of the determinants of capital flows. Models of bond, equity and syndicated loan flows to developing countries have been estimated and used as a forecasting framework.

3.2.3 An Intuitive Interpretation

If over the same period we find that capital flows do not tend to settle at any particular level–that is, they are nonstationary–then at least some of their determinants must also be nonstationary. Thus if we believe that flows to country i, f_{it} , are affected by a vector of pull factors x_{it} and a vector of push factors w_{it},

then we would expect to find a relationship of the form written in equation 3.7. Thus rapid changes in flows are determined by rapid changes in some of the push or some of the pull factors, or both. It is possible, however, that some of the push and pull factors are relatively stable over the sample period but still enter into equation 3.7.

Given that e_{it} is expected to be highly stable over time, equation 3.7 can be interpreted as a long-run relationship because, on average, we would expect to find $f_{it} = \beta' x_{it} + \gamma' w_{it}$, termed a 'cointegrating relationship'. If we assume that actual and desired capital flows coincide in the long run, then we can think of the cointegrating relationship as determining the desired level of capital flows: $f_{it} = \beta' x_{it} + \gamma' w_{it}$. Under this interpretation equation 3.7 is the empirical analog of the theoretical equation 3.2. Hence the error term e_{it} can be thought as the difference between desired and actual flows, $e_{it} = f_{it} - f^*_{it}$. This suggests that, having estimated the long-run parameters β and γ, we can then estimate an error-correction model (equation 3.6), in which changes in flows are a function of changes in the variables determining the desired level of flows–that is, changes in x_{it} and w_{it}–as well as of the error-correction term itself, e_{it}. In fact, econometric theory shows that if a cointegrating relationship exists, then such an error-correction model must also exist. Estimating the dynamic error-correction form then allows us to determine which factors are important in determining short-run movements in capital flows.

One of the most important features of this research involves the interaction of pull factors and push factors with the movements of capital flows. It was found empirically that the level of bond, equity and syndicated loan flows into a country is affected by movements in the domestic pull factors, and at the same time capital flows can have a feedback influence on these variables, through the full dynamic interaction among flows and pull factors allowed for in the model. This research allows for causal interactions between capital inflows and domestic factors that influence such inflows. However, it is not likely that emerging countries' domestic factors would have any significant effect on global variables. Therefore, forecasts of push factors were derived separately by segmenting this part of the model, and were used as exogenous variables in forecasting capital flows to emerging markets. That is, global factors are forecast independently using the Vector Autoregression (VAR) analysis and their evolution influences capital flows into a country but the capital flows of an individual country are not allowed to influence the forecast of the global factors. With respect to global factors, the projections suggest, inter alia, that (i) the level of the EMBI will decline gradually to around 600 until end 2003, (ii) the US high yield spread will remain stable at about 890 from end 2000 until end 2003, (iii) US industrial production will grow at annual rate of 3-4 percent over the forecast period after a slight slowdown to about 2-3 percent in early 2001, (iv) the US short-term interest rate will decline to around 4 percent and (v) the spread between US long-term and short-term interest rates will narrow

to less than 300 basis points by end 2003. The summary of forecast results of capital flows to developing countries are reported in the tables in appendix.

3.2.4 A Dynamic Analysis of Portfolio Flows

The existence of at least one cointegrating relationship between a set of variables implies that an error-correction model exists, because, as established by the Granger representation theorem, for any set of I(1) variables error-correction and cointegration are equivalent representations. Therefore, the residuals from the equilibrium regressions (equation 3.7) can be used to estimate, by generalized least squares, the error-correction models (equation 3.8) as seemingly unrelated regressions.

We adopt the conventional general-to-specific procedure to estimate a parsimonious error-correction model, as suggested by Davidson et al.(1978) and Hendry (1983). The resulting models appeared to be most adequate in terms of high coefficients of determination and residuals that are approximately white noise, although some level of trade-off is recognized as maximizing the coefficient of determination entails the issue of the parsimony in this type of exercise. The forecasting equation estimated for the bond flows to China is as follows.

$$\Delta(BCHI) = 0.2406545418 * \Delta(BCHI(-1)) + 0.09199948254 * \Delta(BCHI(-2))$$

$$-37.34598359 * \Delta(CCP(-1)) + 23.69301456 * \Delta(CCP(-2))$$

$$+8.226456453e-06 * \Delta(CCR(-1)) - 1.658656282e-05 * \Delta(CCR($$

$$-2)) - 1647.636043 * \Delta(CDBT(-1)) + 1025.190626 * \Delta(CDBT($$

$$-2)) + 1.733384267 * \Delta(CIP(-1)) + 7.330162138 * \Delta(CIP(-2))$$

$$-38.99001526 * \Delta(CR(-1)) + 4.722712586 * \Delta(CR(-2))$$

$$-105.1366126 * \Delta(CRAT(-1)) + 124.3883053 * \Delta(CRAT($$

$$-2)) + 6.22011192 * \Delta(CREI(-1)) - 18.89486172 * \Delta(CREI($$

$$-2)) - 1.544318858 * \Delta(CST(-1)) + 0.7325700175 * \Delta(CST($$

$$-2)) - 311.8289697 - 1.113033808 * BCHI(-1) + 13.33327477 * CCP$$

$$(-1) - 1.050687571e - 05 * CCR(-1) + 1064.566858 * CDBT($$

$$-1) + 3.563658884 * CIP(-1) + 51.26336276 * CR(-1)$$

$$+0.9858804968 * CST(-1) + 0.1432157755 * \Delta(EM)$$

$$-31.53754998 * CRAT(-1) - 36.70238669 * CREI(-1)$$

$$-1.814269761 * \Delta(HY) + 29.39658789 * \Delta(IP) + 4.983821677 * \Delta(SW$$

$$-90.13338044 * \Delta(U1) + 100.2563022 * \Delta(U10) \qquad (3.9)$$

where BCHI denotes bond flow for China, CCP the CPI of China, CDBT the ratio of short term debt to foreign reserves of China, CIP the industrial production, CR the short term interest rate of China, CRAT the credit rating of China, CREI the ratio of reserve over import, and the CST the stock price index of China. The first letter of each pull variable represents the country, i.e. 'C' for China. Global (or push) variables are EM for Emerging Market Bond Index yield

spread, HY for US high yield bond spread, IP for US industrial production, SW for US swap rate, U1 for US short-term interest rate and U10 for U.S. long-term interest rate.

3.2.5 Forecast Results

Gross private capital flows to emerging markets increased substantially by about 37.6 percent from 1999 to 2000. This increased level is equivalent to about 76.5 percent of the inflows of 1997. The largest increase was observed in equity flows, which rose in 2000 by about 75 percent compared to the previous year. Bond and loan flows also took an upturn, with increases of about 13 percent and 49 percent respectively by end 2000. The model projects total flows to increase by about 6.9 percent, 9.9 percent and 4 percent in 2001, 2002 and 2003 respectively, over the previous year. (See the tables at the end of this chapter)

Global factors driving this forecast increase appear to include a slight slow down in the performance of the US economy combined with declines in US interest rates coupled with the moderation in the Emerging Market Bond Index since its recovery in late 2000.

On the domestic side, forecast increases in capital flows from the model were usually associated with forecasts of increasing credit ratings and stock prices, and stable or declining short-term debt-reserve ratios. Such countries were also typically forecast to experience stable or moderately rising consumer prices. A

strong forecast upsurge in the CPI is associated with declining capital inflow forecasts. The level of domestic credit and domestic industrial production show mixed signals, although the majority of countries with increasing inflow forecasts also have increasing domestic credit and industrial production forecasts. The economic intuition seems clear: higher inflows result in an accumulation of reserves and a rise in stock prices, a restoration of market confidence and an upward revision of credit rating which induces further capital inflows into the country.

Among the three types of capital flows, equity flows to developing countries showed the largest increase. A possible reason why the model forecasts such strong performance in equity flows is that, compared to bond and loan flows, equity flows in the past have generally been extremely low and probably below the equilibrium level. Thus, the forecast surge in this category of flows may represent a degree of catch-up. Even with the increase of 75% in equity flows for 2000, equity flows would still only account for around 15-20 percent of overall capital flows to emerging markets.

The rapid growth in aggregate private capital flows to emerging markets was expected to slow down in 2001 according to the forecast, due largely to a forecast sluggish performance of the EMBI, together with improvements in the reserves to short term debt ratio and the availability of domestic credit in a number of emerging markets. In Asia, after a hike of 63% in 2000, total inflows are expected to decline by about 3% in 2001 due to drops in bond and loan flows to the region.

The growth in inflow is expected to pick up again in 2002 to 2003. A continued buoyant inflow of funds is anticipated for China.

Latin America also recorded a substantial rise in capital flows during 2000. The recovery was especially evident in the amount of equity flows which began to happen in 1999. In 2000, total equity inflow to Latin American emerging countries reached US$6.8 bn, from US$761 mn in 1999, due to huge inflows to Brazil and Mexico during second half of 2000. Total private capital inflows to the region increased by 19% in 2000, and are forecast to maintain strong growth in 2001 by an increase of 23%. However, the growth rate is expected to decline, with an increase of 9% in 2002 followed by a decrease of 5% for 2003. Brazil anticipates a stable growth in inflows while inflows to Mexico are expected to moderate throughout 2002-2003. Inflows to Argentina are forecast to recover, however, a number of countries in Latin America are likely to have limited access to capital markets in the next few years.

Changes in flows to Eastern Europe are dominated by Russia, and the total flow to the rest of the countries in Eastern Europe is expected to decrease by about 21% in 2001 after a hike of 29% in 2000. The growth in loan inflows was exceptionally high in 2000, but these are forecast to decline in 2002 and 2003. The ratio of equity inflows to total private inflows is especially low in this region compared to the rest of the world.

Inflows to Africa (heavily dominated by South Africa) grew rapidly in 2000

by 59% compared to 1999. This was due to over 300% growth in loan inflows despite drops in bond and equity flows. The level of inflow is projected to decline by about 5% during 2001, but growth is expected to pick up again in 2002-2003. South Africa has been experiencing a steady but increasing growth trend in capital inflows, and most of its domestic pull factors continue to look favourable over the next three years, which is forecast to generate a continuous inflow of capital to the country.

3.3 Capital Flow Forecasts Under Different Scenarios

Capital inflows to developing countries were forecast under two different types of low case scenarios: the partial derivative approach and integrated approach. The partial derivative approach examines capital flow forecasts under a negative shock to one global variable for 12 months while holding other global variables fixed. The second type of low case scenarios, the integrated approach, allows for the negative shock in one global variable to affect other global variables.

3.3.1 Partial Derivative Approach of Low Case Scenario

In this exercise, we allowed for the negative shocks to one of the global variables to continue for 12 months, from July 2001 to June 2002. Negative shocks include (i) a rise in the US high yield bond spread by 60 basis points, (ii) zero percentage growth in US industrial production, (iii) an increase of 30 basis points

in the swap rate, (iv) a 2% rise in the US short-term interest rate and (v) combination of all of above. Except for the last scenario, each scenario was tested while holding all other global variables unchanged from the original scenario, thus conveying the ideal of partial derivative. The results of capital forecasts under low case scenarios are compared with original forecasts in the table in the appendix to this chapter.

Generally, shocks to global financial variables, including those to the US high yield bond spread, swap rates and to US interest rates, caused a slight deviation of total capital flow forecasts from their original trends. However, flows soon began to revert to their original values. Although no countries reacted identically to the shocks, in the case of 2% increase in the US short-term interest rate, the initial declines in capital inflows were mostly linked with decreases in the level of domestic credit, domestic industrial production, and stock prices. In particular, credit ratings declined for most of the developing countries under study. The level of domestic short term interest rates showed mixed signals. A possible explanation for the recovery of capital inflows could be that countries experiencing higher domestic interest rates can attract foreign capital more easily. Countries that experience lower interest rates are faced with lesser debt burden which can spur domestic economic activity, leading to an improvement in credit ratings. These factors may then generate a resumed inflow of foreign capital, which leads to an accumulation of reserves, attracting further inflows.

However, in the case of shocks to global real factors, such as in the scenario with zero growth in US industrial production, the effects were quite different. Flows to most emerging markets dropped substantially, and continued to decline without sign of recovery, resulting as low as 10% less compared with the original scenario for Asia. The main reason for this appears to be due to the severe negative real impact on emerging markets who rely on the US (and developed countries in general) as a prime export destination. Also, developing countries import parts and intermediate goods from the US to produce final goods for re-export, and the activity of this sector would also be damaged by a marked slowdown in US activity, generating further negative multiplier effects.

The capital flow forecasts under low case scenarios are summarized in the tables below for both partial derivative and for the integrated approach. In the appendix, we include a graphical presentation of capital flow projections for selected emerging markets. Graphs showing the changes in the pull factors under the partial derivative approach are also included in the appendix.

3.3.2 Integrated Approach of Worst Case Scenario

Low case scenarios were tested, this time allowing for the simultaneous interaction among global variables for the same 12 months period. The scenarios were, (i) a rise in the US high yield bond spread by 60 basis points, (ii) an increase of 30 basis points in the US swap rate, and (iii) a 2% rise in the US short-term interest

rate. Each of these shocks would affect the rest of the global variables, i.e. EMBI, US high yield bond spread, US industrial production, US swap rate and US interest rates. Hence, three sets of newly integrated global factors were produced for the scenarios and used to forecast future capital inflows to the emerging markets.

A shock to the US high yield bond spread by 60 basis points led to relatively significant decreases in the EMBI and in US industrial production, and an increase in the US swap rate. US interest rates declined slightly. Although the EMBI is positively related to changes in the US high yield bond spread, its correlation with changes in the Nasdaq index has increased significantly in recent years (IMF 2000). Hence it may be possible for the EMBI to decline while the US high yield bond index increases. An increase in the US swap rate of 30 basis points yielded only minor changes to the rest of the global variables, while a 2% increase in US short term interest rates led to a hike in the EMBI as well as increases in most of the global variables and a decrease in US industrial production.

Capital flows to Latin America were most sensitive to US interest rates, and they declined by a maximum of U$600mn in a month, or U$3,700 mn in a year (about 8% of total flows to the region). Asia was also heavily effected by changes in the US interest rate, but was more susceptible to the shock in the US high yield spread, as it resulted in a maximum of a 10.4% reduction of inflows to the region. Flows to Eastern Europe and the former Soviet Union countries were also significantly affected by the shock in US interest rates and in the US high yield

spread. However, flows to the Middle Eastern countries were mostly indifferent to the changes in global factors except for the shock in the US interest rate. Finally, a projection of flows to Africa, dominated by South Africa, was in general, relatively unaffected by any of above scenarios.

3.4 Conclusion

In this research we have examined the determinants of foreign capital inflows to 32 developing countries and provided forecasts of capital inflows for 2001 through 2003, extending previous work by Chuhan, Claessens, and Mamingi (1993) and Taylor and Sarno (1999a, 1999b). Specifically, we investigated the relationship of push and pull factors on three types of capital flows (bond, equity and syndicated loans) to developing countries, and forecast future flows based on this relationship.

We considered in our set of country-specific factors the consumer price index, the level of domestic credit, the short-term debt to reserves ratio, the level of industrial production, the domestic short-term interest rate, credit rating, the reserves to import ratio and the level of the domestic stock market index. Global or "push" factors taken into account in the model included global factors such as the strength of US output growth, US short-term and long-term interest rates, the Emerging Markets Bond Index (EMBI), the US swap rate and the US high yield spread (as proxies for a measure of risk aversion). The forecasting model uses a vector autoregressive framework. The technique allows for causal interactions

between capital inflows and domestic factors that influence such inflows. Global factors are forecast independently and their evolution influences capital flows into a country but the capital flows of an individual country are not allowed to influence the forecast of the global factors. We examined the determinants of portfolio flows by employing cointegration techniques. The results of individual country forecasts are included in the appendix.

Moreover, we also provided forecasts of capital flows to developing countries projected under different low case scenarios, both from a partial derivative approach and from an integrated approach. Under the partial derivative approach, shocks to global financial variables, including the US high yield, swap rate and US interest rates, caused an immediate drop in inflows, but flows begin to recover after 6-8 months and to resume the original trend. Under the shock to global real factors, such as in the scenario with zero growth in US industrial production, the flows to emerging markets dropped substantially, and continued to decline without any signs of recovery. For the integrated low case scenario approach, changes in US interest rates had the most significant effect on capital flows to most of the emerging markets.

Table 3.1a Capital Flows to Emerking Markets : Data from 1997-2000

					2000				total
		1997	1998	1999	I	II	III	IV	
Latin America	Bond	54,344.15	36,511.73	35,070.10	16,382.50	5,990.57	10,503.07	2,089.60	34,965.74
	Equity	4,331.39	138.66	761.26	1,311.21	2,183.17	3,276.71	0.00	6,771.09
	Loan	49,288.91	42,365.38	29,192.25	8,337.96	11,238.82	7,252.32	8,935.78	35,764.88
	sum	107,964.45	79,015.78	65,023.61	26,031.68	19,412.56	21,032.10	11,025.38	77,501.71
	annual forecast								77,501.71
	growth (annum)								19%
Asia	Bond	40,878.77	13,079.43	20,206.63	11,962.89	4,981.06	9,015.93	5,219.90	31,179.77
	Equity	13,234.99	5,397.49	14,448.24	6,034.83	6,678.82	2,296.97	10,823.13	25,833.75
	Loan	69,847.16	31,455.74	27,552.15	7,156.33	7,472.56	17,898.52	11,917.43	44,444.83
	sum	123,960.92	49,932.67	62,207.01	25,154.04	19,132.44	29,211.42	27,960.45	101,458.36
	annual forecast								101,458.36
	growth (annum)								63%
Eastern Europe*	Bond	8,054.29	15,357.55	3,286.57	450.71	-	181.29	360.00	992.00
	Equity	1,755.07	383.25	529.16	19.07	473.19	64.92	-	557.18
	Loan	15,404.05	4,724.61	2,146.63	283.46	2,619.21	2,540.79	672.70	6,116.17
	sum	25,213.41	20,465.41	5,962.35	753.25	3,092.40	2,787.00	1,032.70	7,665.35
	annual forecast								7,665.35
	growth (annum)								29%
Middle East	Bond	1,372.87	1,525.00	1,672.98	-	434.94	700.00	617.41	1,752.35
	Equity	426.38	367.63	291.28	-	56.42	319.37	-	375.78
	Loan	2,585.83	2,083.06	4,732.97	200.00	445.97	285.00	1,011.99	1,942.96
	sum	4,385.07	3,975.69	6,697.23	200.00	937.32	1,304.37	1,629.40	4,071.10
	annual forecast								4,071.10
	growth (annum)								-39%
Africa*	Bond	1,078.95	998.89	1,885.49	1,235.77	250.00	-	-	1,485.77
	Equity	1,107.77	685.44	4,187.58	269.50	180.44	1,438.26	46.92	1,935.12
	Loan	3,496.27	1,342.09	2,521.58	5,065.00	3,500.00	550.00	1,141.08	10,256.08
	sum	5,682.98	3,026.42	8,594.65	6,570.27	3,930.44	1,988.26	1,188.00	13,676.97
	annual forecast								13,676.97
	growth (annum)								59%
	TOTAL	267,206.8	156,415.97	148,484.86	58,709.23	46,505.16	56,323.15	42,835.94	204,373.5
	annual forecast								204,373.5
	changes in annual flow		-41%	-5%					37.64%

* Capital flows to Eastern Europe and Africa are mostly dominated by Russia and South Africa respectively.

Table 3.1b Capital Flows to Emerking Markets : Forecast from 2001-2002

		2001				total	2002				total
		I	II	III	IV		I	II	III	IV	
Latin America	Bond	10628.37986	10780.3381	11735.608	11484.76358	44,629.09	11213.34228	10964.96423	10783.2955	10725.62061	43,687.22
	Equity	1,102.26	1,019.53	1,363.55	1,348.96	4,834.30	1,392.36	1,426.16	1,450.49	1,472.58	5,741.59
	Loan	11,007.13	11,183.12	11,942.24	12,054.23	46,186.72	12,137.18	12,060.60	12,066.08	12,074.44	48,338.30
	sum	22,737.77	22,982.99	25,041.40	24,887.95	95,650.11	24,742.89	24,451.72	24,299.86	24,272.64	97,767.11
	annual forecast					95,650.11					97,767.11
	growth (annum)					23%					2%
Asia	Bond	5,952.69	7,030.59	8,100.71	8,166.16	29,250.14	8,860.69	8,499.64	8,842.36	8,088.44	34,291.14
	Equity	7,201.21	7,578.54	3,874.57	8,865.64	27,519.95	8,177.92	8,528.84	8,113.64	9,476.24	34,296.64
	Loan	10,506.22	10,352.12	10,635.19	10,600.59	42,094.12	11,585.22	11,968.52	12,603.11	12,396.40	48,553.26
	sum	23,660.11	24,961.25	22,610.47	27,632.39	98,864.22	28,623.83	28,997.01	29,559.11	29,961.09	117,141.04
	annual forecast					98,864.22					117,141.04
	growth (annum)					-3%					18%
Eastern Europe*	Bond	3,031.40	161.91	138.89	186.16	3,518.37	143.68	144.18	144.40	144.52	576.77
	Equity	14.50	21.24	23.17	25.52	84.44	27.21	28.65	29.54	29.98	115.38
	Loan	442.95	693.05	642.43	698.30	2,476.74	691.89	696.16	704.59	715.01	2,807.65
	sum	3,488.86	876.20	804.49	909.99	6,079.54	862.78	868.99	878.53	889.51	3,499.81
	annual forecast					6,079.54					3,499.81
	growth (annum)					-21%					-42%
Middle East	Bond	508.05	545.64	527.67	539.08	2,120.44	550.01	564.32	580.70	597.48	2,292.51
	Equity	213.15	172.39	159.83	155.28	700.65	153.72	154.19	155.82	158.09	621.81
	Loan	369.37	521.84	544.54	593.28	2,029.02	625.85	651.53	672.70	690.81	2,640.90
	sum	1,090.57	1,239.87	1,232.04	1,287.63	4,850.11	1,329.58	1,370.04	1,409.22	1,446.38	5,555.22
	annual forecast					4,850.11					5,555.22
	growth (annum)					19%					15%
Africa*	Bond	7.30	141.60	134.24	153.84	436.98	128.67	90.67	51.53	20.03	290.90
	Equity	1,138.06	856.69	785.89	729.01	3,509.64	689.18	673.16	671.52	675.74	2,709.60
	Loan	1,732.63	2,074.82	2,598.60	2,623.22	9,029.27	3,024.99	3,195.16	3,336.46	3,569.75	13,126.37
	sum	2,877.99	3,073.11	3,518.73	3,506.07	12,975.89	3,842.85	3,959.00	4,059.51	4,265.51	16,126.88
	annual forecast					12,975.89					16,126.88
	growth (annum)					-5%					24%
	TOTAL	53,855.30	53,133.41	53,207.13	58,224.03	218,419.88	59,401.93	59,646.76	60,206.23	60,835.14	240,090.1
	annual forecast					218,419.88					240,090.1
	changes in annual flow					6.87%					9.92%

* Capital flows to Eastern Europe and Africa are mostly dominated by Russia and South Africa respectively.

Table 3.1c Capital Flows to Emerking Markets : Forecast for 2003

		2003				total
		I	II	III	IV	
Latin America	Bond	10739.8872	10797.88284	10882.45468	10965.76648	43,385.99
	Equity	1,489.36	1,503.72	1,515.82	1,528.00	6,036.90
	Loan	12,126.37	12,199.96	12,287.22	12,380.00	48,993.56
	sum	24,355.62	24,501.57	24,685.49	24,873.77	98,416.45
	annual forecast					98,416.45
	growth (annum)					1%
Asia	Bond	8343.967559	7946.232328	8576.001636	8475.512662	33,341.71
	Equity	9,484.89	9,627.45	9,883.25	10,598.14	39,593.74
	Loan	12,421.56	11,999.58	12,154.81	12,129.82	48,705.77
	sum	30,250.42	29,573.26	30,614.07	31,203.47	121,641.22
	annual forecast					121,641.22
	growth (annum)					4%
Eastern Europe*	Bond	145.13	146.05	147.03	147.93	586.14
	Equity	30.25	30.52	30.85	31.22	122.85
	Loan	730.72	746.62	764.75	783.38	3,025.47
	sum	906.11	923.19	942.63	962.54	3,734.46
	annual forecast					3,734.46
	growth (annum)					7%
Middle East	Bond	614.18	630.50	646.33	661.59	2,552.60
	Equity	160.70	163.49	166.38	169.28	659.85
	Loan	707.11	722.14	736.24	749.55	2,915.04
	sum	1,481.98	1,516.14	1,548.94	1,580.42	6,127.49
	annual forecast					6,127.49
	growth (annum)					10%
Africa*	Bond	0.98	-	-	-	0.98
	Equity	680.04	682.69	684.65	687.62	2,735.01
	Loan	3,754.50	3,999.06	4,250.58	4,493.60	16,497.74
	sum	4,435.52	4,681.76	4,935.23	5,181.22	19,233.73
	annual forecast					19,233.73
	growth (annum)					19%
	TOTAL	61,429.64	61,195.91	62,726.37	63,801.43	249,153.35
	annual forecast					249,153.35
	changes in annual flow					4%

* Capital flows to Eastern Europe and Africa are mostly dominated by Russia and South Africa respectively.

Table 3.2 Capital Flow forecasts to Emerging Markets under Partial Derivative Approach of Low Case Scenario(% of changes from original scenario)

		2001						2002					
	Scenarios*	M7	M8	M9	M10	M11	M12	M1	M2	M3	M4	M5	M6
Latin America	hy+60bp	- 0.38	- 0.01	0.00	0.08	- 0.03	- 0.05	- 0.07	- 0.06	- 0.02	- 0.02	- 0.02	- 0.02
	ip flat	-	- 4.00	- 4.84	- 6.39	- 5.54	- 4.88	- 4.82	- 5.09	- 5.26	- 5.45	- 5.65	- 5.84
	sw+30bp	0.16	- 0.06	0.01	0.02	- 0.01	- 0.00	0.03	0.01	0.00	0.01	0.01	0.01
	u1+2%	- 0.00	0.00	- 0.59	- 0.11	0.01	- 0.04	- 0.20	- 0.08	0.04	- 0.05	- 0.07	- 0.04
	combination	- 2.42	- 0.04	- 0.57	0.54	- 0.01	- 0.11	- 0.17	- 0.17	- 0.05	0.02	0.03	0.02
Asia	hy+60bp	- 2.95	- 2.79	- 3.16	- 3.28	- 2.99	- 3.31	- 3.56	- 3.53	- 3.60	- 3.69	- 3.69	- 3.70
	ip flat	-	1.87	- 0.88	- 2.71	- 4.91	- 6.40	- 6.46	- 7.93	- 8.83	- 9.62	- 10.20	- 10.40
	sw+30bp	- 0.25	0.08	0.12	0.08	0.10	0.04	0.03	0.08	0.09	0.05	0.04	0.04
	u1+2%	0.79	0.99	0.16	0.45	0.23	0.19	- 0.27	- 0.09	0.10	- 0.06	- 0.05	- 0.04
	combination	- 3.43	0.51	- 0.08	- 1.40	0.50	- 0.14	- 1.04	- 0.49	- 0.48	- 0.64	- 0.52	- 0.45
Eastern Europe**	hy+60bp	41.05	13.79	- 0.34	- 2.58	- 0.61	- 0.67	- 2.31	- 1.85	- 0.93	- 0.55	- 0.27	- 0.11
(Former Soviet	ip flat	-	- 34.70	22.44	25.15	49.06	47.78	43.67	40.11	38.67	37.46	37.25	37.60
Union inlc.)	sw+30bp	- 2.53	- 6.52	0.27	- 0.77	0.11	- 0.17	0.41	0.14	0.01	0.00	0.03	0.03
	u1+2%	- 5.74	21.59	- 18.80	11.82	5.34	7.09	4.84	4.88	2.05	- 0.20	- 1.79	- 2.34
	combination	36.56	77.87	0.79	- 6.03	- 4.62	- 2.78	- 10.12	- 7.36	- 3.33	- 1.09	0.42	1.20
Middle East	hy+60bp	0.12	- 0.31	- 0.09	- 0.08	- 0.08	- 0.08	0.01	0.05	0.06	0.05	0.05	0.05
	ip flat	-	- 9.87	- 8.73	- 7.39	- 5.76	- 7.22	- 7.95	- 8.01	- 7.54	- 7.20	- 6.92	- 6.66
	sw+30bp	- 0.98	- 0.01	0.16	0.10	- 0.10	- 0.04	0.03	0.06	0.05	0.04	0.04	0.04
	u1+2%	- 5.94	4.48	0.03	0.64	- 0.54	0.59	0.78	0.78	0.42	0.40	0.42	0.43
	combination	0.06	- 2.42	- 0.42	- 0.42	- 0.44	- 0.31	0.35	0.74	0.80	0.76	0.77	0.78
Africa**	hy+60bp	- 0.15	0.08	- 0.17	0.01	- 0.20	- 0.07	- 0.06	- 0.07	- 0.05	- 0.03	- 0.04	- 0.03
	ip flat	-	- 9.76	- 5.73	- 6.76	- 6.15	- 6.76	- 7.20	- 7.73	- 7.46	- 7.78	- 7.75	- 7.70
	sw+30bp	0.22	- 0.29	0.05	0.10	0.04	0.14	0.09	0.08	0.09	0.07	0.06	0.07
	u1+2%	2.75	0.43	- 0.46	- 0.18	- 0.11	- 0.09	- 0.14	0.13	0.06	0.10	0.13	0.10
	combination	- 0.99	0.81	- 0.41	1.15	- 1.03	0.05	- 0.15	0.22	0.17	0.23	0.21	0.25

* Negative Scenarios include (i)60 b.p. higher US high yield bond spread, (ii)0% growth in US Indistrail Production, (iii)30 b.p. higher US swap rates, (iv)2% increase in the US short-term interest rate, and (v)combination of all of above.

** Capital flows to Eastern Europe and Africa are mostly dominated by Russia and South Africa respectively.

Table 3.3 Capital Flow Forecasts to Emerging Markets under Integrated Approach of the Low Case Scenarios (% of changes)

		2001						2002								2003			
	scenarios	M7	M8	M9	M10	M11	M12	M1	M2	M3	M4	M5	M6	QIII	QIV	QI	QII	QIII	QIV
Latin America	sw+30bp	- 0.28	0.04	- 0.32	- 0.56	- 0.48	- 0.54	- 0.69	- 0.80	- 0.88	- 0.97	- 1.03	- 1.05	- 0.84	- 0.76	- 0.85	- 0.88	- 0.81	- 0.65
	hy+60bp	- 1.52	- 0.70	- 1.10	- 1.17	- 1.35	- 1.48	- 1.71	- 1.81	- 1.82	- 1.87	- 1.94	- 2.01	- 1.50	- 1.63	- 1.38	- 1.20	- 0.89	- 0.48
	u1+2%	0.54	0.34	- 1.40	- 2.84	- 3.04	- 4.01	- 4.85	- 5.27	- 6.01	- 7.03	- 7.53	- 8.00	- 7.71	- 6.47	- 6.14	- 5.00	- 3.99	- 2.73
Asia	sw+30bp	- 0.63	- 8.68	2.69	- 1.86	- 2.43	- 0.66	- 3.09	0.58	- 2.54	- 3.65	1.80	- 3.41	- 1.94	- 1.58	- 1.28	- 0.98	- 0.91	- 1.00
	hy+60bp	- 1.22	- 10.4	0.57	- 4.48	- 4.40	- 2.31	- 5.60	- 1.97	- 4.73	- 6.27	- 0.80	- 5.63	- 2.44	- 1.62	- 1.56	- 1.34	- 1.13	- 1.03
	u1+2%	1.04	- 6.50	2.53	- 0.41	- 3.10	- 2.56	- 3.68	0.01	- 3.25	- 4.00	1.52	- 3.95	- 5.05	- 2.55	- 2.09	- 2.39	- 2.51	- 2.65
Eastern Europe	sw+30bp	0.43	0.59	0.92	0.50	0.14	- 0.54	- 0.83	- 1.10	- 1.39	- 1.34	- 1.46	- 1.54	0.15	1.08	0.46	0.25	0.11	0.02
	hy+60bp	- 9.74	- 7.24	- 3.49	- 5.96	- 8.94	- 10.9	- 9.87	- 9.66	- 9.75	- 9.57	- 9.86	- 10.1	- 4.79	- 2.01	0.85	2.16	3.06	3.71
	u1+2%	2.31	5.24	11.0	1.39	- 6.56	- 1.33	- 7.02	- 14.0	- 14.4	- 17.5	- 22.4	- 21.1	- 25.6	- 29.6	- 27.3	- 22.3	- 19.3	- 16.6
Middle East	sw+30bp	- 0.80	- 0.87	- 0.61	- 0.54	- 0.79	- 0.90	- 0.80	- 0.65	- 0.52	- 0.43	- 0.33	- 0.21	- 0.65	0.17	- 0.15	- 0.20	- 0.17	- 0.08
	hy+60bp	0.00	- 0.01	- 0.03	- 0.03	- 0.03	- 0.03	- 0.02	- 0.02	- 0.01	- 0.01	- 0.01	- 0.01	1.07	3.33	2.38	0.65	- 0.60	- 1.22
	u1+2%	- 7.29	- 3.46	- 6.84	- 6.11	- 6.13	- 5.82	- 5.55	- 5.13	- 4.76	- 4.08	- 3.23	- 2.31	7.21	7.02	6.84	5.68	4.31	3.52
Africa	sw+30bp	0.25	0.02	0.28	0.20	0.10	0.04	- 0.02	- 0.09	- 0.18	- 0.32	- 0.44	- 0.55	- 0.28	- 0.21	- 0.13	- 0.09	- 0.08	- 0.06
	hy+60	- 0.55	0.91	0.13	- 0.23	- 0.89	- 1.01	- 0.59	- 0.29	- 0.19	- 0.03	0.04	0.17	-	-	-	-	-	-
	u1+2%	3.15	3.29	4.92	2.68	2.16	1.99	1.79	2.05	2.12	2.04	2.24	2.34	-	-	-	-	-	-

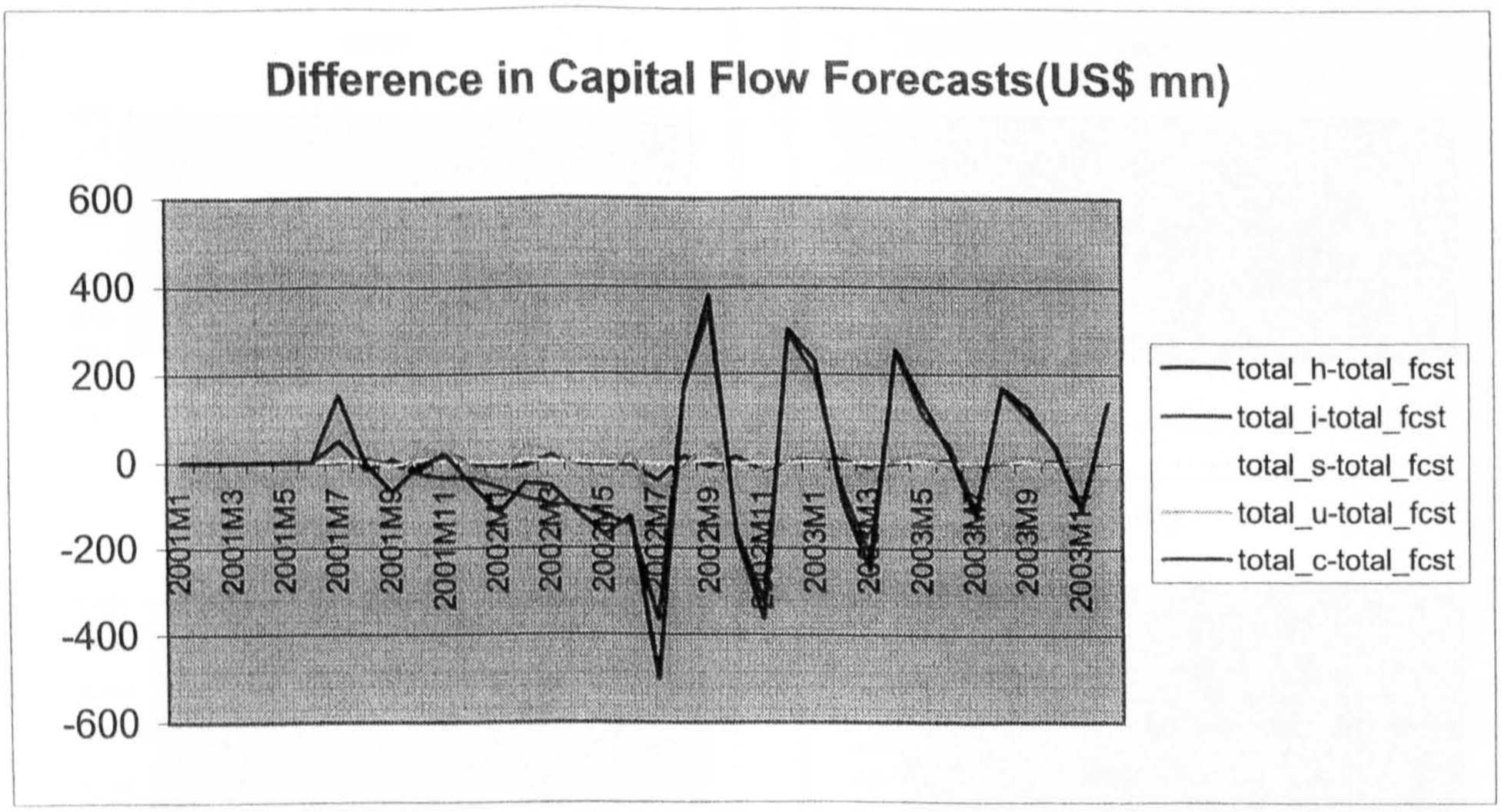
* Negative Scenarios include (i)60 b.p. higher US high yield bond spread, (ii)30 b.p. higher US swap rates, and (iii)2% increase in the US short-term interest rate.

** Capital flows to Eastern Europe and Africa are mostly dominated by Russia and South Africa respectively.

Figure 3: Capital Flow Forecasts under Low Case Scenarios for Selected Countries

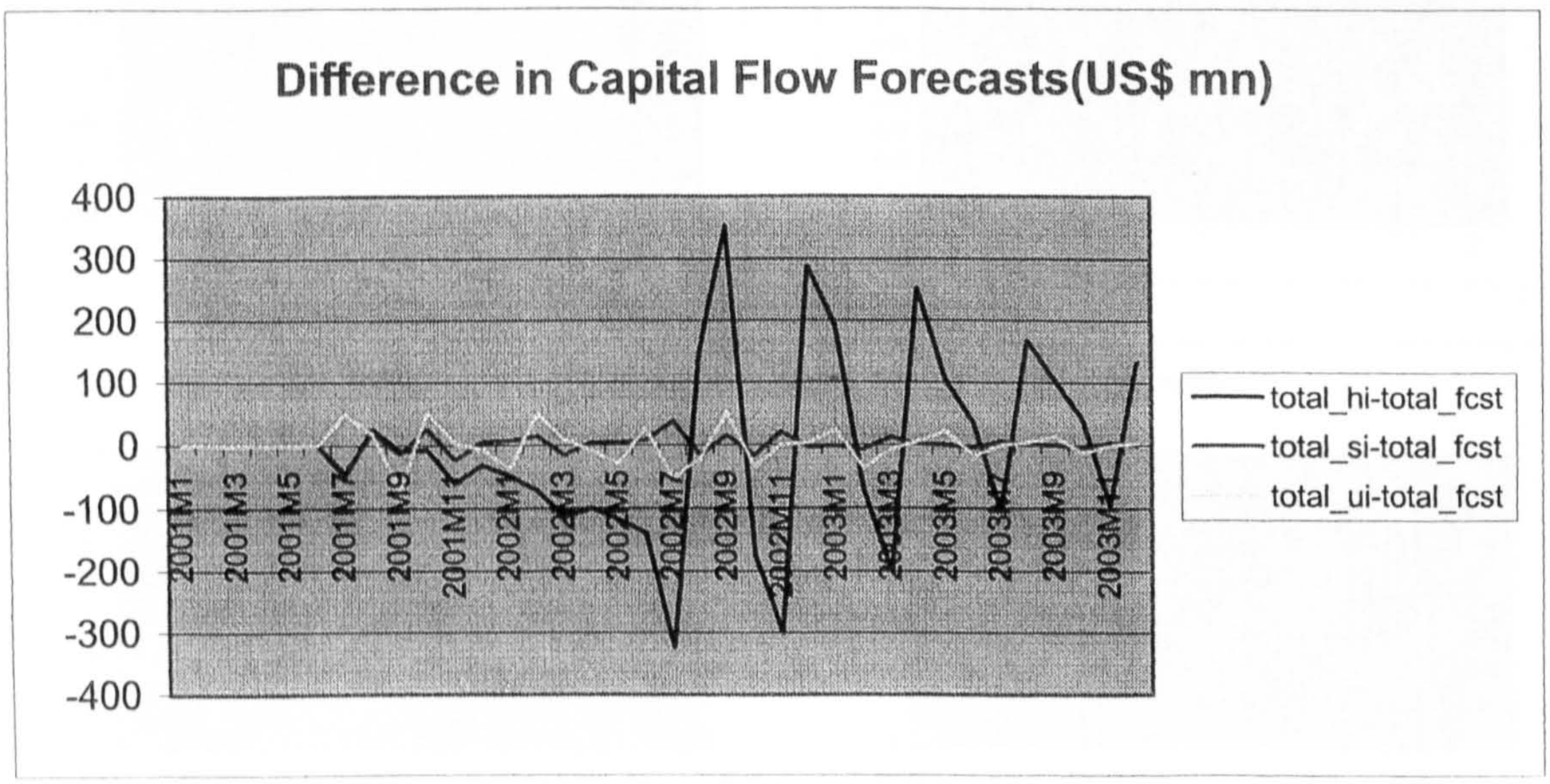
China

Fig 3.1.1 Partial Derivatives Approach



* Above series indicate the forecast differences between the original and various low case scenarios.
For example "total_h-total_fcst" represent the forecast difference between the original (total_fcst) and the forecast under 60 b.p. higher US high yield bond spread (total_h) from July 2001 to June 2002.
The variables total_i, total_s, total_u, total_c represent forecast under flat US industrial production, 30b.p. higher swap rate, 2% increasease US interest rate and the combination of all low case senarios

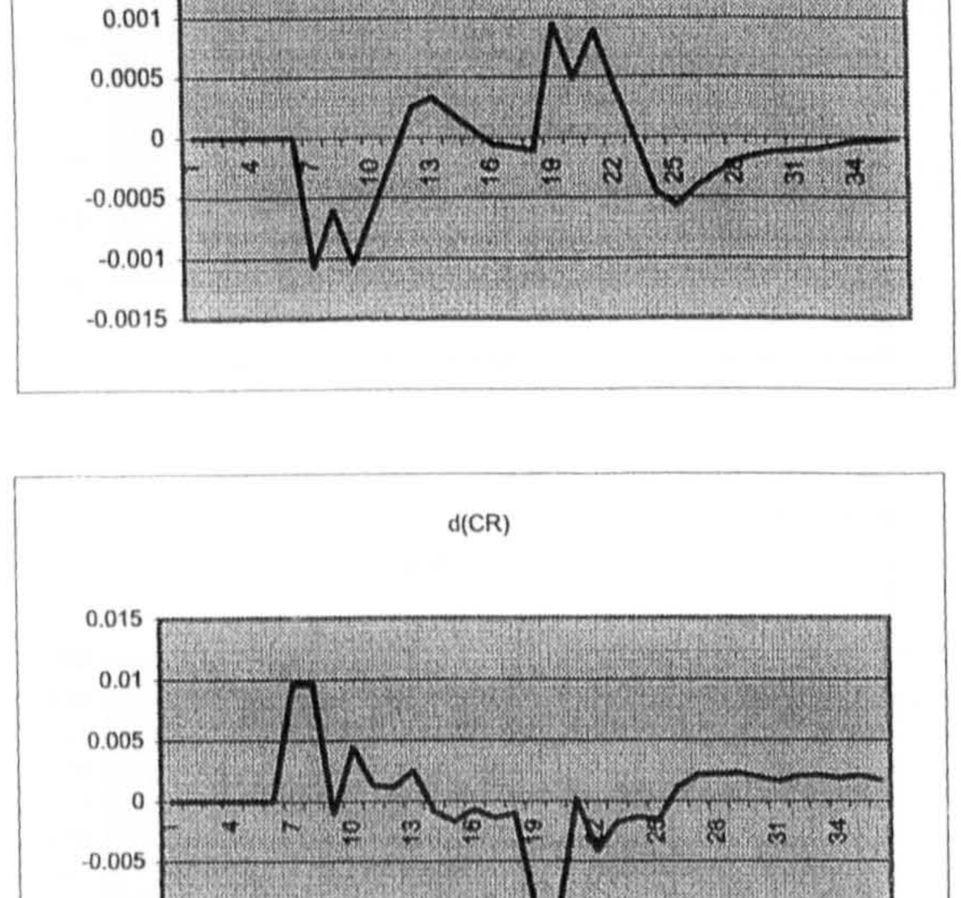
Fig 3.1.2 Integrated Approach

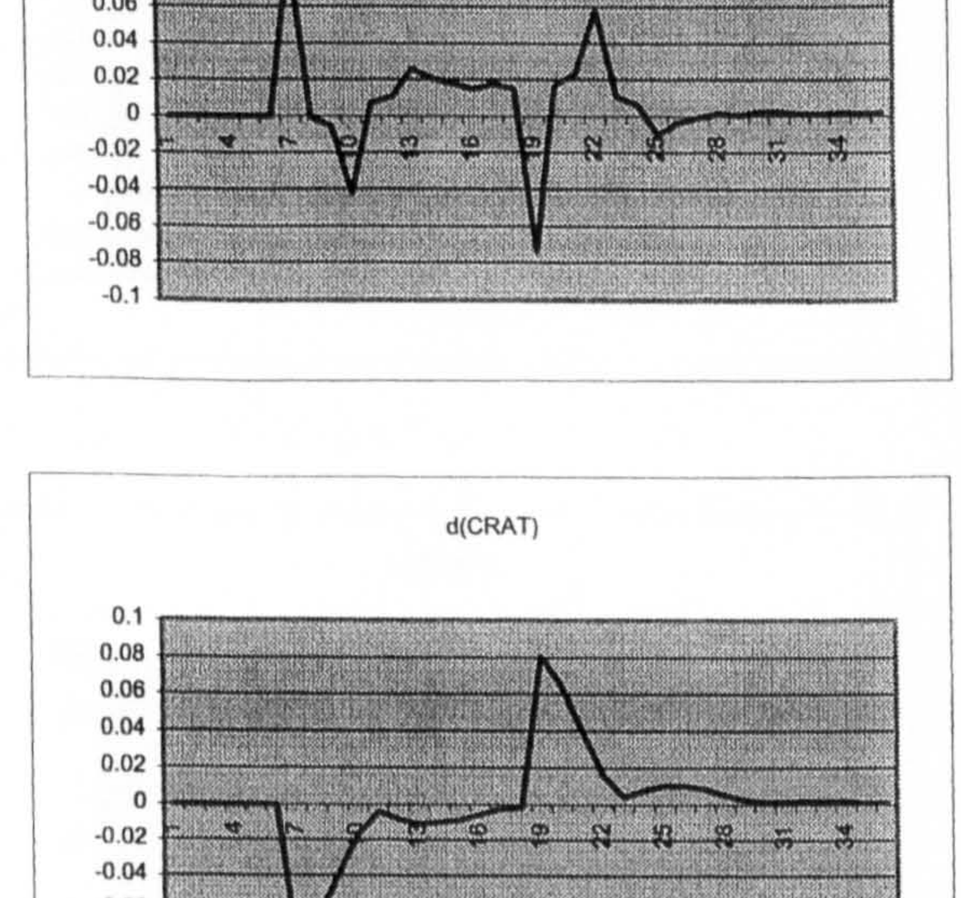


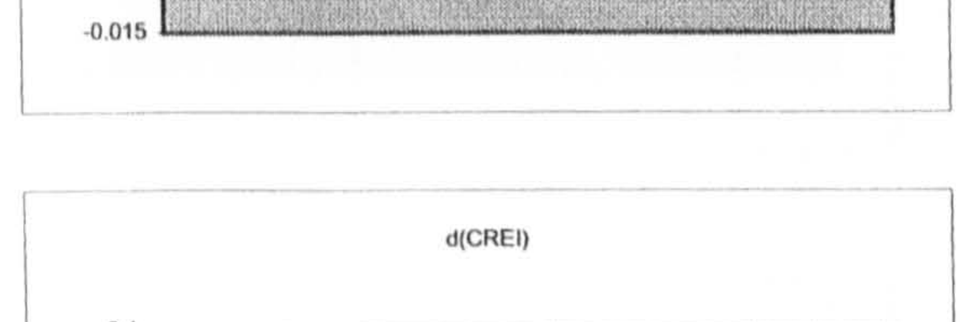
* Above series indicate the forecast differences between the original and integrated low case scenarios.
"i" in "total_hi-total_cast" signifies that the series are forecasts under ingetrated low case scenarios.

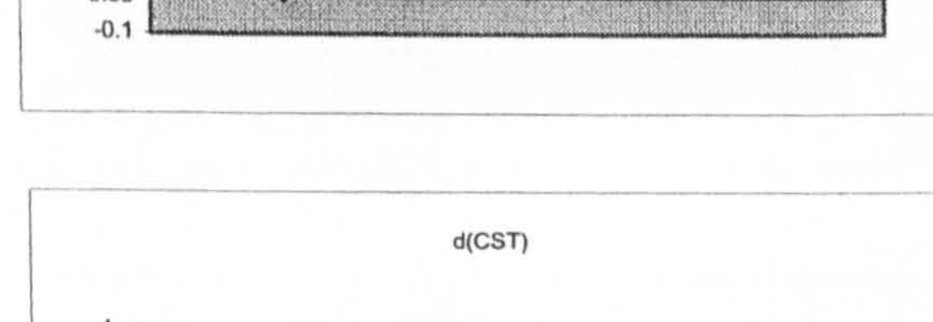
3.1.3 Changes in the Pull Factors under Partial Derivative Approach of Low Case Scenario

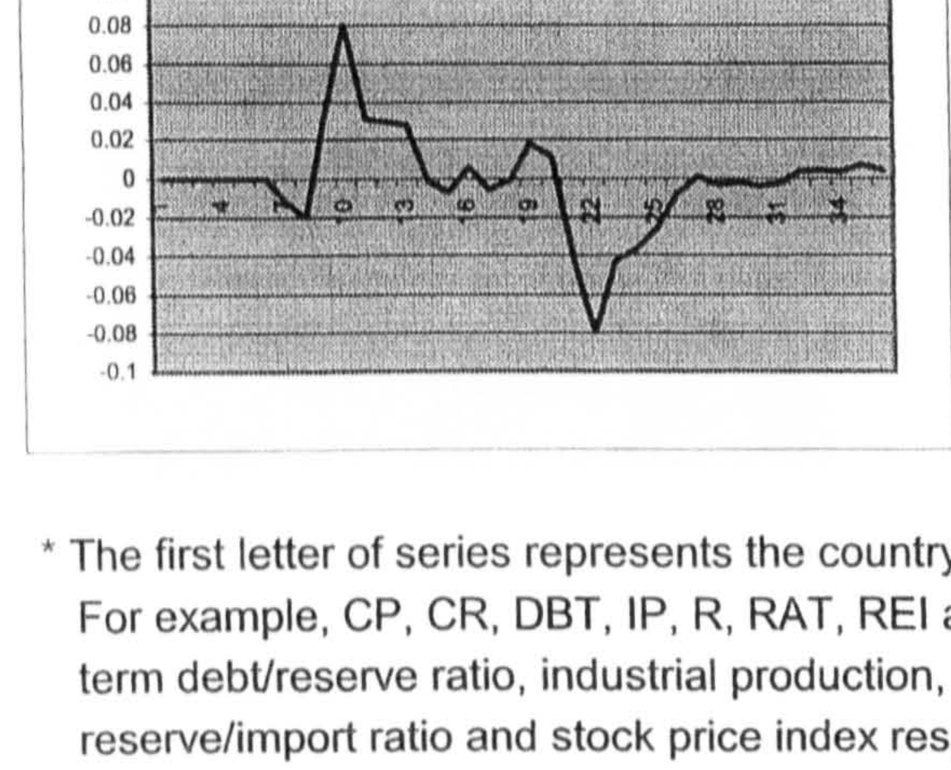
Fig 3.1.3 (a) 2% Increase in the US short-term interest rate

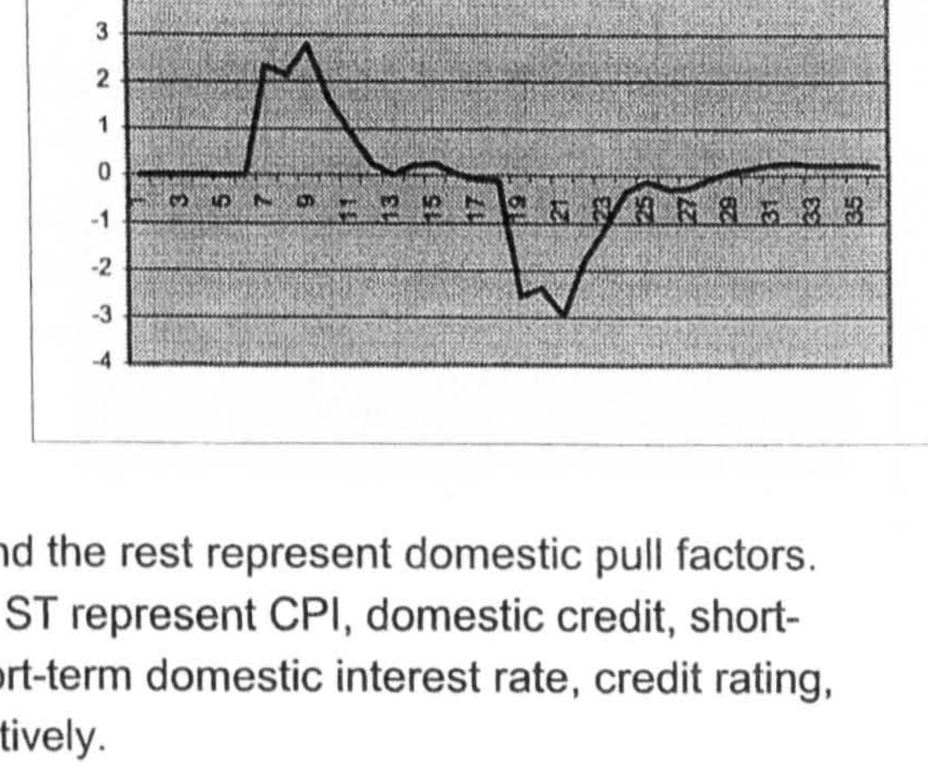








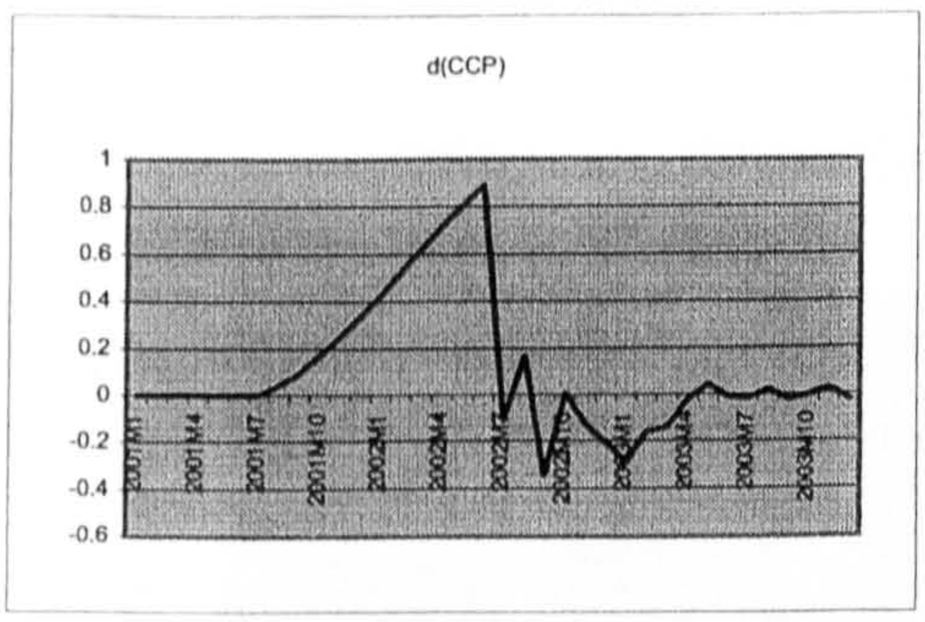


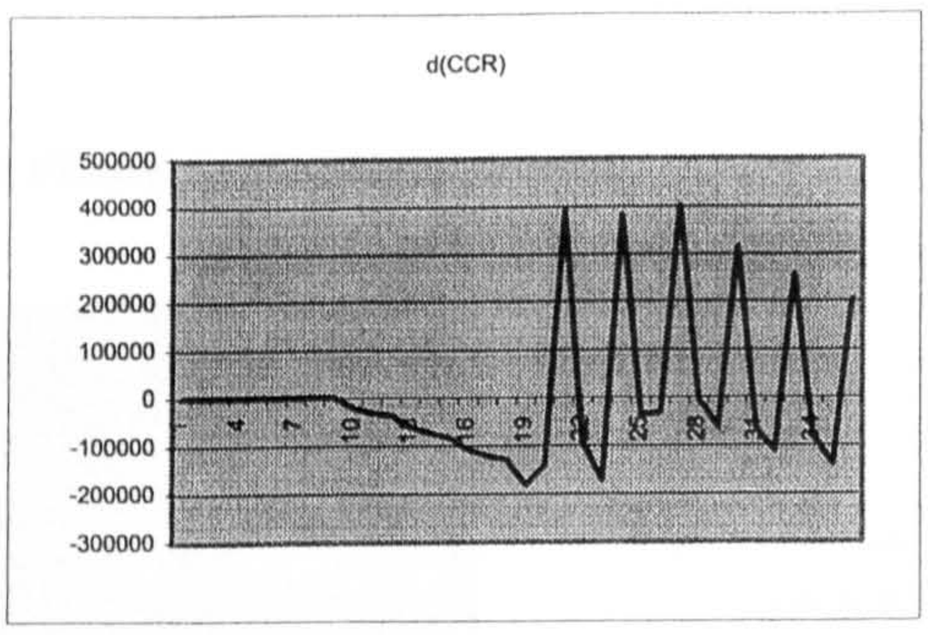


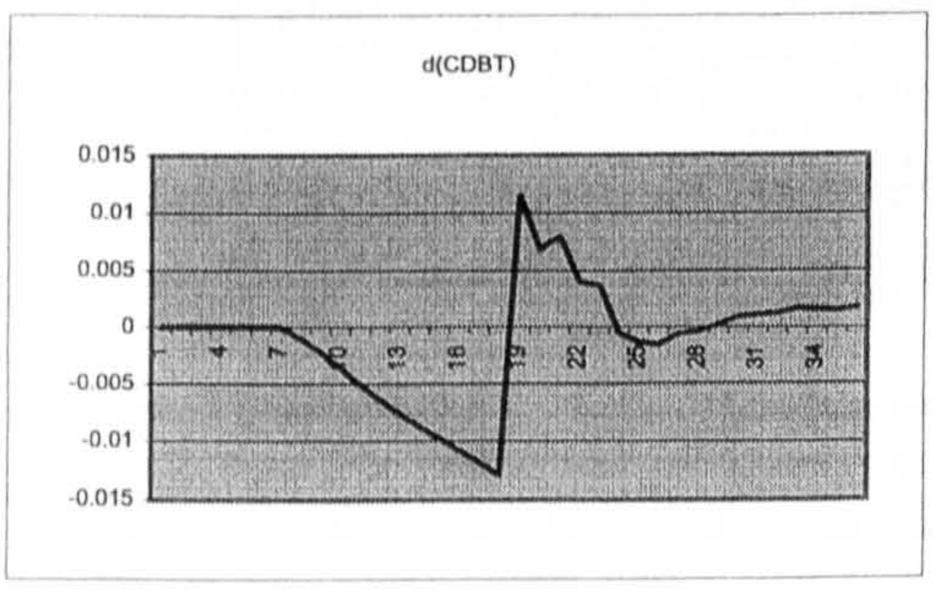
* The first letter of series represents the country, and the rest represent domestic pull factors. For example, CP, CR, DBT, IP, R, RAT, REI and ST represent CPI, domestic credit, short-term debt/reserve ratio, industrial production, short-term domestic interest rate, credit rating, reserve/import ratio and stock price index respectively.

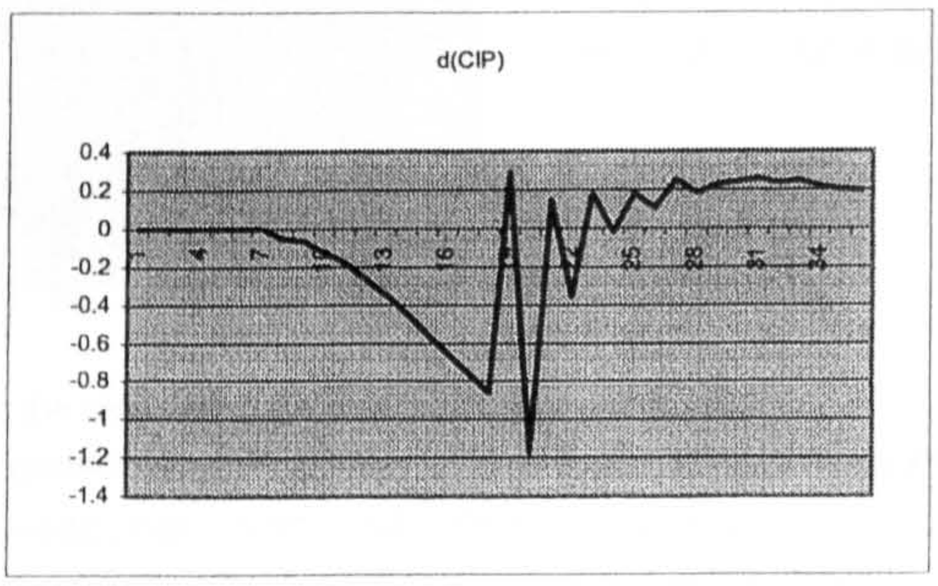
Figure 3.1-China 3

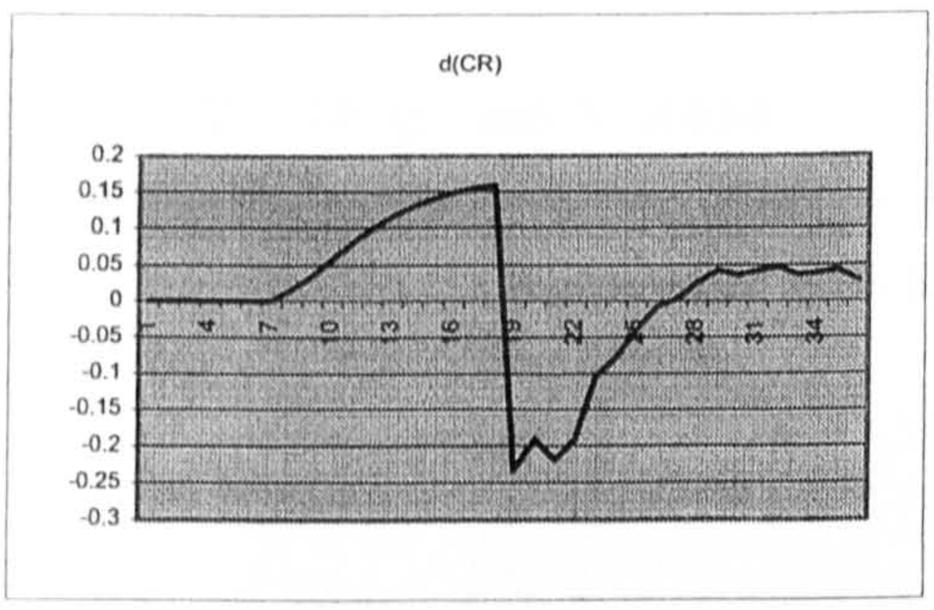
Fig 3.1.3 (b) 0% Growth in the US Industrial Production

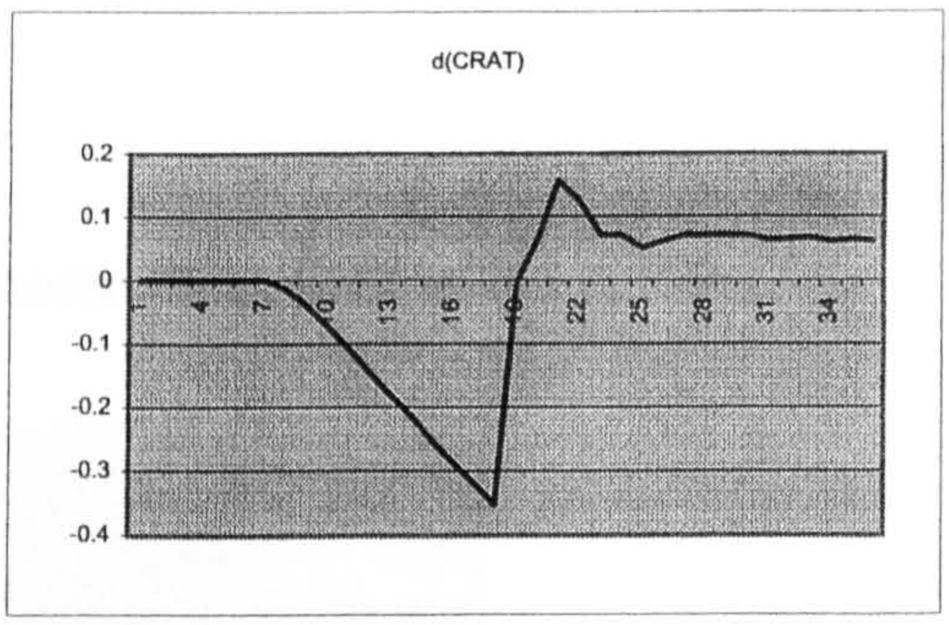


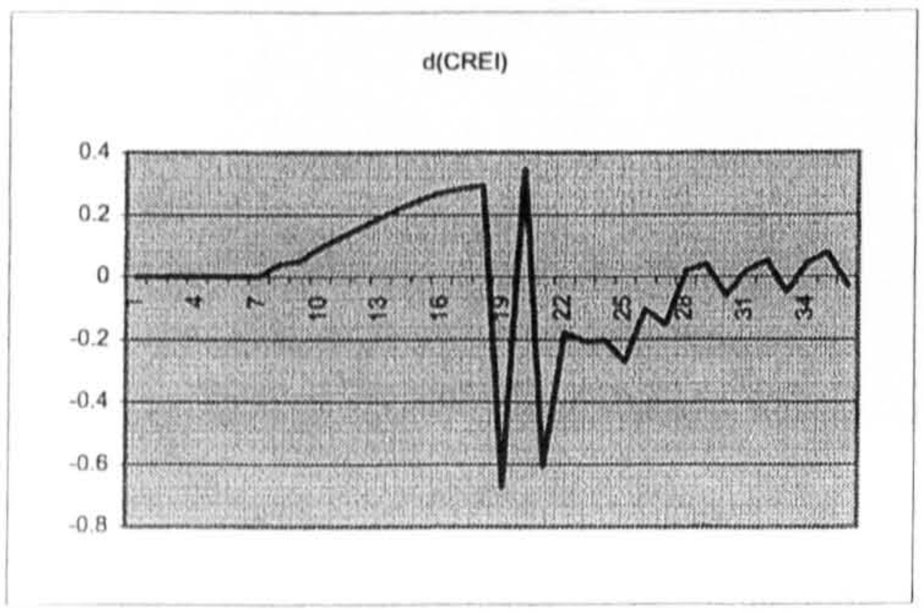


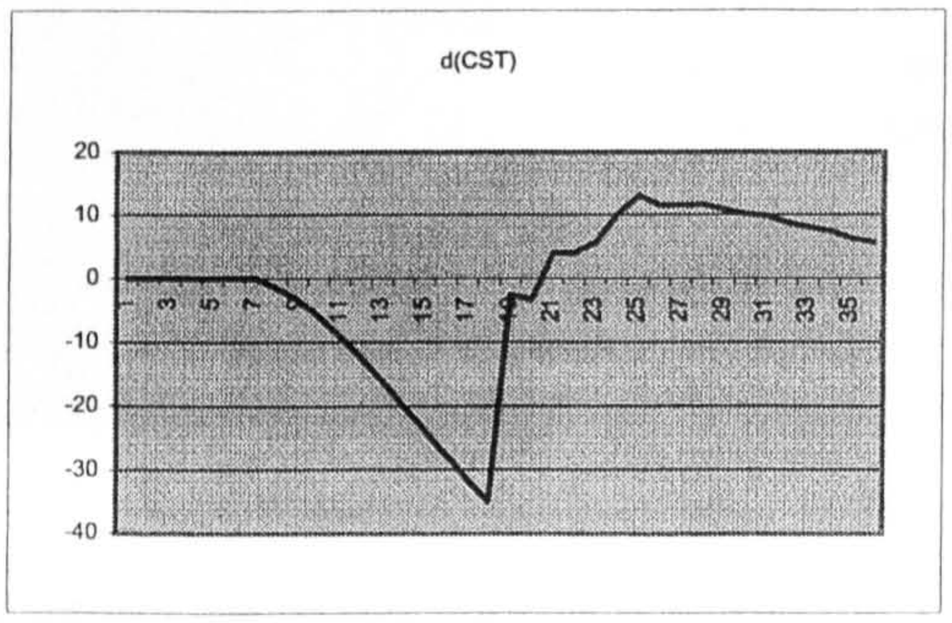






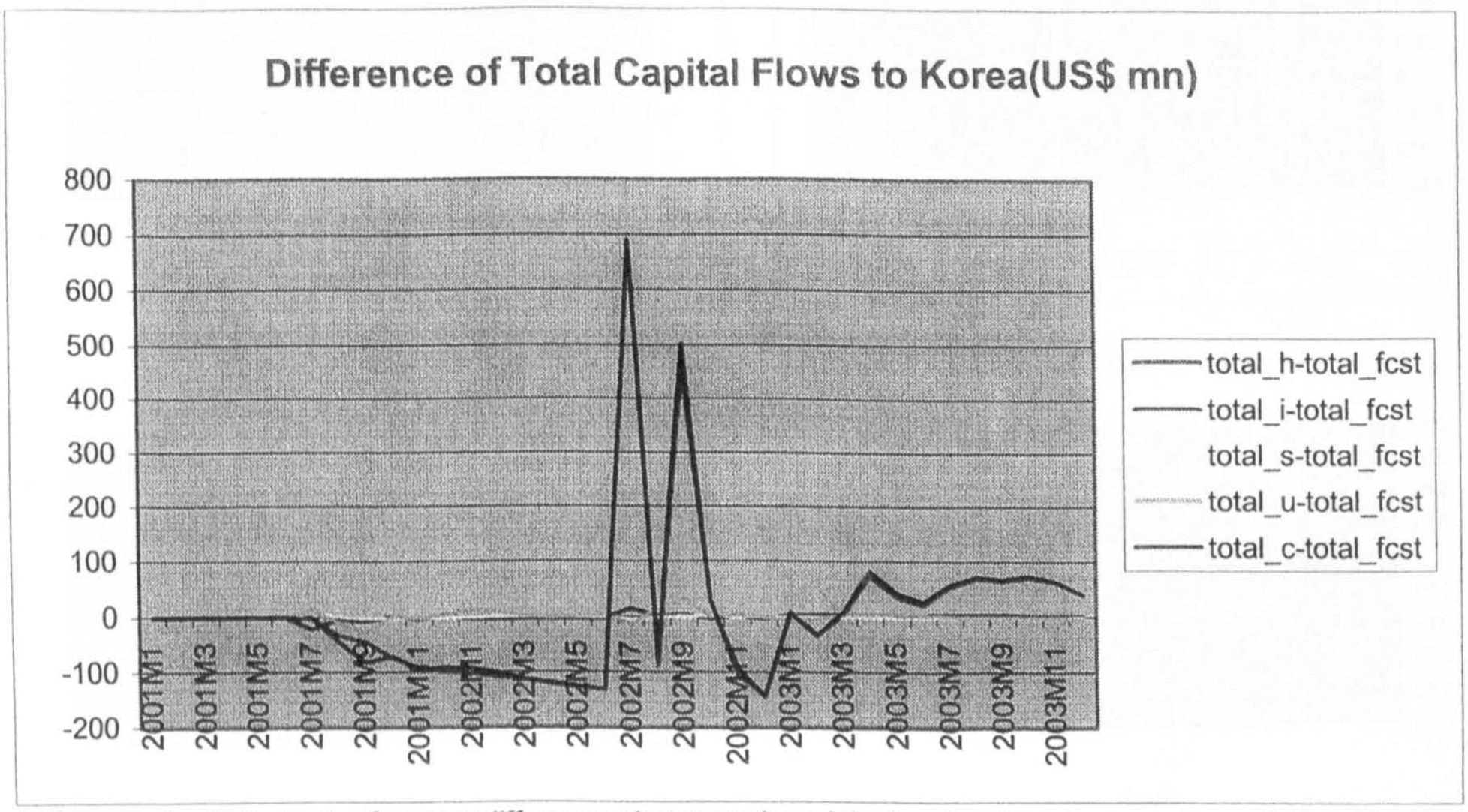






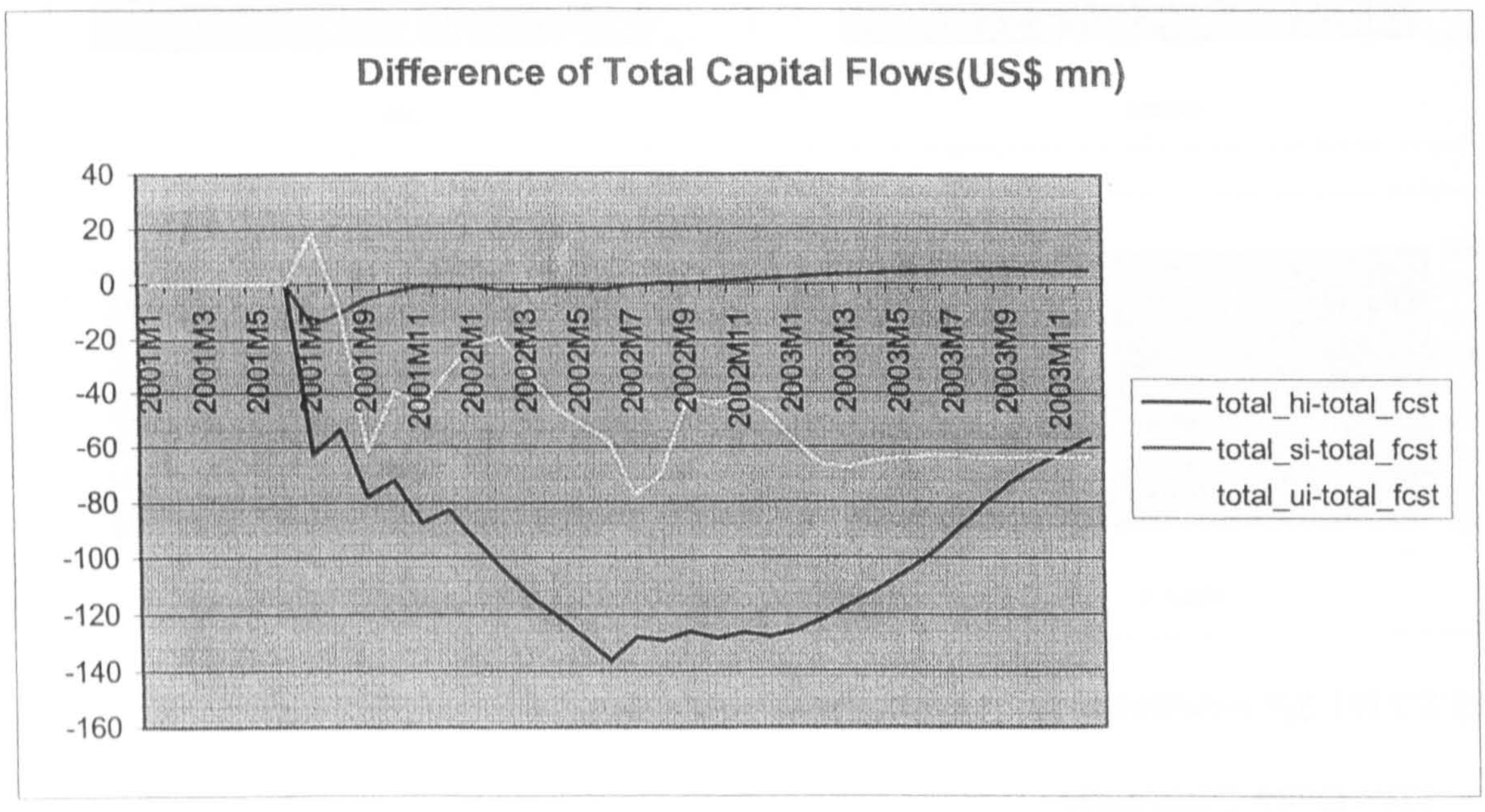
Korea

Fig 3.2.1 Partial Derivatives Approach



* Above series indicate the forecast differences between the original and various low case scenarios.
For example "total_h-total_fcst" represent the forecast difference between the original forecast (total_fcst) and the forecast under 60 b.p. higher US high yield bond spread (total_h) from July 2001 to June 2002.
The variables total_i, total_s, total_u, total_c represent forecast under flat US industrial production, 30b.p. higher swap rate, 2% increasease US interest rate and the combination of all low case senarios

Fig 3.2.2 Integrated Approach

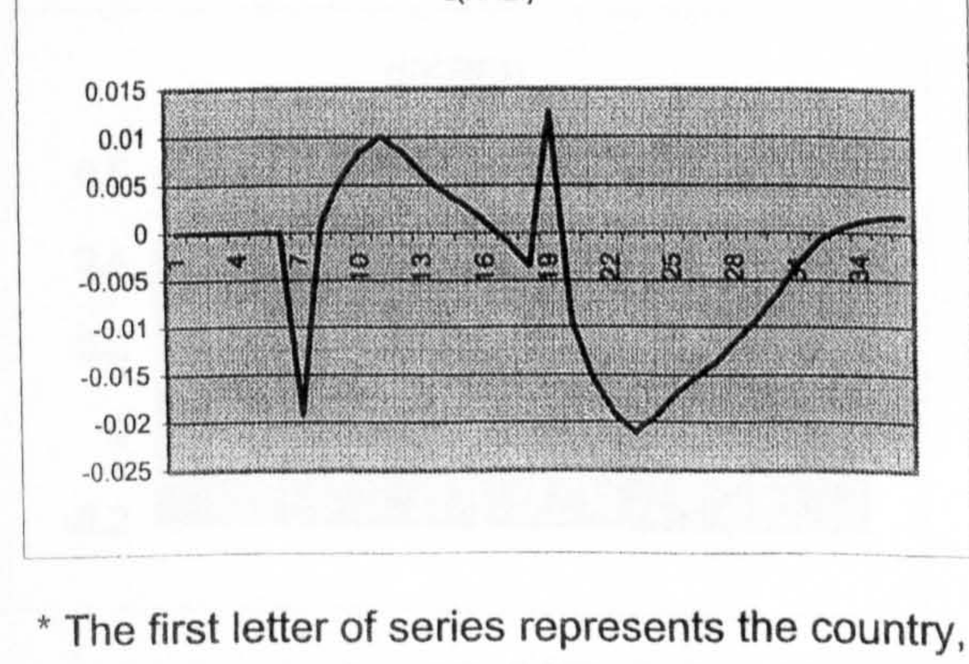


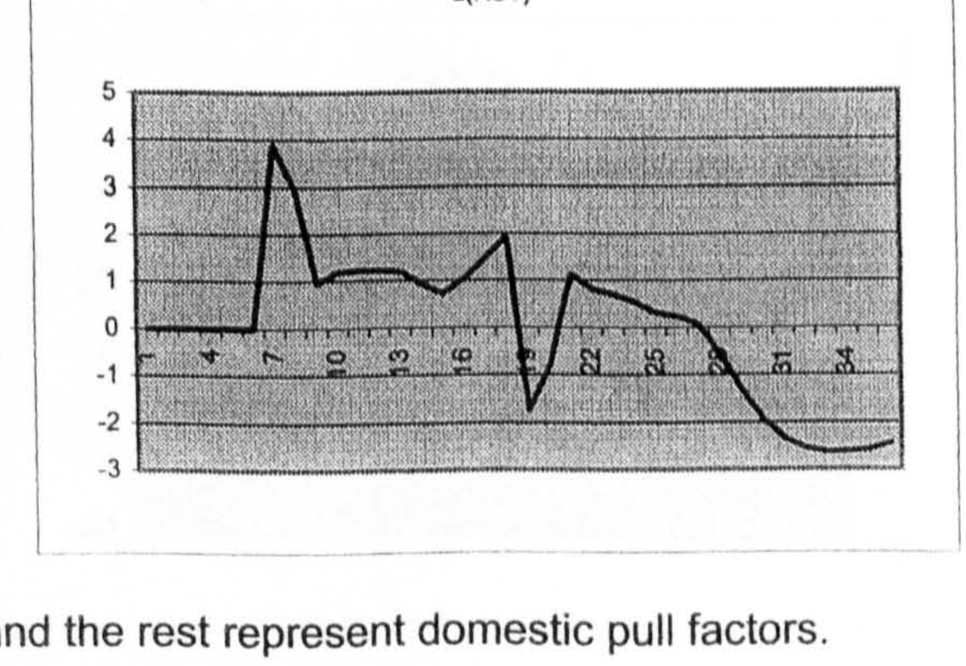
* Above series indicate differences between the original forecasts and the forecasts under integrated low case scenarios.
For example, "i" in "total_hi-total_cast" signifies that the series are forecasts under ingetrated low case scenarios.

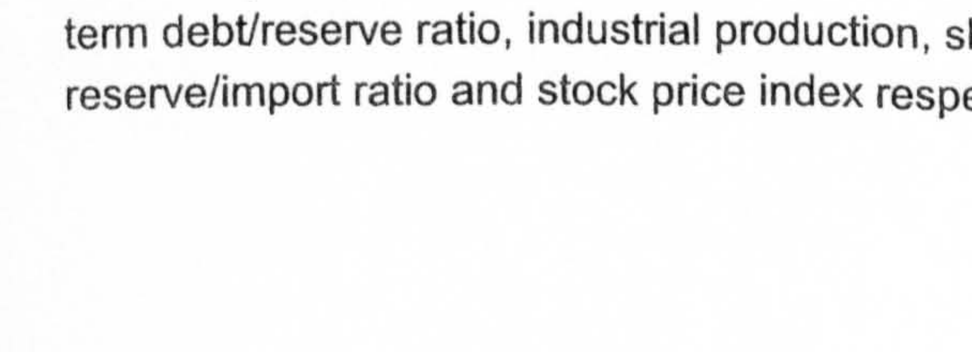
Figure 3.2-Korea 2

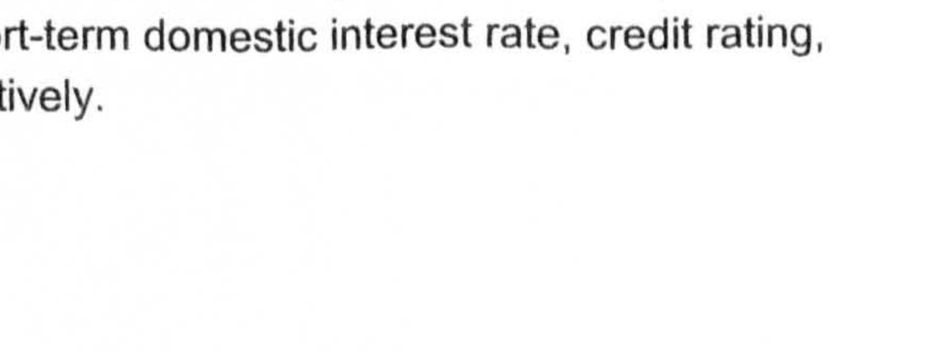
3.2.3 Changes in the Pull Factors under Partial Derivative Approach of Low Case Scenarios

Fig 3.2.3 (a) 2% Increase in the US short-term interest rate





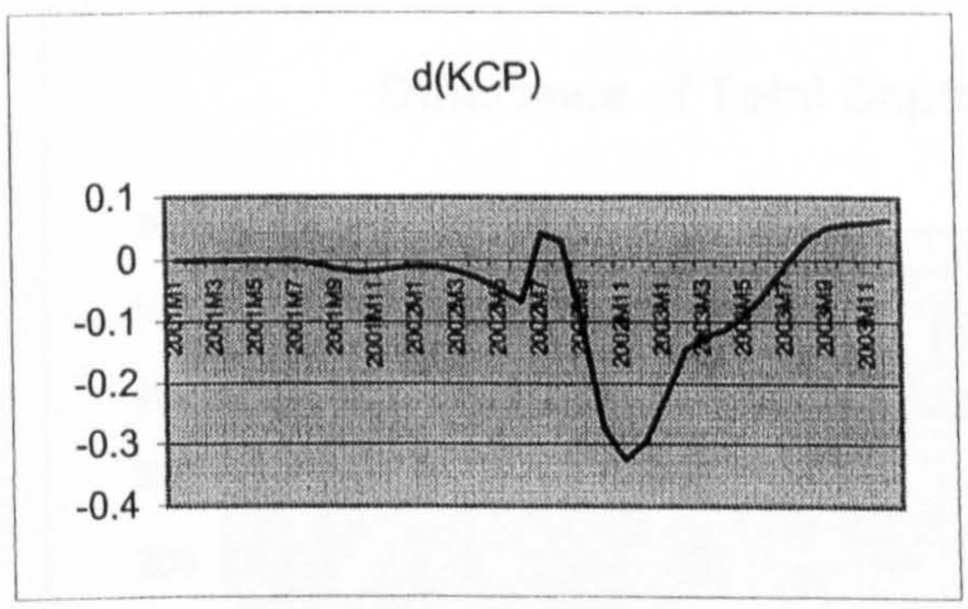


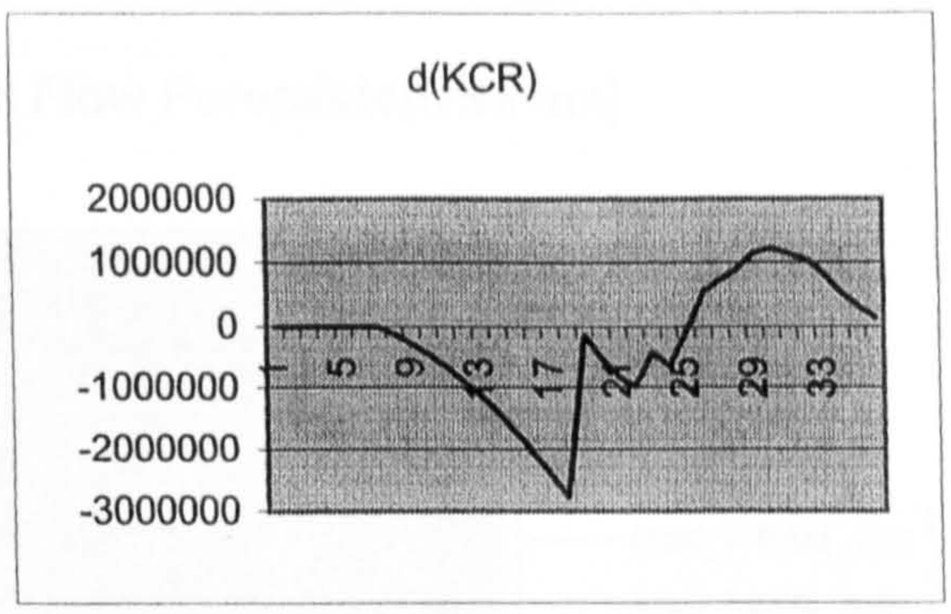


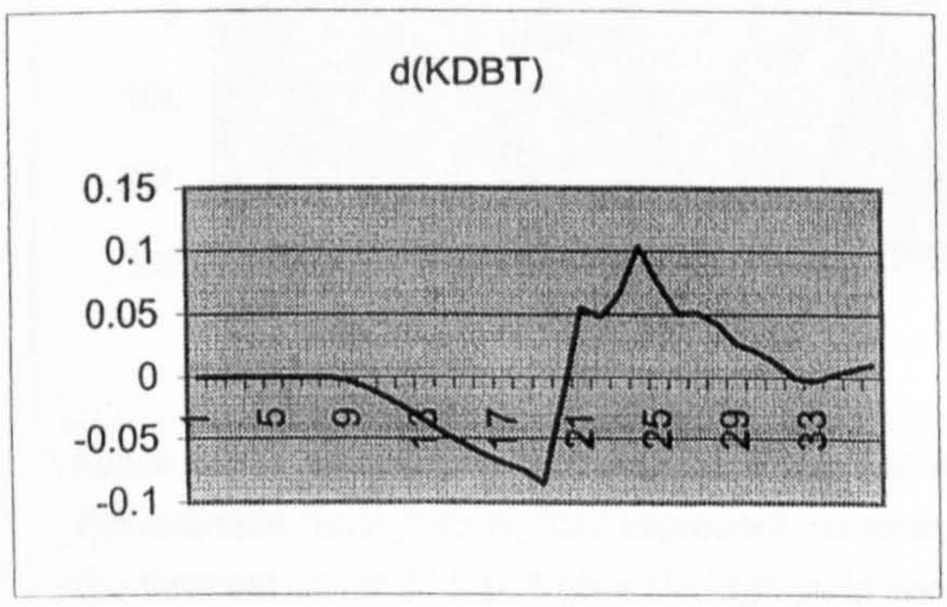
* The first letter of series represents the country, and the rest represent domestic pull factors. For example, CP, CR, DBT, IP, R, RAT, REI and ST represent CPI, domestic credit, short-term debt/reserve ratio, industrial production, short-term domestic interest rate, credit rating, reserve/import ratio and stock price index respectively.

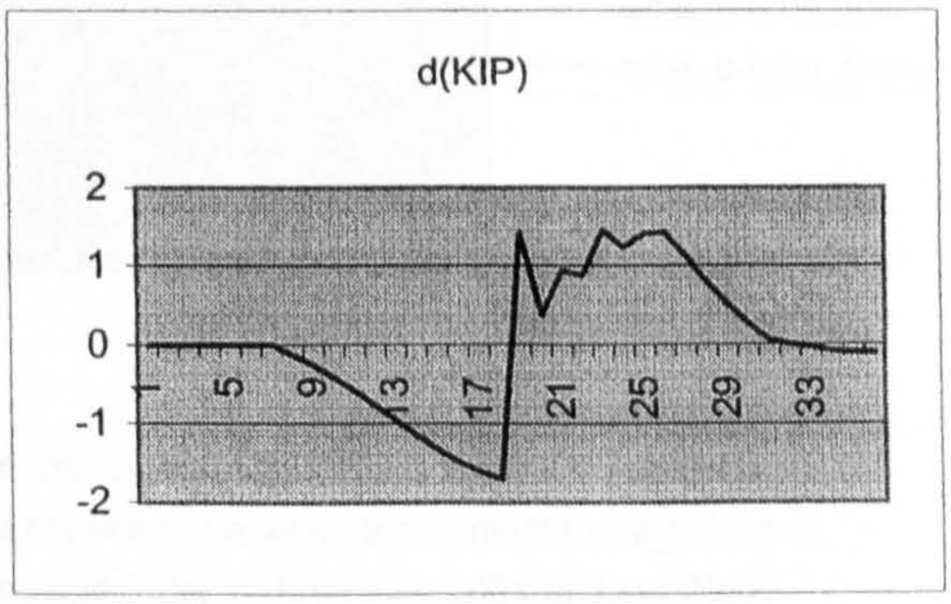
Figure 3.2-Korea 3

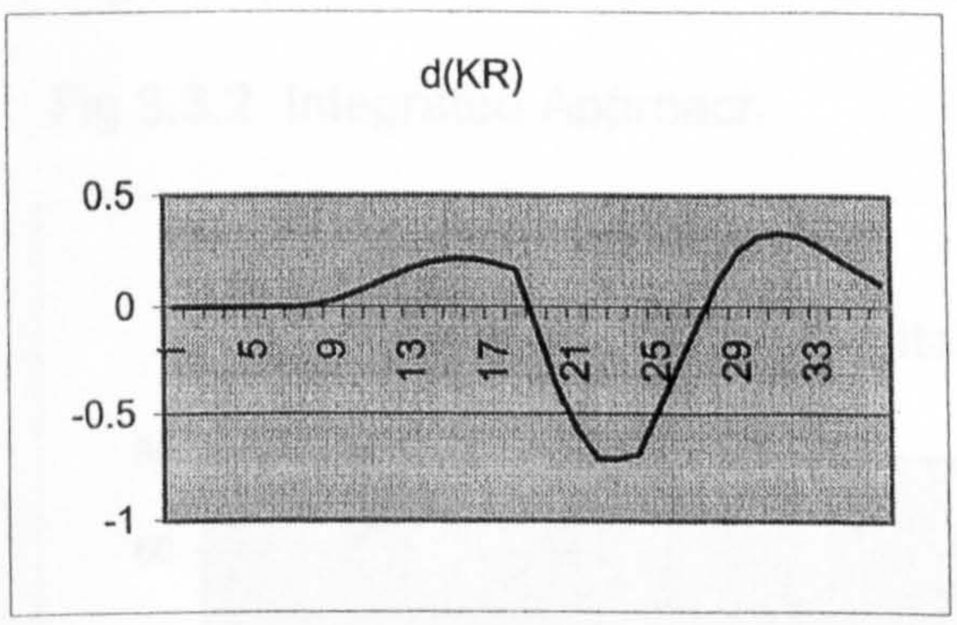
Fig 3.2.3 (b) 0% Growth in the US Industrial Production

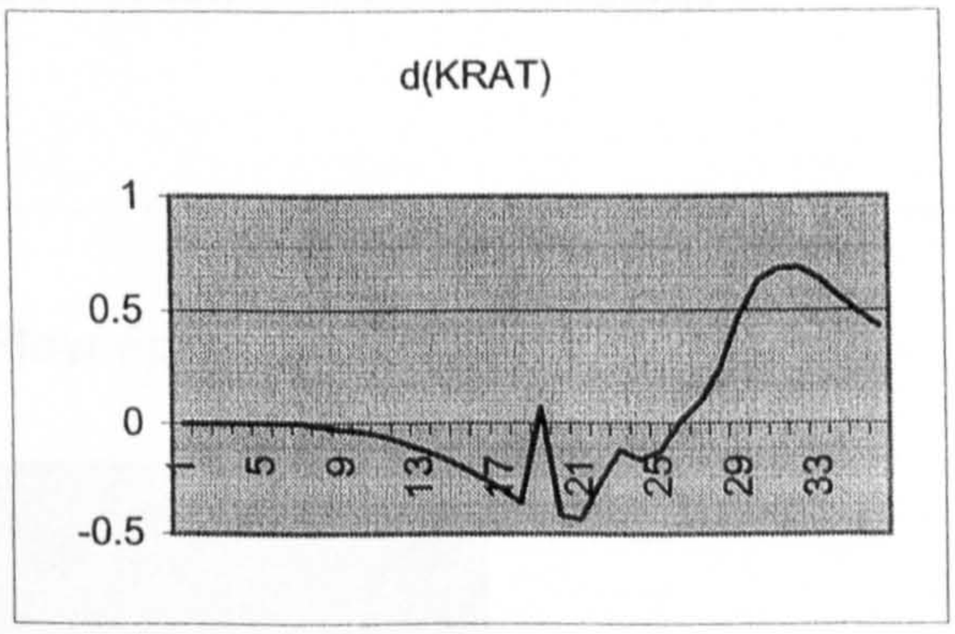


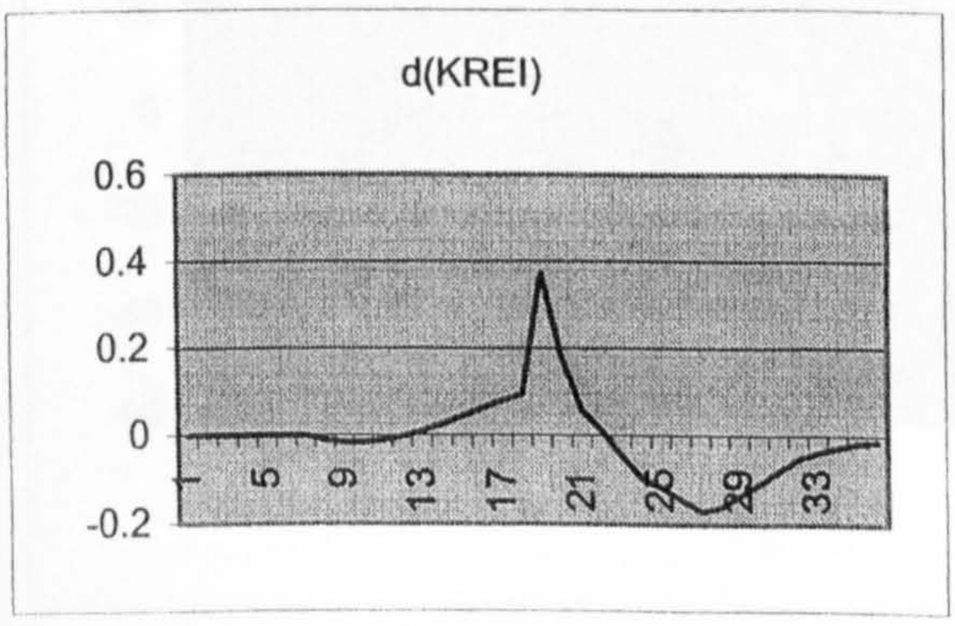


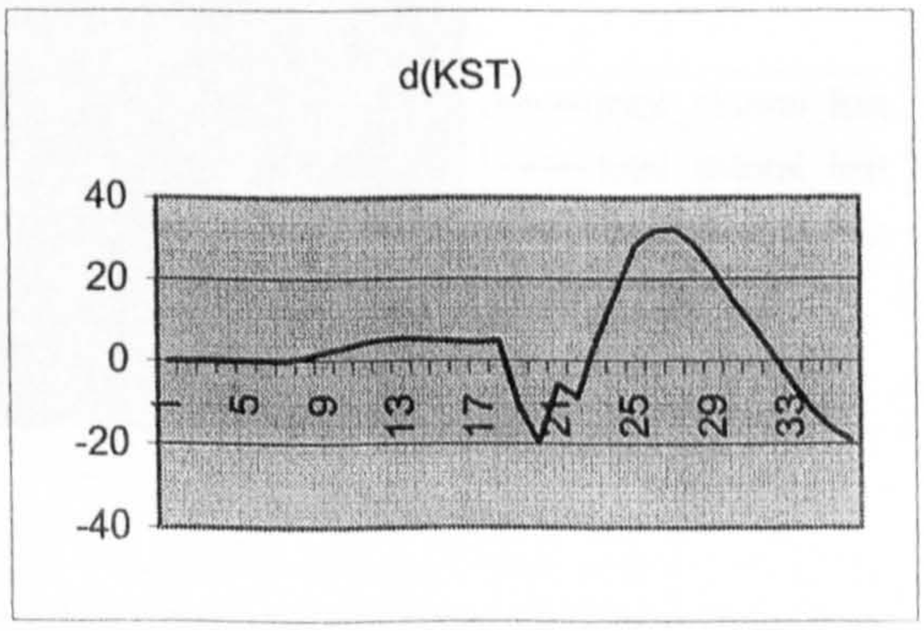






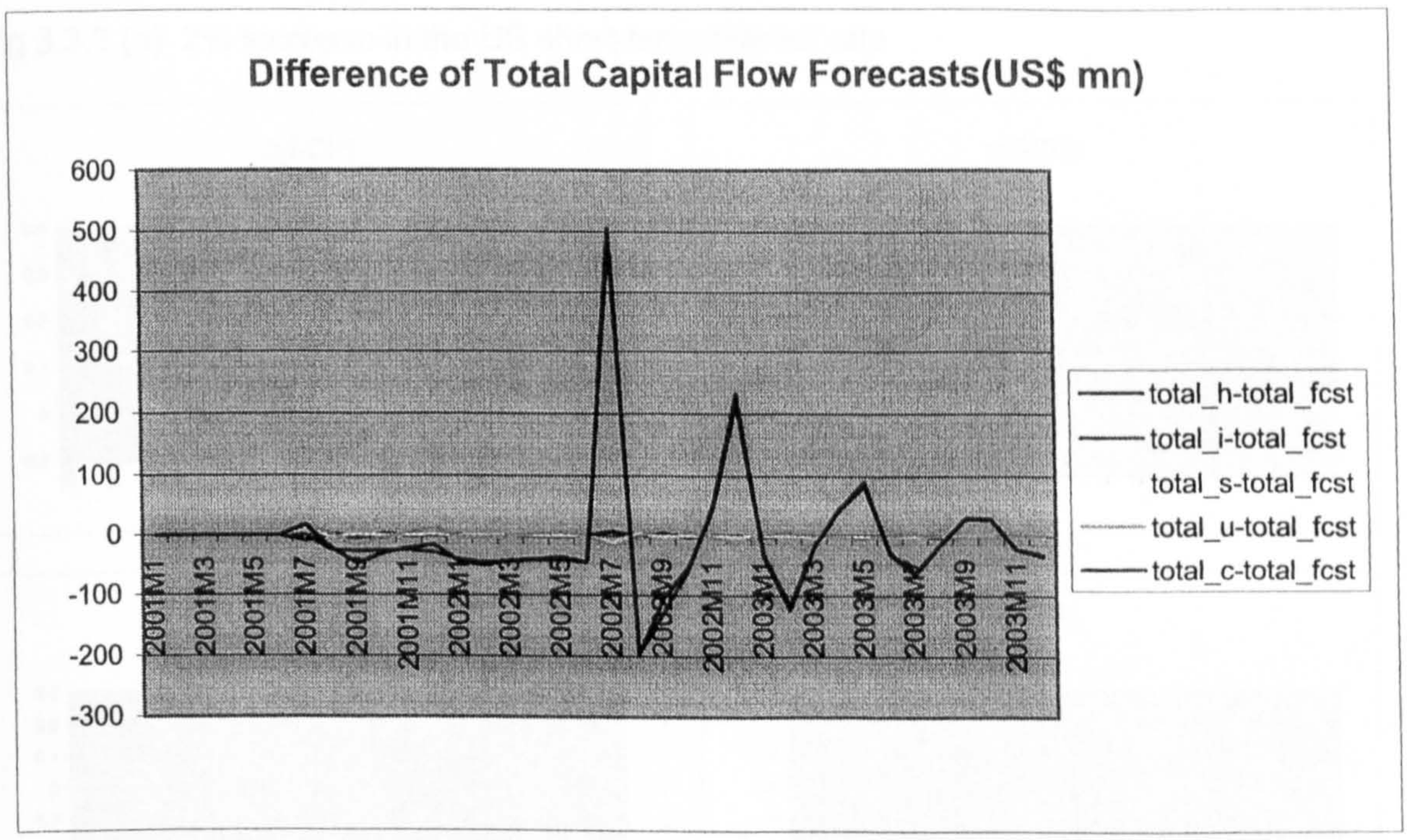






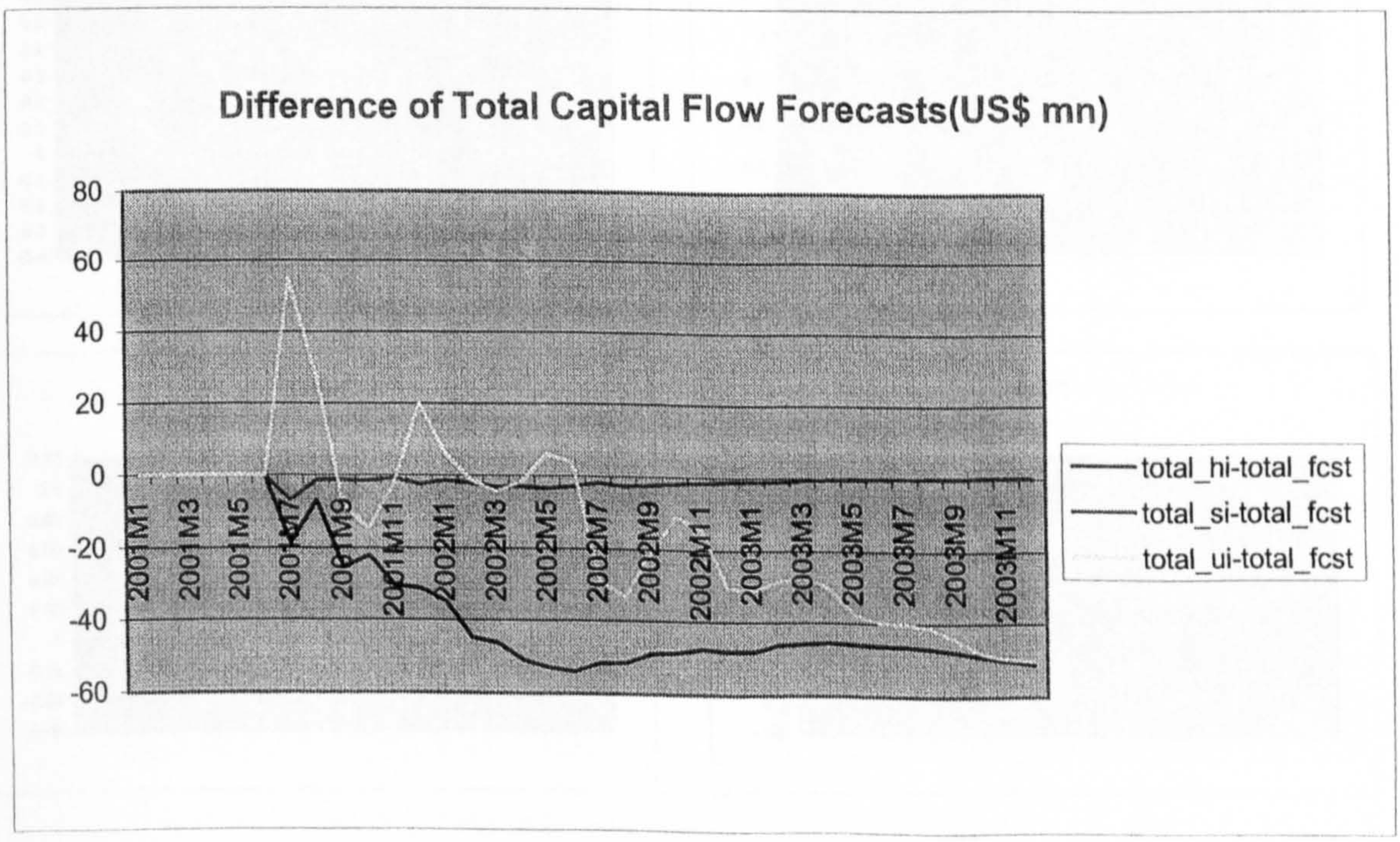
South Africa

Fig 3.3.1 Partial Derivatives Approach



* Above series indicate the forecast differences between the original and various low case scenarios.
For example "total_h-total_fcst" represent the forecast difference between the original (total_fcst) and the forecast under 60 b.p. higher US high yield bond spread (total_h) from July 2001 to June 2002.
The variables total_i, total_s, total_u, total_c represent forecast under flat US industrial production, 30b.p. higher swap rate, 2% increasease US interest rate and the combination of all low case senarios

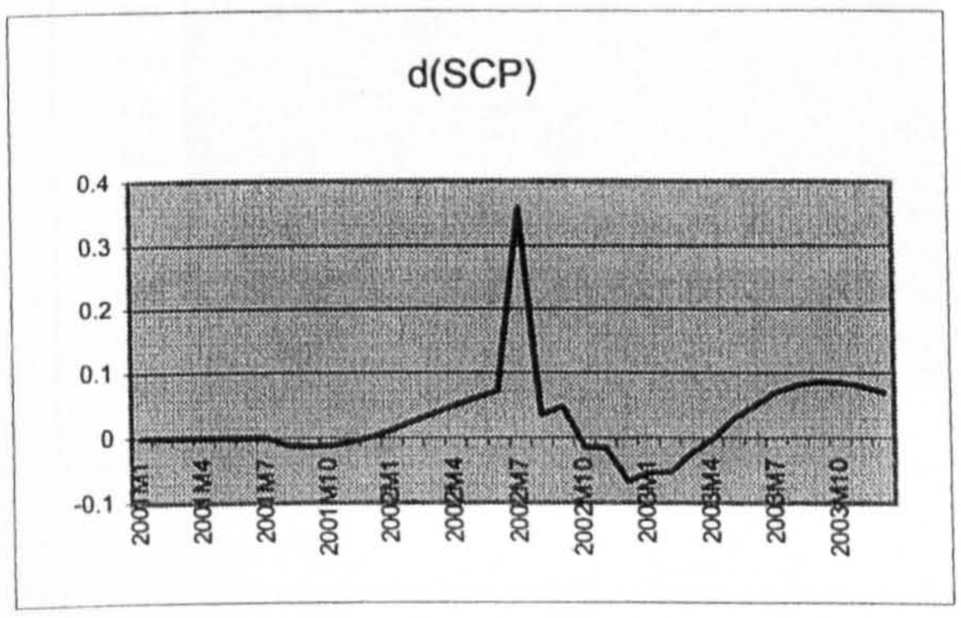
Fig 3.3.2 Integrated Approach

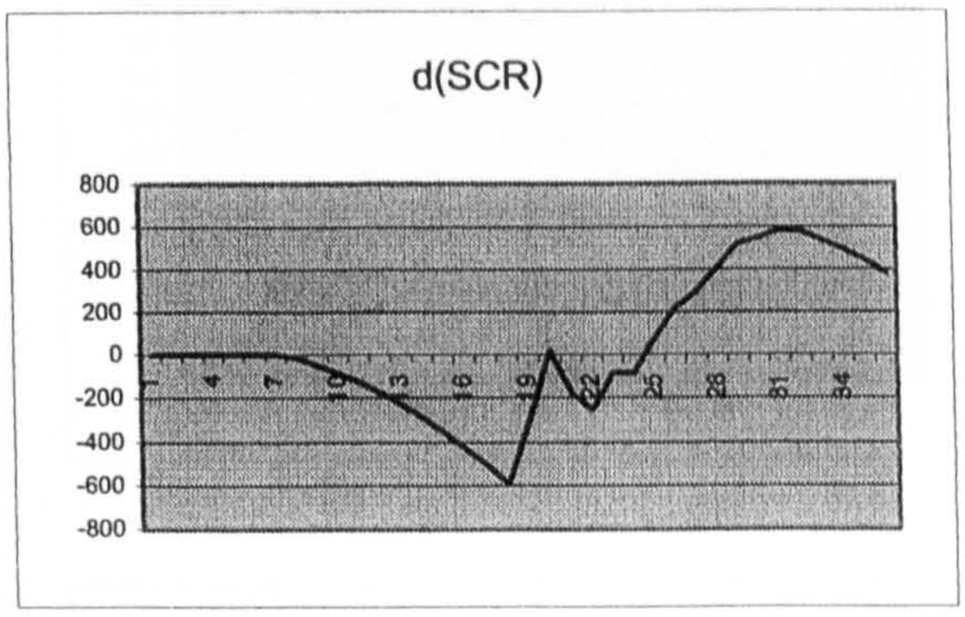


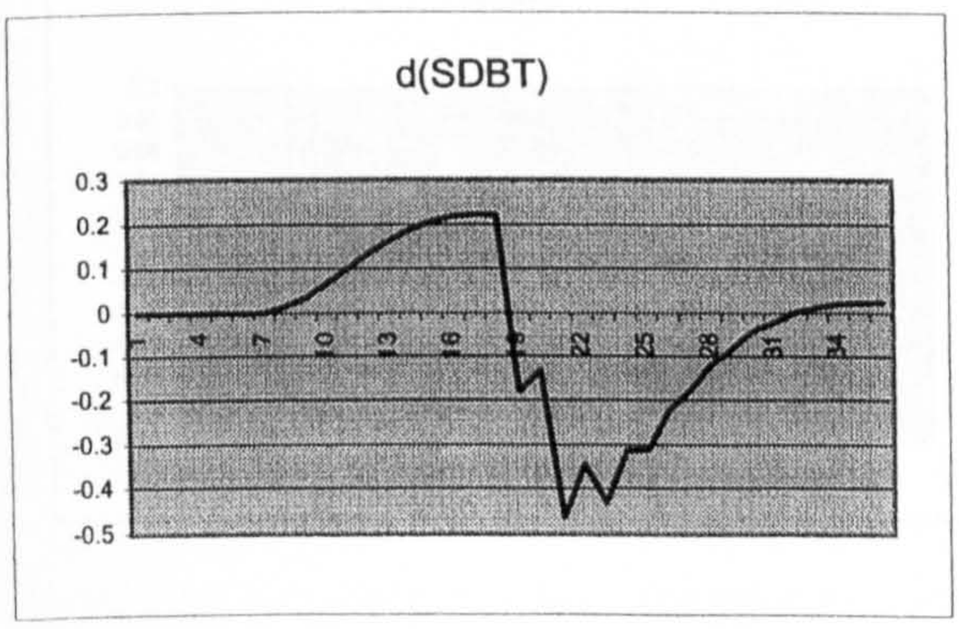
* Above series indicate differences between the original forecasts and the forecasts under integrated low case scenarios.
For example, "i" in "total_hi-total_cast" signifies that the series are forecasts under ingetrated low case scenarios.

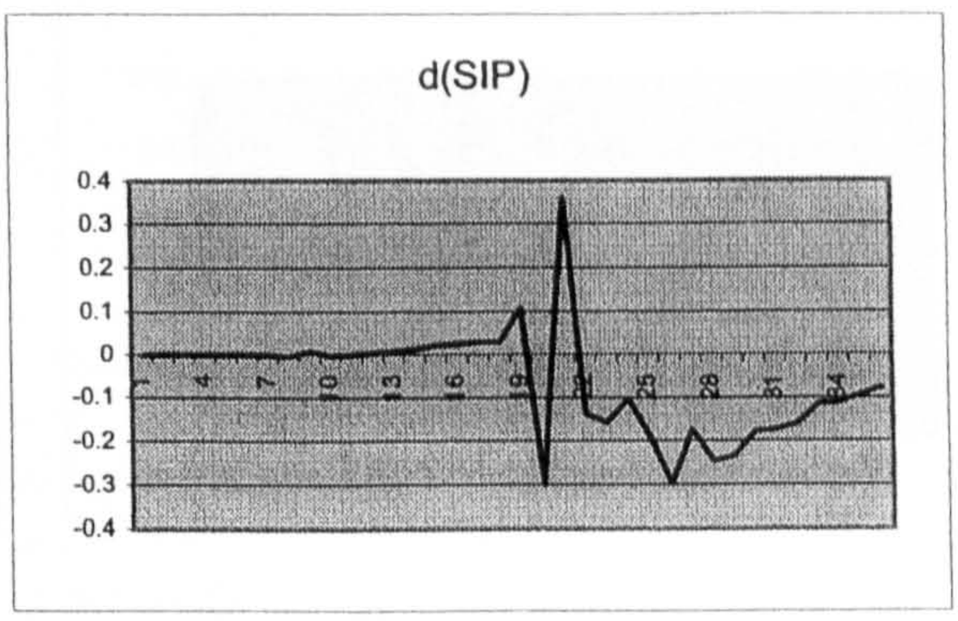
3.3.3 Changes in the Pull Factors under Partial Derivative Approach of Low Case Scenarios

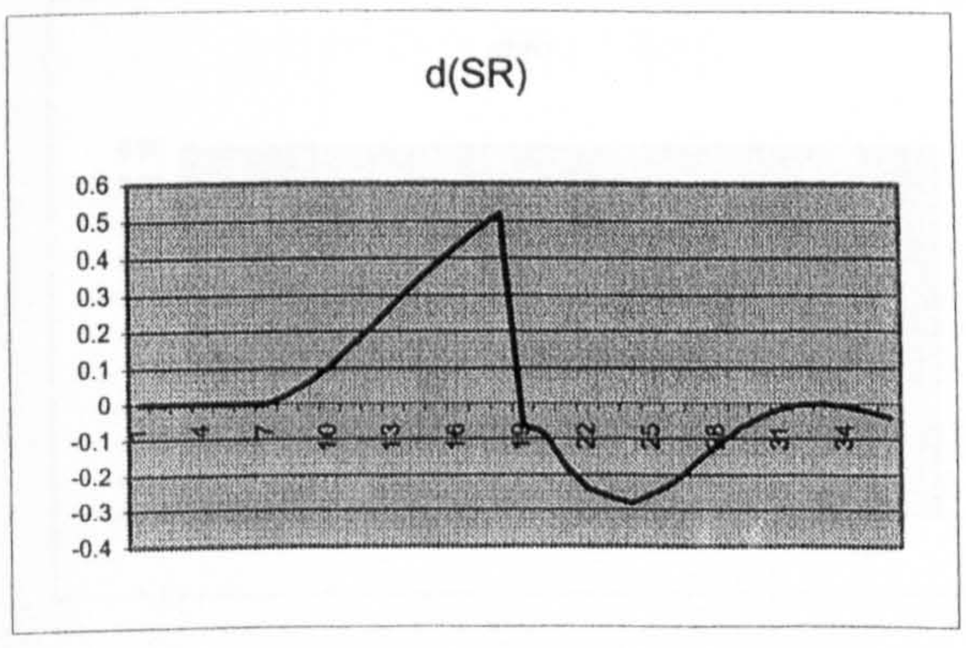
Fig 3.3.3 (a) 2% Increase in the US short-term interest rate

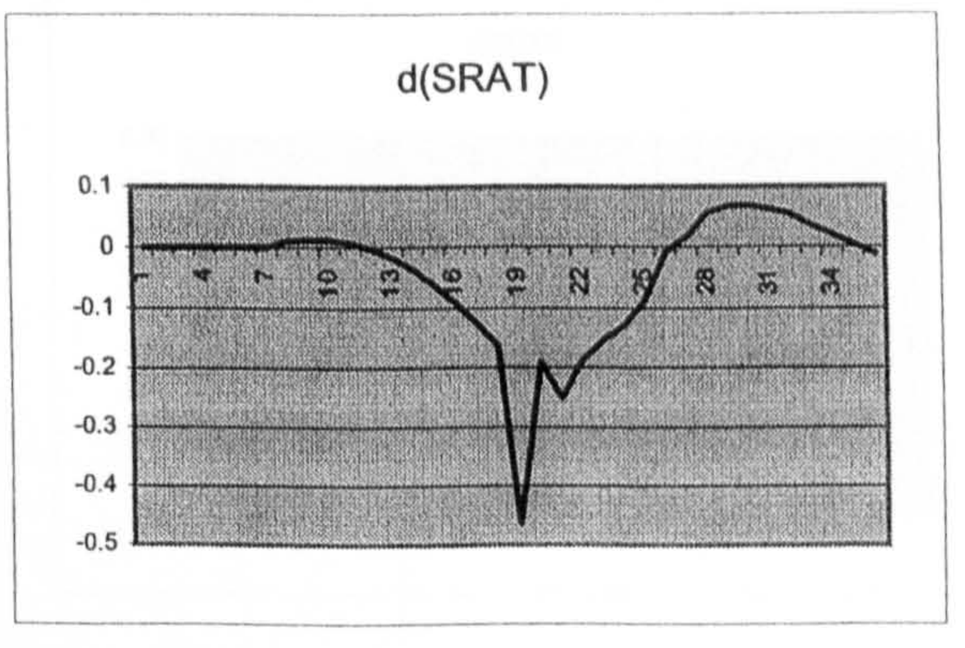


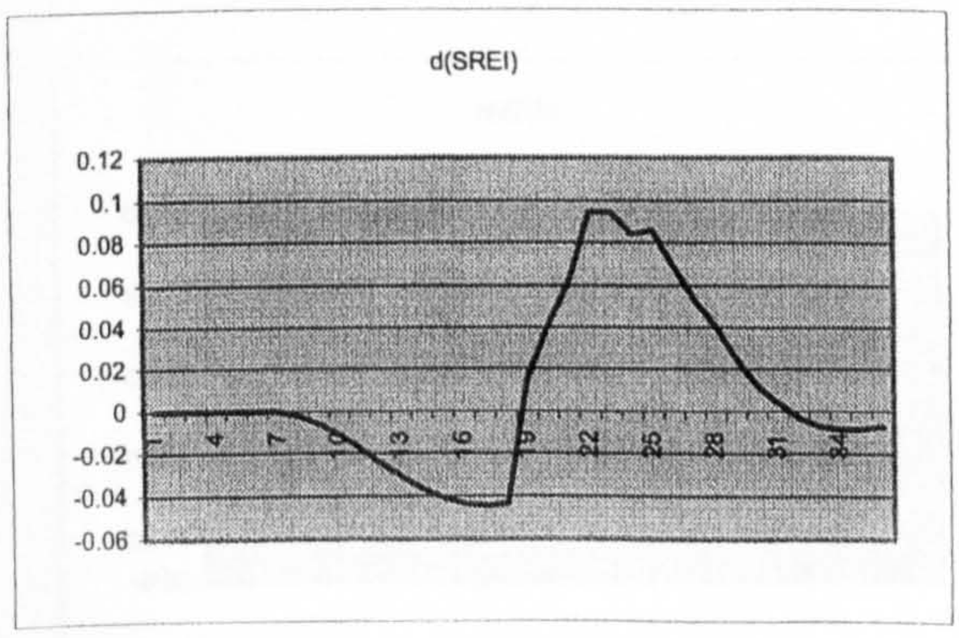


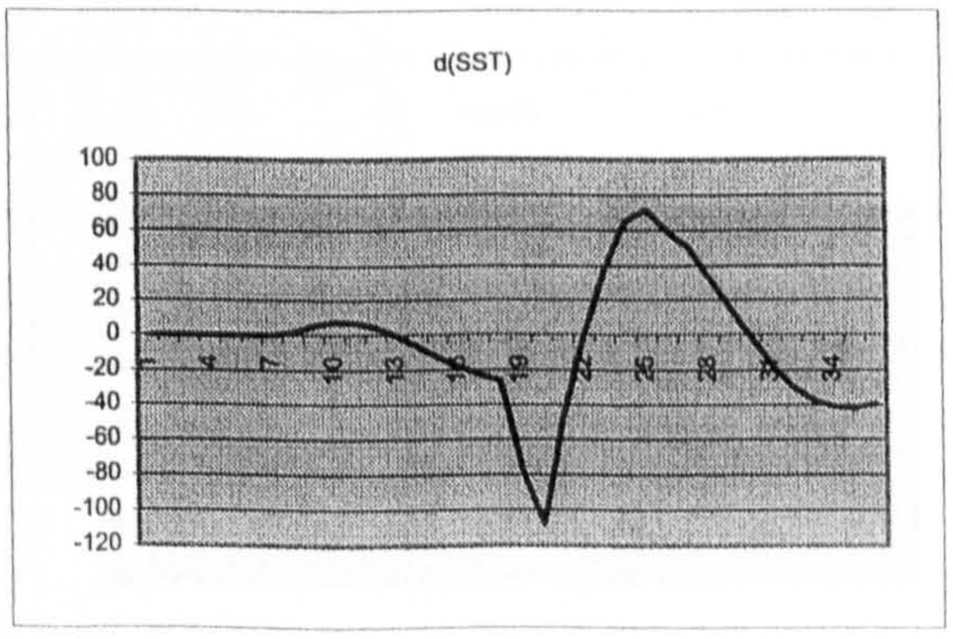






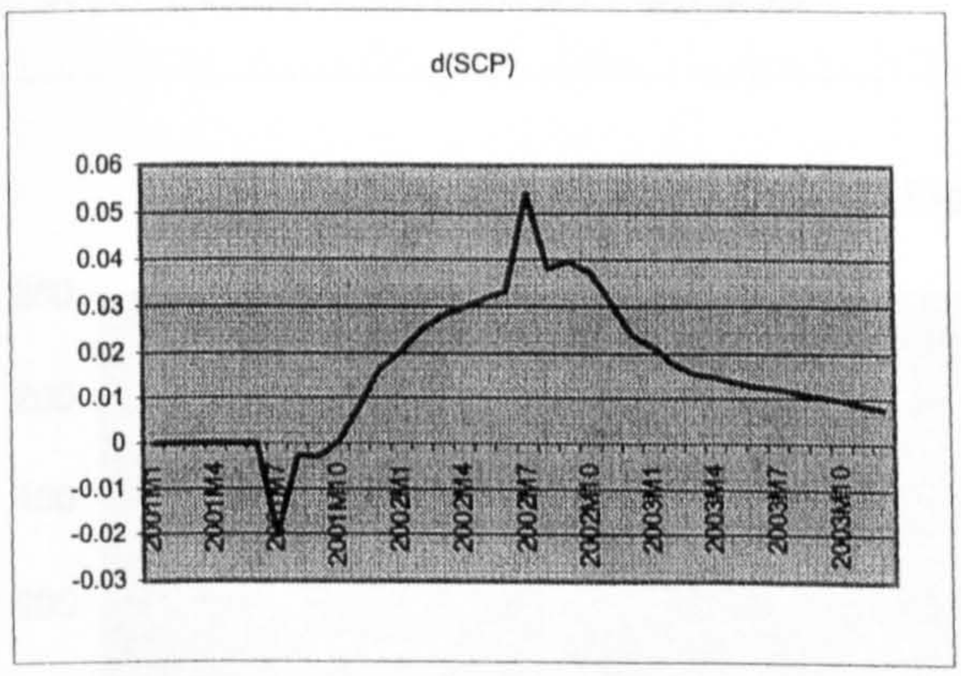


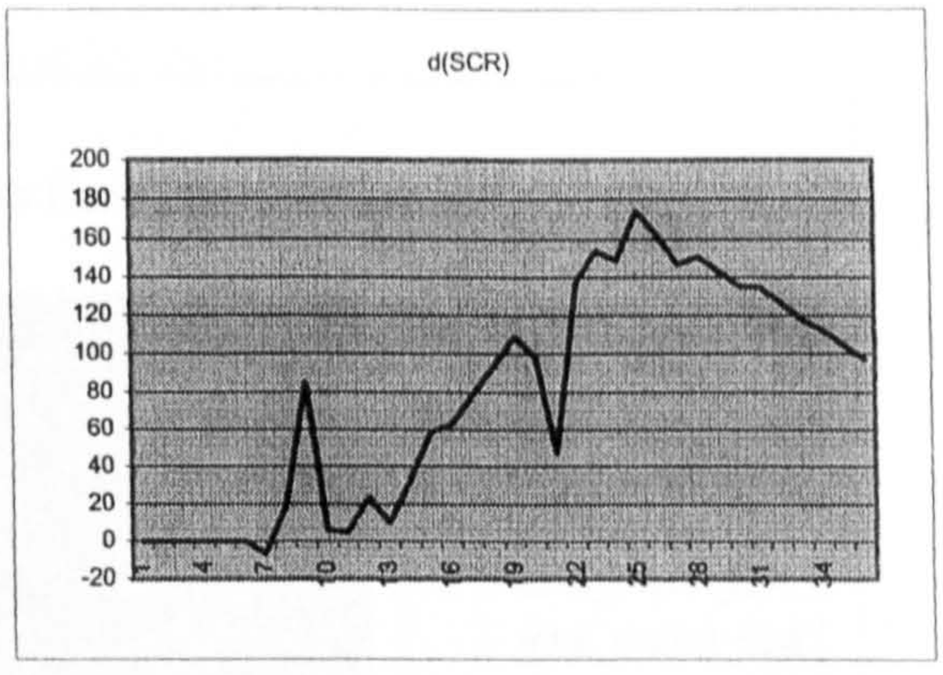


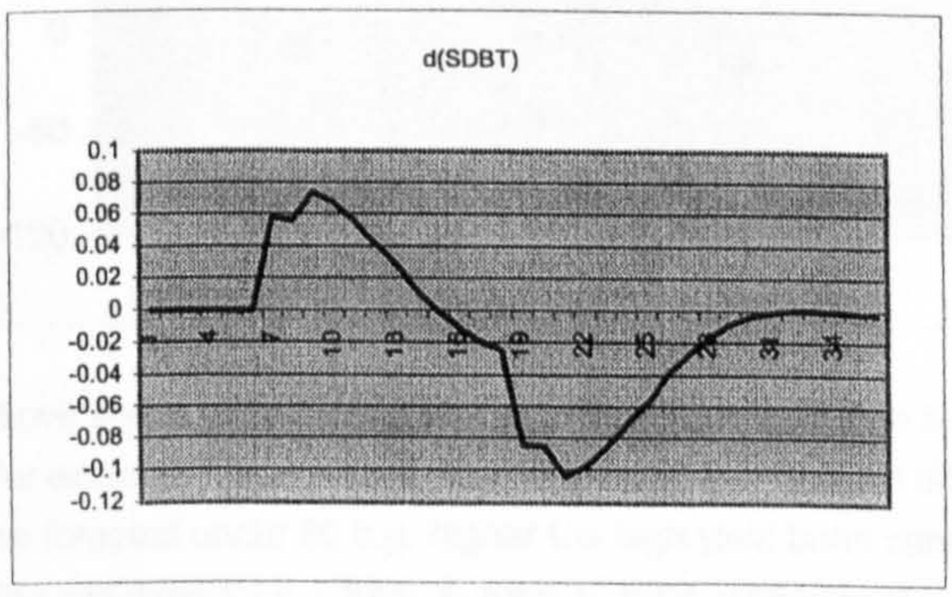


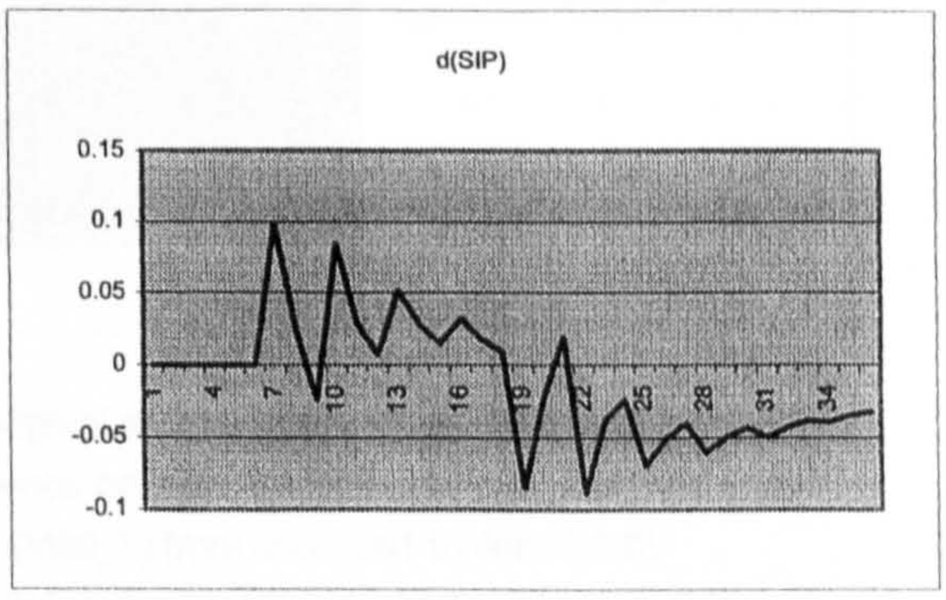
* The first letter of series represents the country, and the rest represent domestic pull factors. For example, CP, CR, DBT, IP, R, RAT, REI and ST represent CPI, domestic credit, short-term debt/reserve ratio, industrial production, short-term domestic interest rate, credit rating, reserve/import ratio and stock price index respectively.

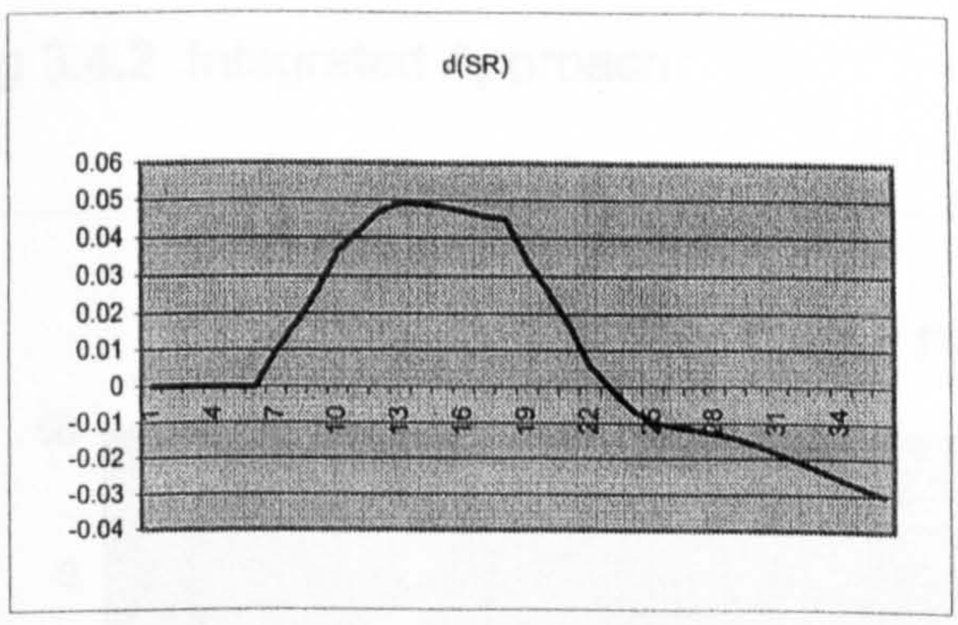
Fig 3.3.3 (b) 0% Growth in the US Industrial Production

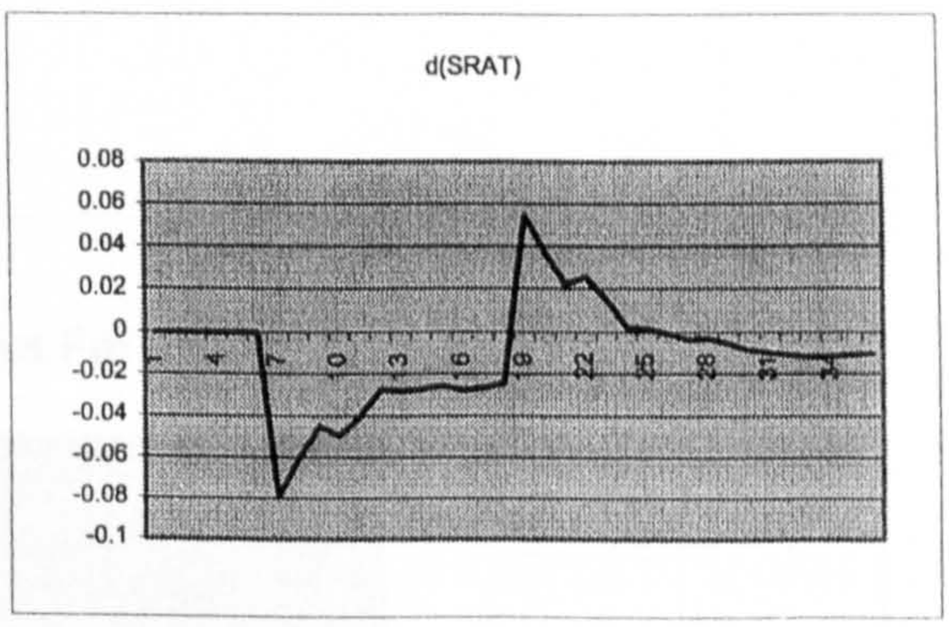


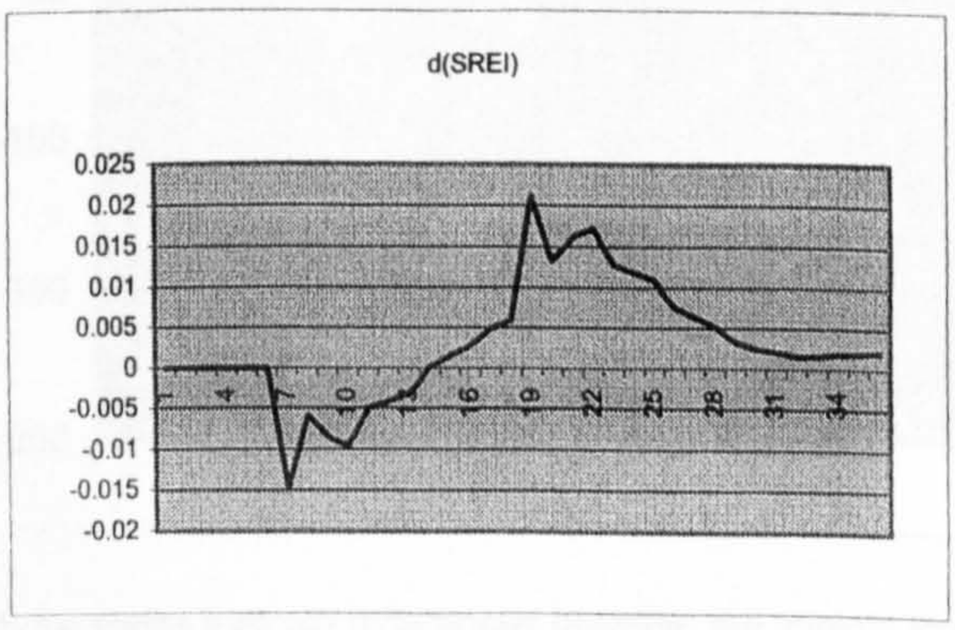












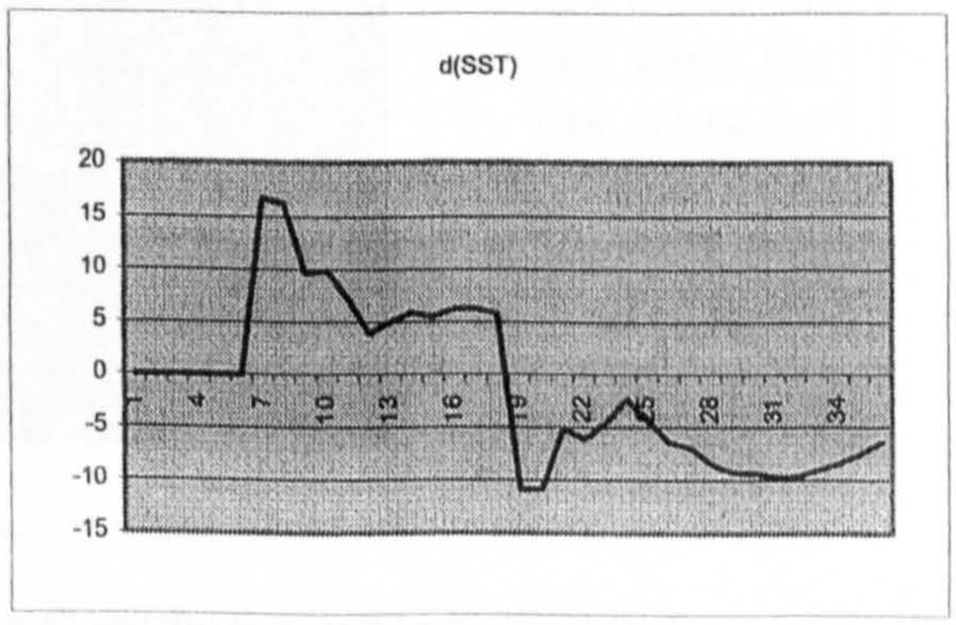
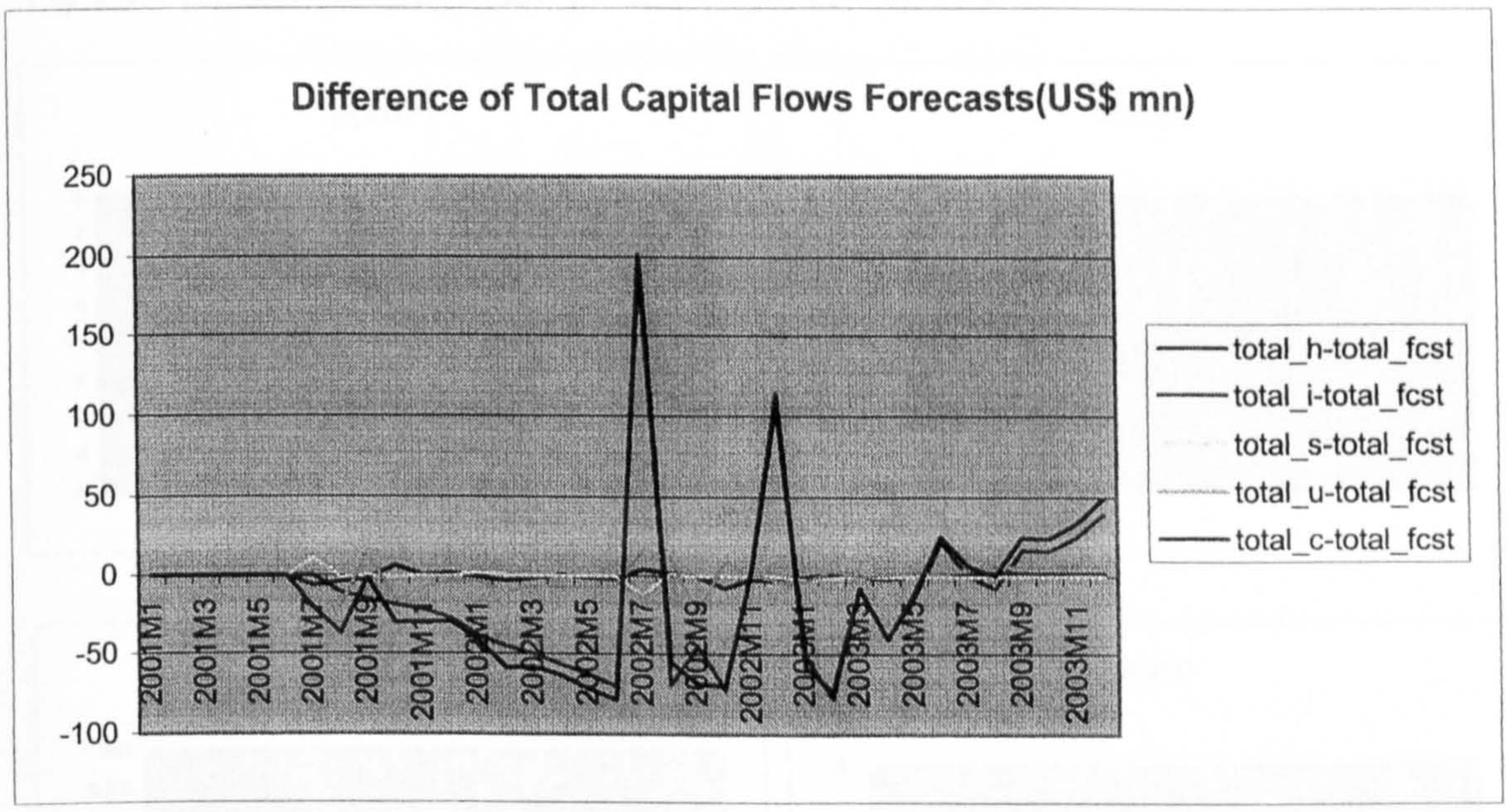


Figure 3.4-Venezuela 1

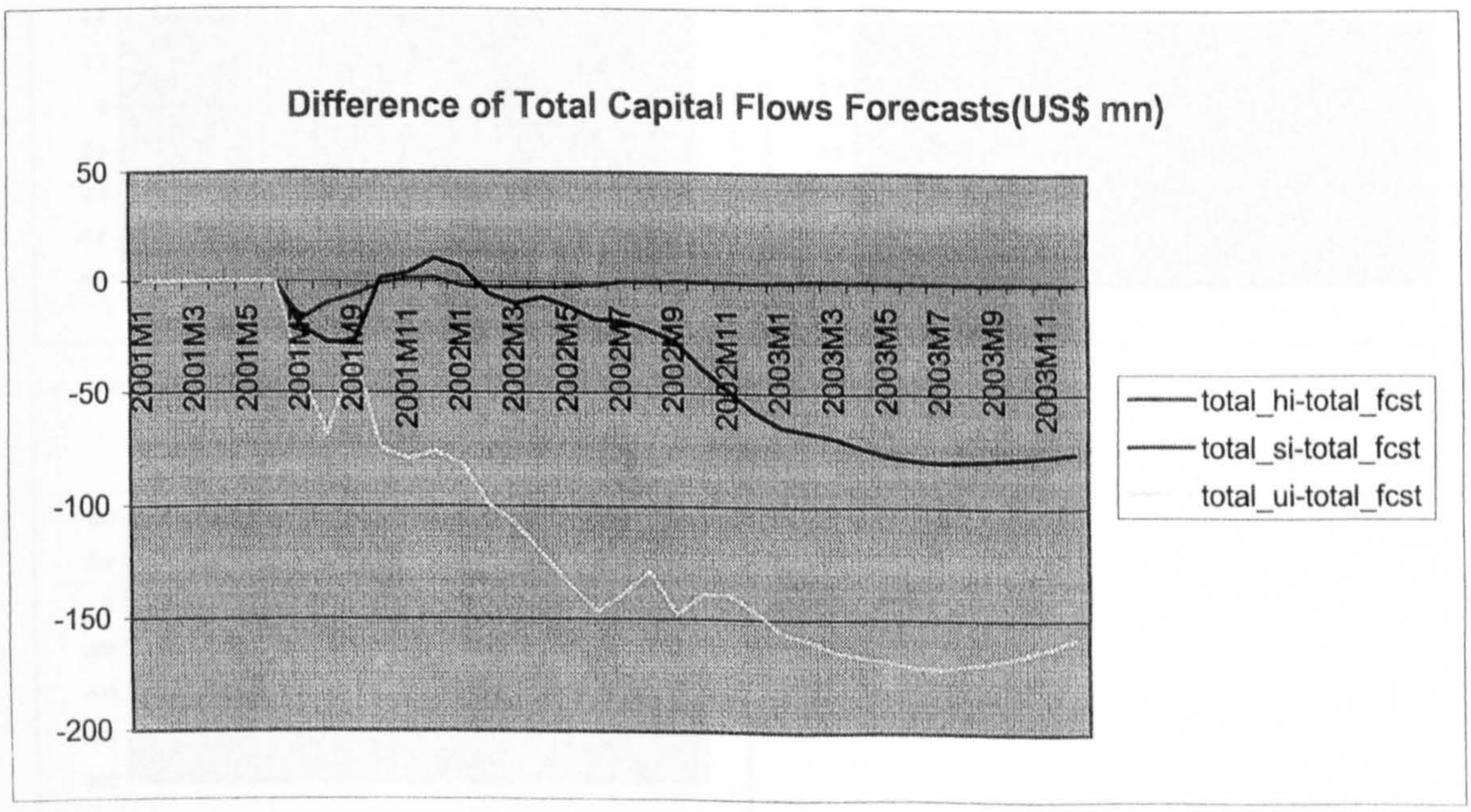
Venezuela

Fig 3.4.1 Partial Derivatives Approach



* Above series indicate the forecast differences between the original and various low case scenarios.
For example "total_h-total_fcst" represent the forecast difference between the original (total_fcst) and the forecast under 60 b.p. higher US high yield bond spread (total_h) from July 2001 to June 2002.
The variables total_i, total_s, total_u, total_c represent forecast under flat US industrial production, 30b.p. higher swap rate, 2% increasease US interest rate and the combination of all low case senarios

Fig 3.4.2 Integrated Approach

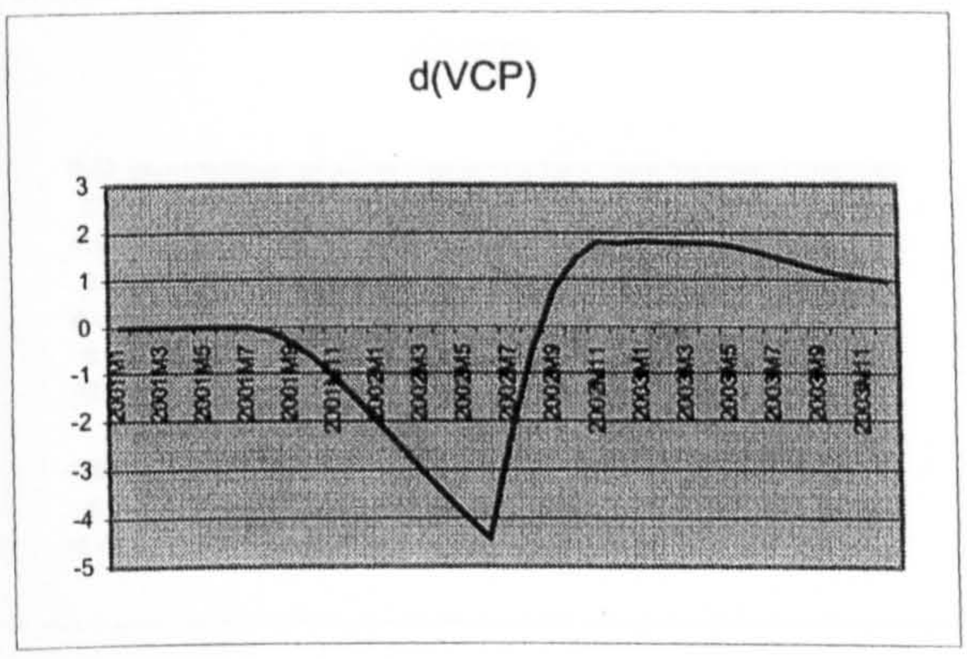


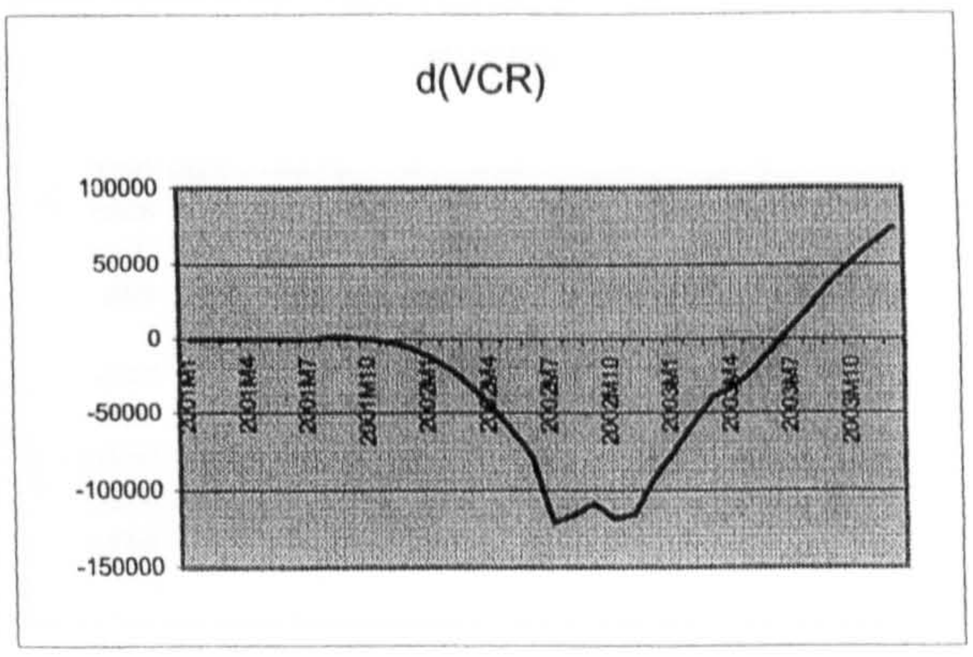
* Above series indicate differences between the original forecasts and the forecasts under integrated low case scenarios.
For example, "i" in "total_hi-total_cast" signifies that the series are forecasts under ingetrated low case scenarios.

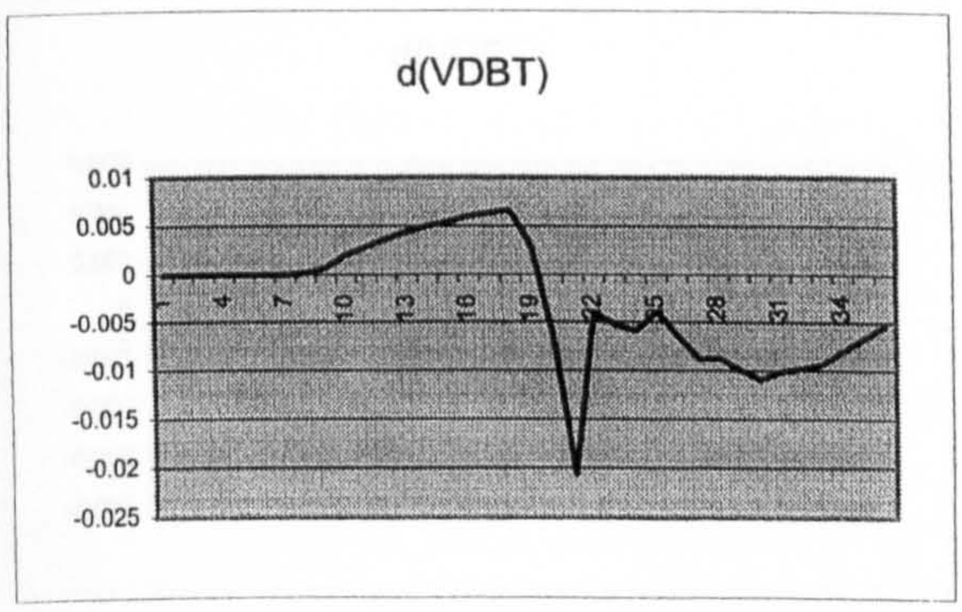
Figure 3.4-Venezuela 2

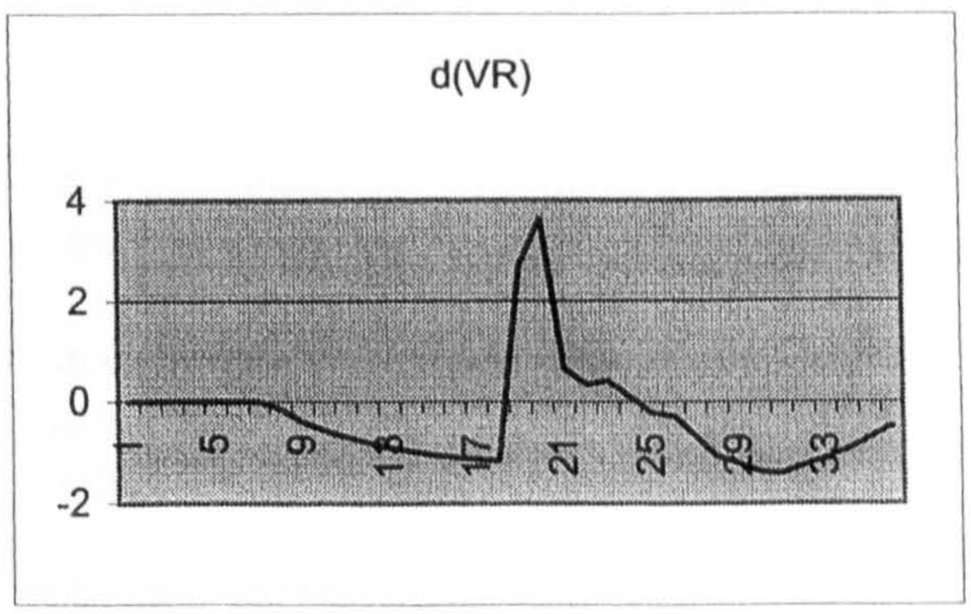
3.4.3 Changes in the Pull Factors under Partial Derivative Approach of Low Case Scenarios

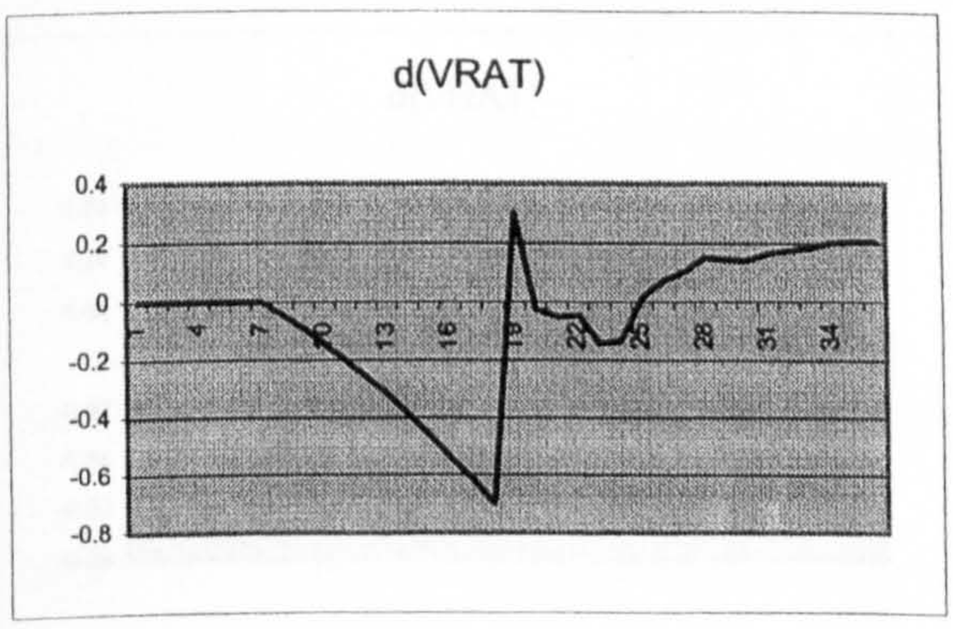
Fig 3.4.3 (a) 2% Increase in the US short-term interest rate

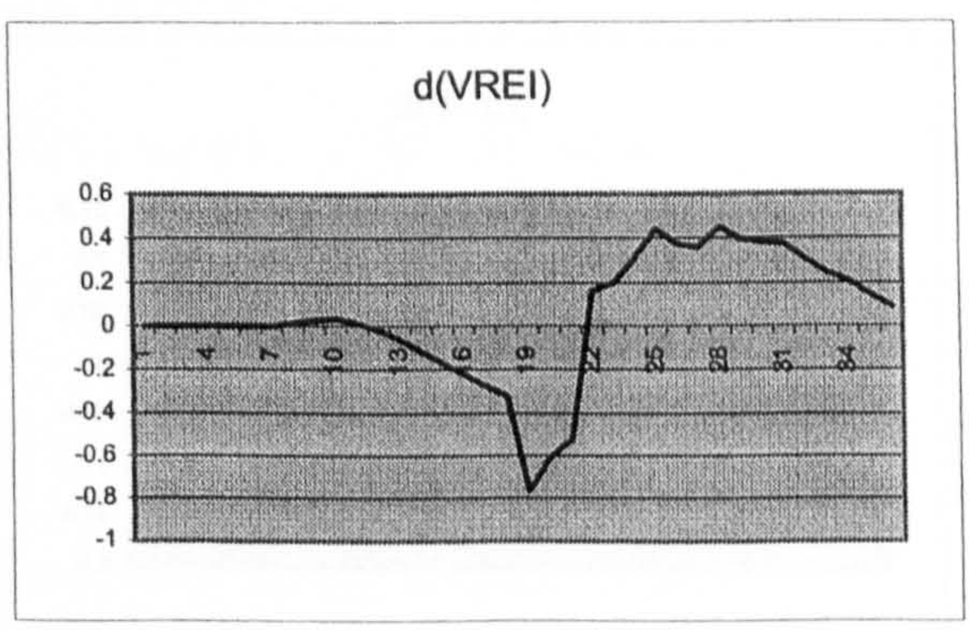


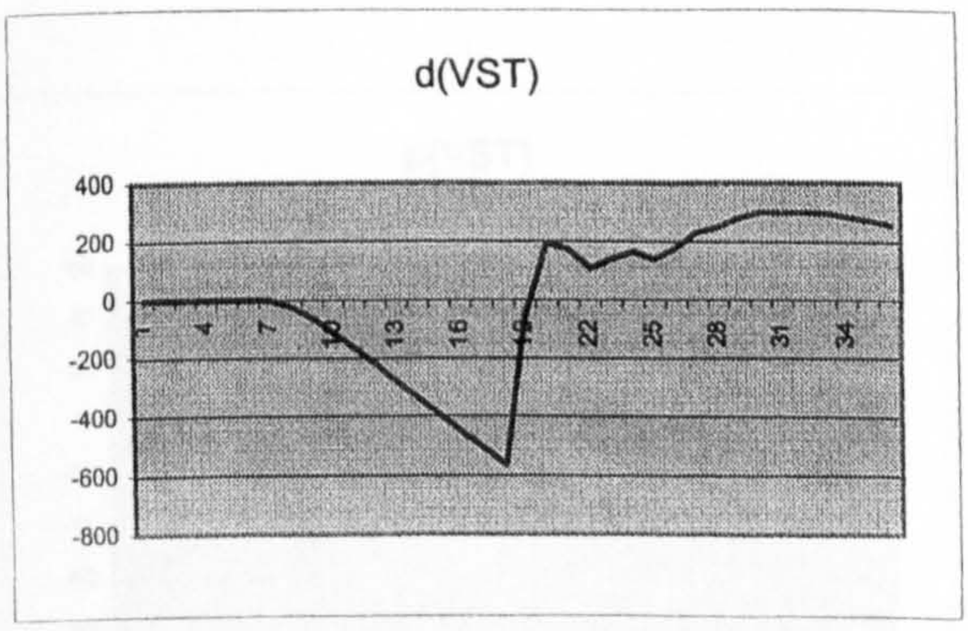








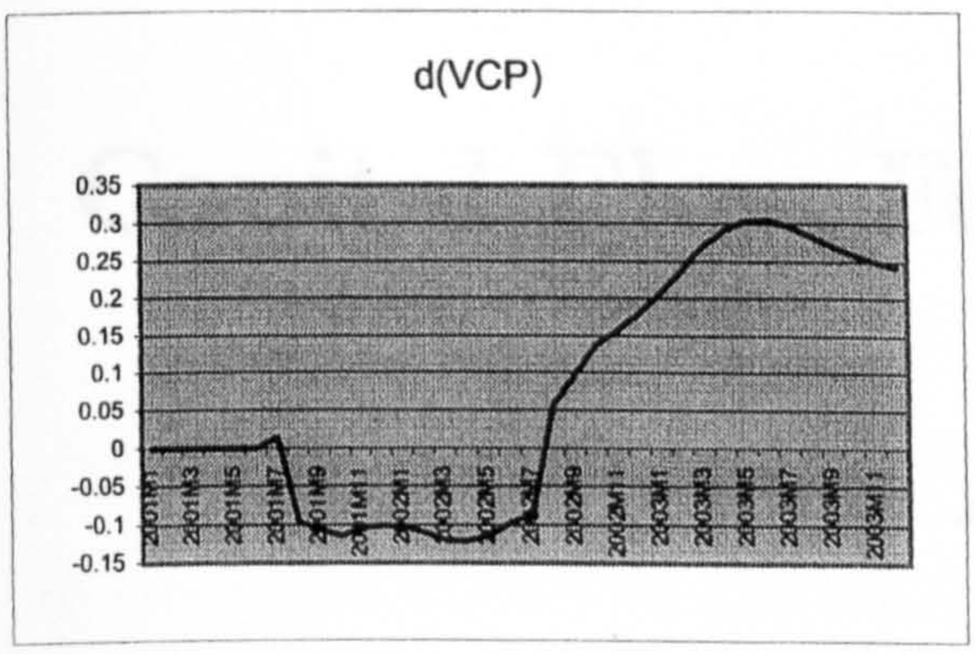


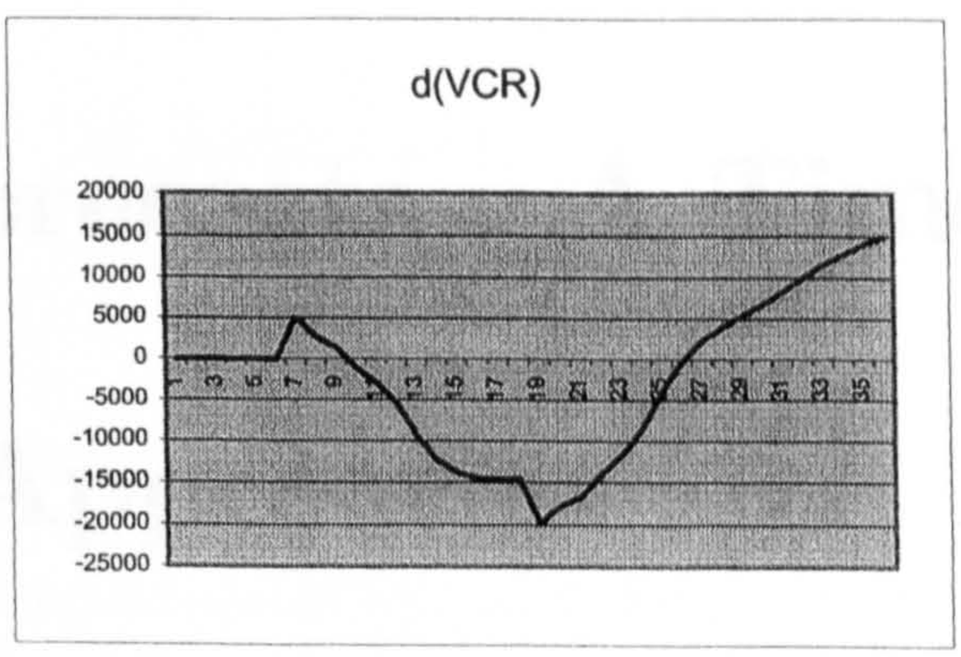


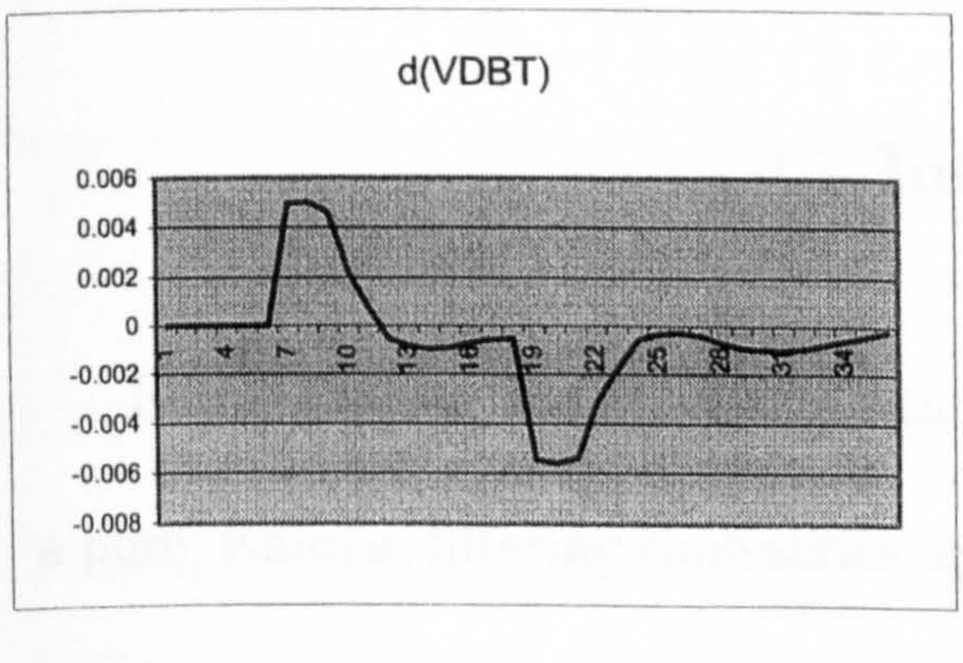
* The first letter of series represents the country, and the rest represent domestic pull factors. For example, CP, CR, DBT, IP, R, RAT, REI and ST represent CPI, domestic credit, short-term debt/reserve ratio, industrial production, short-term domestic interest rate, credit rating, reserve/import ratio and stock price index respectively.

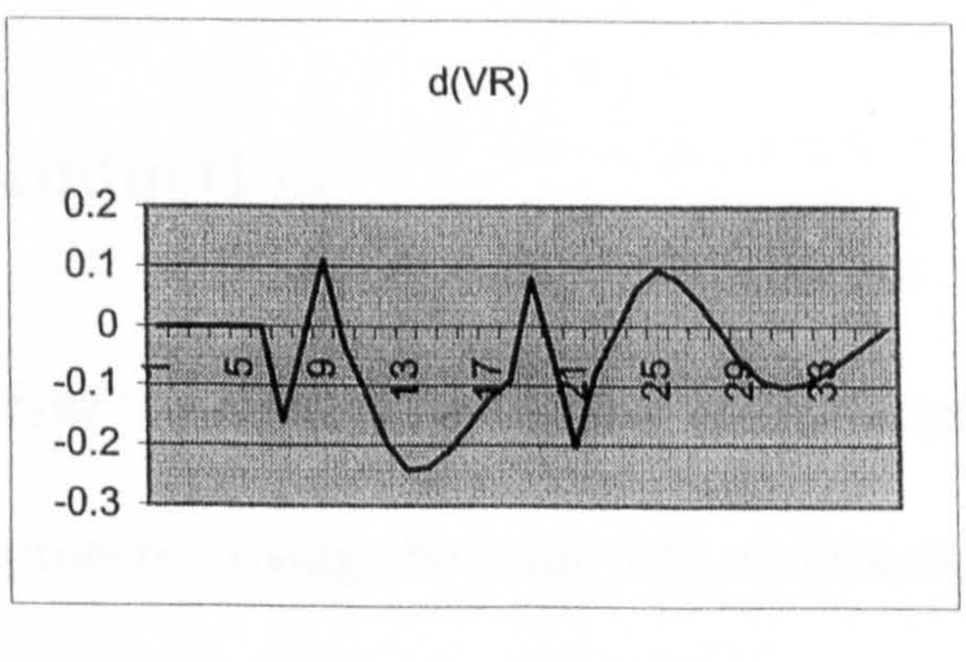
Figure 3.4-Venezuela 3

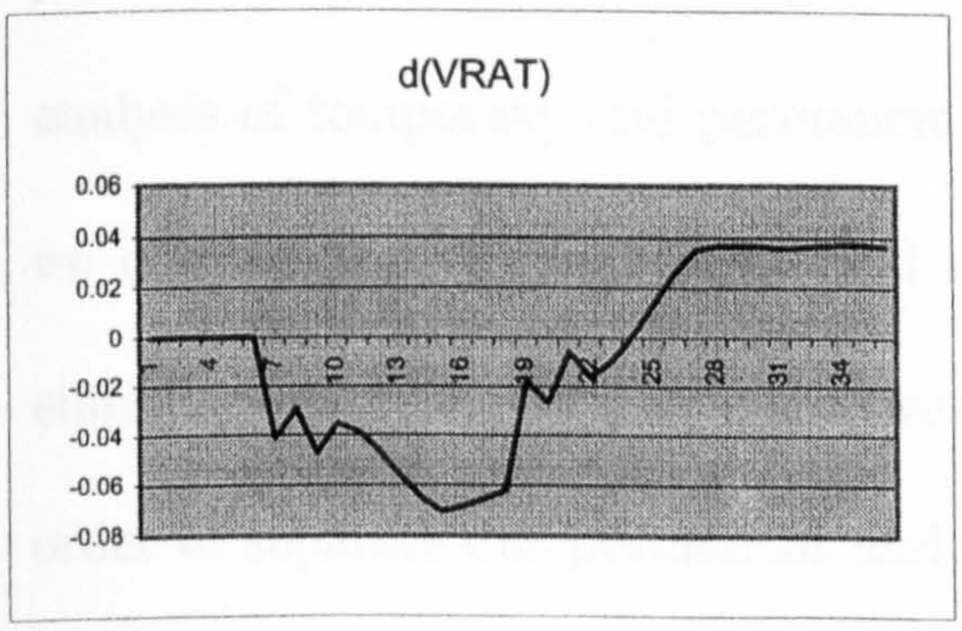
Fig 3.4.3 (b) 0% Growth in the US Industrial Production

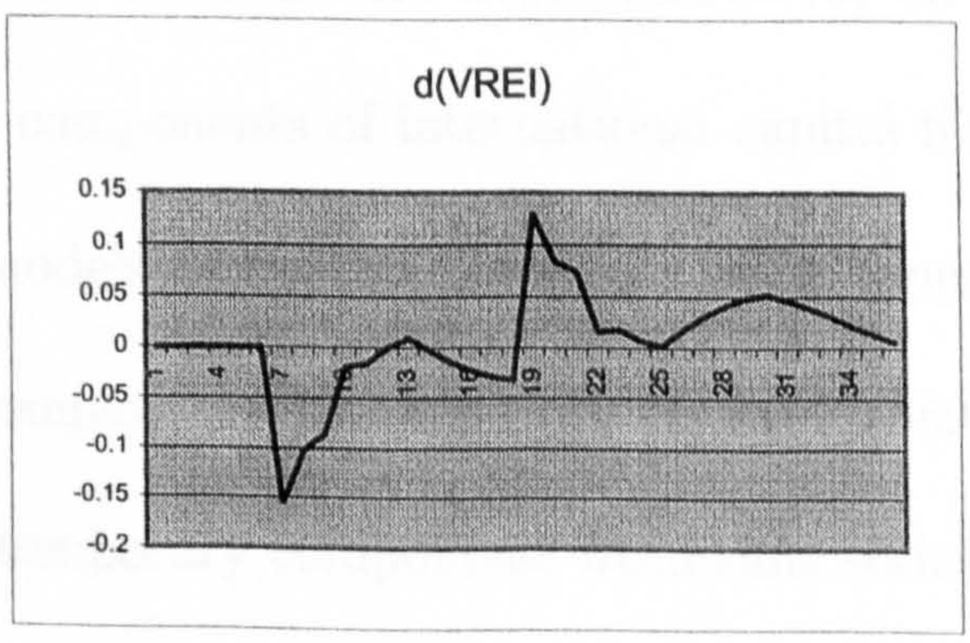


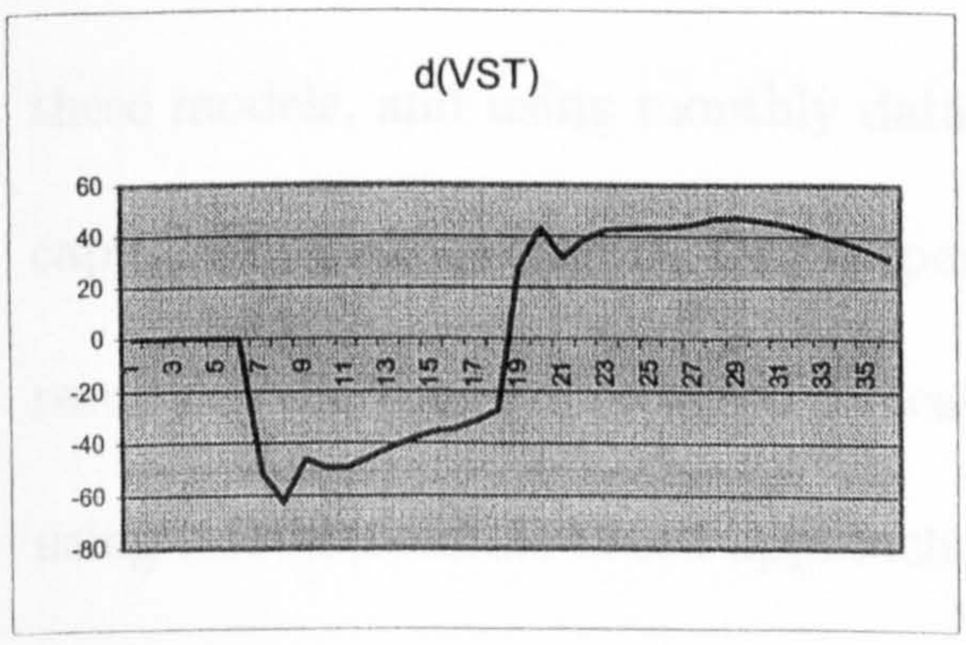












Chapter 4

Capital Flow Forecasts : A Time Series Approach

4.1 Introduction

In this chapter, we provide capital flow forecasts to developing countries using a pure, Kalman filtering time-series approach. Using the same sets of data as the previous chapter and extending the work of Sarno and Taylor(1999 a,b) on the analysis of temporary and permanent components of international capital flows, we develop and estimate statistical models of capital flows to a wide range of emerging markets. In particular, we employ the Kalman filter (Harvey 1989) in order to separate out permanent and temporary components from time series for flows of bond, equity and syndicated loans to 32 emerging markets. Based on these models, and using monthly data up to December 2000, forecasts of various capital flows are presented for the period January 2001 to December 2003. The results of the time series based forecasts are then compared with those obtained using a fundamentals-based approach.

4.2 Modelling and Forecasting Capital Flows to Developing Countries : Time Series Approach

4.2.1 Time Series Approach

Papers such as Claessens et al.(1995) and Sarno and Taylor (1999a,b) have taken a time series approach by estimating statistical models of capital flows that are designed to capture the intrinsic characteristics of series for various categories of capital flows to developing countries without explicit reference to underlying economic determinants. The essential idea is to break the time series down into unobserved permanent and temporary components using maximum likelihood Kalman filtering methods. Consider a panel data set of N countries with capital flows of a certain category for the ith country at time t generically denoted f_{it}. The unobserved components model may be written

$$f_{it} = \mu_{it} + \upsilon_{it} + \epsilon_{it}, \quad i = 1, ..., N; \; t = 1, ..., T \tag{4.1}$$

where f_{it} may be any of the capital-account items such as bond, equity or loan flows, and μ_{it} is a trend component, the irregular component. ϵ_{it} is approximately normally independently distributed with zero mean and constant variance, and υ_{it} represents a first-order autoregressive, AR(1) component:

$$\upsilon_{it} = \rho_{\upsilon i}\upsilon_{it-1} + \xi_{it} \tag{4.2}$$

where ξ_{it} is approximately normally independently distributed with zero mean and constant variance, and the autoregressive coefficient is constrained to be less than unity in absolute value in order to ensure stationarity of the component.

The stochastic trend component is modelled as:

$$\mu_{it} = \mu_{it-1} + \beta_{it-1} - \eta_{it} \tag{4.3}$$

and

$$\beta_{it} = \rho_{\beta i}\beta_{it-1} + \zeta_{it} \tag{4.4}$$

where β_{it} represents the slope of gradient of the trend component μ_{it} and $\rho_{\beta i}$ represents the damping factor, while each of the disturbances η_{it} and ζ_{it} is assumed to be approximately normally independently distributed with zero mean and constant variance.

The irregular component, ε_{it}, the level disturbance η_{it} and the slope disturbance ζ_{it} are mutually uncorrelated. The slope component may be treated as fixed rather than stochastic and also be excluded from the trend specification when this is appropriate.

Intuitively, the above equations express the capital flow as the sum of a permanent component (μ_{it}), a purely temporary and zero persistence component (ε_{it}), and a more slowly decaying temporary component (υ_{it}). In addition, the drift in the random walk component (β_{it}) may itself vary over time. Thus the model sep-

arates out the persistent and temporary components of the data in a very general, comprehensive and intuitive fashion.

It should be clear that the unobservable components model is 'non-standard' in the sense that one cannot apply least squares estimation directly to the above equations. The statistical treatment of the unobserved components model outlined above may be conveniently handled, however, by writing it in state space form, involving a measurement equation relating the unobserved components (the state vector) to an observed series, together with a transition equation governing the evolution of the state vector. The state-space parameters can then be estimated by maximum likelihood Kalman filtering methods (Harvey, 1989; Cuthbertson et al., 1992). The estimated hyperparameters (i.e. the variance parameters) indicate the relative contribution of each component in the state vector to explaining the total variation in the time series under consideration. In some sense, therefore, the estimated variances allow us – by providing information on the size of the nonstationary and the stationary components in the series – to quantify the degree of persistence of the series in question.

The modelling and forecasting procedures are essentially a general-to-specific procedure where we start from the most general unobserved components model equations 4.1 - 4.4 and test down by imposing exclusion restrictions on the parameters found to be statistically insignificant at conventional nominal levels of significance. In choosing the most appropriate model for each country's bond[1],

[1]International bond issues by all (private, public and secondary) borrowers in the given

equity[2] and syndicated loan[3] flows, we rely on the coefficient of determination and on the Akaike information criterion (Harvey, 1989, pp 263-270). Based on the chosen model, out-of-sample forecasts are derived for periods up to December 2003. In Table 4.1, we classify the various model specifications which were selected for capital flows to our set of developing countries on the basis of the goodness of fit criteria discussed above. In Tables 4.2 - 4.4, we report the results of estimating the most appropriate structural time series model in state space form by Kalman filter maximum likelihood methods for each of the capital inflows series examined. In the second and third columns of these tables we report details of the unobserved components included in the estimated structural time series model. In the fourth column we report the estimated standard deviations of the disturbances of the stochastic components included in the state and in parentheses we report the Q-ratios–i.e. the ratios of each estimated standard deviation to the largest standard deviation across components–for each model, which indicates the relative statistical importance of the components. In the last three columns we report the estimated AR(1) coefficient (the damping factor ρ_v), which provides evidence on the degree of persistence of the stationary AR(1) component of the model, the coefficient of determination (which can be regarded as quite high for all of the estimated models), and the p-value from Ljung-Box

country, excluding cancelled issues. These include eurobonds, global bonds and foreign bonds

[2]International equity issues in the international capital markets by all borrowers in the given country.

[3]Publicly announced syndicated loans to all borrowers (public and private).

test statistics of the hypothesis of no serial correlation in the residuals. In Table 4.5, the results of time series based approach forecasts are summarised for bond, equity and syndicated loan flows to 32 developing countries.

Table 4.1: Restricted structural time-series models adopted in modelling capital flows

Model 1: Stochastic level (fixed slope) + AR(1) + irregular component

$$[\sigma_\zeta^2 = 0]$$

$$f_t = \mu_t + \upsilon_t + \epsilon_t$$

$$\mu_t = \mu_{t-1} + \beta + \eta_t$$

$$\nu_t = \rho_\upsilon \upsilon_{t-1} + \xi_t \qquad | \rho_\upsilon | < 1$$

Model 2: Stochastic level (no slope) + AR(1) + irregular component

$$[\sigma_\zeta^2 = 0, \rho_\beta = 0]$$

$$f_t = \mu_t + \upsilon_t + \epsilon_t$$

$$\mu_t = \mu_{t-1} + \eta_t$$

$$\nu_t = \rho_\upsilon \upsilon_{t-1} + \xi_t \qquad | \rho_\upsilon | < 1$$

Model 3: Stochastic level (no slope) + AR(1)

$$[\sigma_\zeta^2 = 0, \rho_\beta = 0, \sigma_\epsilon^2 = 0]$$

$$f_t = \mu_t + \upsilon_t$$

$$\mu_t = \mu_{t-1} + \eta_t$$

$$\nu_t = \rho_\upsilon \upsilon_{t-1} + \xi_t \qquad | \rho_\upsilon | < 1$$

Model 4: Stochastic level (no slope) + irregular component

$$[\sigma_\zeta^2 = 0,\ \rho_\beta = 0,\ \sigma_\epsilon^2 = 0,\ \rho_v = 0]$$

$$f_t = \mu_t + \upsilon_t + \epsilon_t$$

$$\mu_t = \mu_{t-1} + \eta_t$$

Model 5: Stochastic level (fixed slope) + AR(1)$[\sigma_\zeta^2 = 0,\ \sigma_\epsilon^2 = 0]$

$$f_t = \mu_t + \upsilon_t + \epsilon_t$$

$$\mu_t = \mu_{t-1} + \beta + \eta_t$$

$$\nu_t = \rho_v \upsilon_{t-1} + \xi_t \qquad | \rho_v | < 1$$

Model 6: Stochastic level (fixed slope) + irregular component

$$[\sigma_\zeta^2 = 0,\ \sigma_\xi^2 = 0,\ \rho_v = 0]$$

$$f_t = \mu_t + \upsilon_t + \epsilon_t$$

$$\mu_t = \mu_{t-1} + \beta + \eta_t$$

4.2.2 Estimation Results

Tables 4.2 - 4.4, show that for all countries, the largest variance of the disturbance is always one of the stationary components in the state vector, either in the irregular or the AR(1) component. For Korean bond flows, for example, model 3 was arrived at after our general-to-specific approach. This is a structural model of the form: $f_t = \mu_t + \upsilon_t$ with $\mu_t = \mu_{t-1} + \eta_t$, and $\nu_t = \rho_v \upsilon_{t-1} + \xi_t$, $| \rho_v | < 1$ so that bond flows to Korea are seen to have both a permanent component (μ_t) and

AR(1) component (ν_t). The standard deviation of the AR(1) component (σ_ν) is more than five times the standard deviation of the innovation to the permanent component (σ_η), indicating the dominance of the more temporary component over the permanent component in explaining the variation of flows. In Table 4.2, this shows up as a Q-ratio for the AR(1) component of 1.0 (since it is the largest component) and a Q-ratio for the permanent component (or level) of 0.183. This indicates that although there is a permanent component in Korean bond inflows, it is dominated by a more temporary, AR(1) component. In 75-80% of the flows, the largest parameter is the variance of the disturbance of the irregular component which has no persistence at all.(Model 4 or Model 6) In the remainder of the cases, such as bond flows to Korea as indicated above, the AR(1) parameter has the largest variance, which implies some slight degree of persistence The Q-ratios for the stochastic level (μ_t) are very low, suggesting that the contribution of the nonstationary, more persistent, component in explaining the variance of equity and bond flows is extremely low, whereas more temporary components (such as ν_t and ξ_t) are, by contrast, very large. Nevertheless, the stochastic levels are always found to be statistically significantly different from zero at conventional nominal levels of significance, as implied by the estimated coefficients of the final state vector and the corresponding root mean square errors for the nonstationary stochastic component included in the estimated model.

The results from estimating the unobserved components model for bond, eq-

uity and syndicated loan flows to developing countries suggest that a statistically significant nonstationary permanent component is present in the data, but that this is generally very small in size, contributing very little to explaining variation in the series. Hence, one can visualise the capital flows as a long tube composed of two types of unobservable components, first the thin, thread-like permanent component in the centre, surrounded and covered by thick layers of temporary components that determine the magnitude (or thickness of the tube) and direction of capital flows. Countries that had received relatively large flows in the previous years were able to record such inflows due to the active temporary components in the flows. Inflows to these countries are expected to remain high if the temporary components continue to exert huge, positive effects.

4.3 Comparison of Capital Flow Forecasts : Time Series versus Fundamentals-based Approach

Summaries of the capital flow forecasts to developing countries are reported in Table 4.5. The results of capital flow analysis discussed above suggest that bond, equity and loan flows are characterized by a statistically significant but very small permanent components, and therefore are potentially susceptible to reversals (Sarno and Taylor, 1999a). Indeed, during the first year of the forecast, negative growth in capital inflows to emerging markets is anticipated. The Table 4.5 compares the capital flow forecast results under the time series and fundamen-

tals based (see chapter 3) approaches for the period 2001-2003. It is shown that forecasts of total capital flows to emerging markets under the time series approach is lower than that under the fundamentals based approach. Especially during the first year of the forecast, the time series based model projects a reversal of capital flows by -6%, where as the fundamentals based model projects continued growth of inflows by 14% into the region. This is largely due to the forecast differences in Latin America which comprise 38% of total capital flows to 32 emerging markets. Specifically, time series model predicts -6% growth in total capital inflows to Latin America whereas fundamental based model projects 23% increase in capital inflows. The time series model also produces lower flow forecasts for Asia, Eastern Europe, and Africa compared with the fundamental based model. For example, equity flows to Korea was projected at -13% growth in 2001 under the time series approach, whereas the fundamental based model predicted 7% increase. However, the relative percentage of inflows into each region over total capital inflows remain at similar level compared with 2000; 38% of total capital flows for Latin America, 51% for Asia, 3% for Eastern Europe, 2% for the Middle East and 5% for Africa. Total capital inflows are anticipated to resume to year 2000 level by 2003.

Note that the fundamentals-based approach, on the other hand, forecasts capital flows to emerging markets under the scenario that the US economy will experience a soft landing in 2001 to 2003. That is, the fundamental based forecasts

assume a slight slow down in the performance of the US economy (3-4% growth in the US. industrial production), combined with declines in US interest rates and moderation in the Emerging Market Bond Index. In our previous chapter, we conducted capital flow forecasts under the partial derivative approach of low case scenarios. The results of this exercise indicated that shocks to global financial variables had only minor effects, but a shock to a global real variable (0% growth in the US. industrial production) resulted in a substantial decline in capital inflows to emerging markets. The forecast results under the time series approach are indeed very similar to the fundamentals-based approach under the low case scenario of 0% US industrial production growth. The former projects -6% growth, where as the latter predicts -5.2% growth in 2001. The fundamentals-based approach forecast with 0% US industrial production and 2% lower US short term interest rate gave similar results. Therefore, the positive projection of capital flows under the fundamentals-based approach compared to that under the time series approach can partially be attributed to the assumption of continued growth in the US economy which helps emerging markets export growth and maintain the confidence necessary to continue capital attraction. This coincides with the results that the largest gap in forecast difference was in Latin America and in Asia for whom the US serves as their major export market.

The major difference between the Kalman filtering time series-based approach and the pull versus push fundamentals-based approach is that the former involves

the evolution of unobserved variables. The time series approach of capital flow forecasting incorporates both permanent and temporary unobserved components. The results of the present study revealed that for emerging markets, although the permanent component is statistically significant, flows were mostly dominated by the temporary components[4]. These unobserved temporary components may include the influence of market sentiment and the herding behaviour of market participants. Unlike the assets of mature financial markets of industrialized countries, emerging market assets may be viewed as relatively high-risk. Due to the scarcity and the asymmetry of information in developing countries, herding behaviour may rise among investors, and is often temporary. In a fundamentals-based approach, the pull variable 'credit rating' may be linked to market sentiment since these ratings offer financial markets an estimate of the probability that borrowers will default on their debt obligations. However, credit rating itself may not fully incorporate market sentiment, since credit rating agencies themselves, having failed to predict the emergence of the East Asian crisis, have been criticized for their procyclical rating assignments and aggravation of the crisis[5].

4.4 Conclusion

This paper has provided capital inflow forecasts to 32 emerging markets using a structural time series model in state space form estimated by maximum likeli-

[4]Sarno and Taylor (1999) find that the temporary component is, however, relatively much smaller for private capital flows to Japan and Australia.

[5]See Ferri, Liu, and Stiglitz.(1999)

hood Kalman filtering methods for each of the capital inflows series examined. We employed a general-to-specific procedure where we started from the most general unobserved components model and tested down by imposing exclusion restrictions on parameters found to be statistically insignificant at conventional nominal levels of significance. In choosing the most appropriate model for each country and capital flow, we relied on the coefficient of determination and on the Akaike information criterion.

The analysis of the properties of capital flows using these unobserved components models suggest that a statistically significant nonstationary component is present in the data, but that this is generally dominated by a stationary, temporary component. That is to say, the bond, equity and loan flows to emerging markets may be regarded as largely temporary and reversible in nature. This coincides with international financial markets' classification of emerging market assets as risky assets.

In general, the model projects lower capital inflows for 2001-2003 compared to a fundamentals-based forecast (chapter 3), and a possible reversal of capital flows during 2001 due to the relatively large proportion of the temporary components and their temporary nature. The major difference between the Kalman filtering time series-based approach and the 'pull versus push' fundamentals approach is that the time series approach involves the evolution of unobserved variables. The pure time series approach to capital flow forecasting incorporates both permanent

and temporary unobserved components. The results of the study revealed that for emerging markets, capital flows were mostly dominated by the temporary components. These unobserved temporary components may include the influence of market sentiment and the temporary herding behaviour of market participants because many emerging markets do not operate fully developed or informationally transparent financial markets. In fundamentals based approach, the pull variable 'credit rating' may be linked to market sentiment since these ratings offer financial markets an estimate of the probability that borrowers will default on their debt obligations. However, credit rating itself may not fully incorporate market sentiment, since credit rating agencies themselves, having failed to predict the emergence of the East Asian crisis, have been criticized for their procyclical rating assignments and aggravation of the 1997-98 crisis. In this context, future studies involving the herding behaviour of credit rating agencies in assigning sovereign credit ratings for emerging markets could provide further insights into understanding the turbulence of capital flows and financial markets. This issue is taken up in chapter 5.

Table 4.2 Unobserved Component Estimation Result - Bond Flows

	Model	Components	Est. SD of error term	AR param.	AIC<BIC>	Coeff. of det.	LB stat
Argentina	5	Stc lvl, Fxd slp, AR(1)	Lvl:77.131(0.126), AR(1):613.39(1.000)	0.13	12.996 <13.084>	0.382	9.543
Brazil	3	Stc lvl, AR(1)	Lvl:66.258(0.092), AR(1):690.27(1.000)	0.17	13.188 <13.254>	0.38	24.61
Bulgaria	6	Stc lvl, Fxd slp, Irr	Lvl:0.000(0.000) Irr:4.686(1.000)		3.125 <3.19>	0.51	0.681
China	4	Stc lvl, Irr	Lvl:33.067(0.132) Irr:251.12(1.000)		11.206 <11.250>	0.396	9.513
Colombia	4	Stc lvl, Irr	Lvl:8.979(0.056) Irr:161.23(1.000)		10.244 <10.288>	0.487	20.95
Hungary	4	Stc lvl, Irr	Lvl:29.253(0.155) Irr:189.06(1.000)		10.661 <10.705>	0.406	8.545
India	4	Stc lvl, Irr	Lvl:17.212(0.1663) Irr:103.53(1.000)		9.468 <9.512>	0.412	5.697
Indonesia	4	Stc lvl, Irr	Lvl:49.205(0.225) Irr:218.49(1.000)		11.021 <11.065>	0.437	13.53
Jamaica	6	Stc lvl, Fxd slp, Irr	Lvl:0.000(0.000) Irr:37.605(1.000)		7.29 <7.356>	0.538	10.82
Jordan	4	Stc lvl, Irr	Lvl:0.000(0.000) Irr:9.7015(1.000)		4.569 <4.612>	0.509	0.464
Korea	3	Stc lvl, AR(1)	Lvl:103.22(0.183) AR(1):563.22(1.000)		12.887 <12.952>	0.411	9.866
Lebannon	6	Stc lvl, Fxd slp, Irr	Lvl:0.000(0.000) Irr:148.13(1.000)		9.964 <10.030>	0.536	19.36
Lithuania	6	Stc lvl, Fxd slp, Irr	Lvl:1.212(0.0344) Irr:32.265(1.000)		7.247 <7.312>	0.552	15.01
Malaysia	4	Stc lvl, Irr	Lvl:15.879(0.0563) Irr:281.80(1.000)		11.361 <11.405>	0.452	3.245
Mexico	2	Stc lvl, AR(1), Irr	Lvl:119.16(0.1693) Irr:703.95(1.000) AR(1):193.49(0.275)		13.517 <13.605>	0.552	11.8
Morocco	6	Stc lvl, Fxd slp, Irr	Lvl:1.0590(0.0359) Irr:29.500(1.000)		6.836 <6.902>	0.503	7.865
Pakistan	6	Stc lvl, Fxd slp, Irr	Lvl:1.658(0.0438) Irr:37,869(1.000)		7.334 <7.378>	0.551	12.68
Peru	4	Stc lvl, Irr	Lvl:0.477(0.0233) Irr:20.438(1.000)		6.081 <6.124>	0.512	10.93
Philippines	6	Stc lvl, Fxd slp, Irr	Lvl:9.8824(0.0386) Irr:255.76(1.000)		11.159 <11.224>	0.528	14.89
Russia	5	Stc lvl, Fxd slp, AR(1)	Lvl:62.284(0.0995) AR(1):626.11(1.000)		12.992 <13.079>	0.284	13.93
Africa	4	Stc lvl, Irr	Lvl:6.310(0.0346) Irr:182.27(1.000)		10.468 <10.512>	0.481	16.9
Thailand	4	Stc lvl, Irr	Lvl:36.529(0.2111) Irr:173.000(1.000)		10.54 <10.584>	0.462	14.65
Turkey	5	Stc lvl, Fxd slp, AR(1)	Lvl:14.326(0.0387) AR(1):370.60(1.000)		11.91 <12.00>	0.394	4.047
Ukraine	6	Stc lvl, Fxd slp, Irr	Lvl:11.906(0.1699) Irr:70.084(1.000)		8.701 <8.766>	0.246	36.66
Venezuela	6	Stc lvl, Fxd slp, Irr	Lvl:32.935(0.0765) Irr:430.69(1.000)		12.239 <12.304>	0.489	14.75

Table 4.3 Unobserved Component Estimation Result - Equity Flows

	Model	Components	Est. SD of error term	AR param.	AIC<BIC>	Coeff. of det.	LB stat
Argentina	2	Stc lvl, AR(1), Irr	Lvl:0.000(0.000), AR(1): 18.557(0.238) Irr:78.042(1.000)	-0.41	8.834 <8.921>	0.523	Q(10,8)= 10.44
Brazil	4	Stc lvl, Irr	Lvl:9.213(0.0352), irr:261.43(1.000)	0.168	13.188 <13.254>	0.435	Q(10,9)= 2.121
China	4	Stc lvl, Irr	Lvl:98.825(0.0961) Irr:1028.7(1.000)		13.9908 <13.0345>	0.528	Q(10,9)= 41.53
Colombia	4	Stc lvl, Irr	Lvl:0.983(0.109) Irr:9.028(1.000)		4.532 <4.576>	0.462	Q(10,9)= 31.33
Egypt	3	Stc lvl, AR(1)	Lvl:1.6358(0.045) AR(1):36.426(1.000)	-0.06	7.276 <7.341>	0.514	Q(10,9)= 12.51
Hungary	4	Stc lvl, Irr	Lvl:17.782(0.151) Irr:117.88(1.000)		9.7128 <9.756>	0.396	Q(10,9)= 16.5
India	4	Stc lvl, Irr	Lvl:17.782(0.1508) Irr:117.88(1.000)		9.468 <9.7565>	0.3963	Q(10,9)= 15.29
Indonesia	4	Stc lvl, Irr	Lvl:8.2805(0.0621) Irr:133.32(1.000)		9.8702 <9.9139>	0.4485	Q(10,9)= 9.818
Jordan	6	Stc lvl, Fxd slp, Irr	Lvl:01587(0.000) Irr:3.0261(1.000)		2.2988 <2.3643>	0.4981	Q(10,9)= 15.94
Korea	3	Stc lvl, AR(1)	Lvl:121.13(0.7265) AR(1):166.74(1.000)	-0.45	11.142 <11.207>	0.4333	Q(10,8)= 7.488
Lebannon	4	Stc lvl, Irr	Lvl:0.0000(0.000) Irr:58.659(1.000)		8.1677 <8.2144>	0.5804	Q(10,9)= 0.3563
Lithuania	6	Stc lvl, Fxd slp, Irr	Lvl:0.2285(0.0175) Irr:13.068(1.000)		5.1886 <5.2542>	0.5105	Q(10,9)= 1.244
Malaysia	3	Stc lvl, AR(1)	Lvl:3.5880(0.0565) Irr:63.508(1.000)		8.397 <8.462>	0.4795	Q(10,8)= 7.743
Mexico	4	Stc lvl, Irr	Lvl:20.329(0.067) Irr:305.33(1.000)		11.532 <11.576>	0.4693	Q(10,9)= 7.325
Morocco	6	Stc lvl, Fxd slp, Irr	Lvl:0.0000(0.000) Irr:9.9001(1.000)		4.621 <4.687>	0.5211	Q(10,9)= 2.108
Pakistan	3	Stc lvl, AR(1)	Lvl:0.0000(0.000) AR(1):80.175(1.000)		8.808 <8.873>	0.4241	Q(10,8)= 0.9822
Papua Guinea	4	Stc lvl, Irr	Lvl:0.372(0.0094) Irr:36.679(1.000)		7.394 <7.437>	0.481	Q(10,9)= 1.437
Peru	4	Stc lvl, Irr	Lvl:0.0000(0.000) Irr:81.079(1.000)		8.815 <8.8587>	0.5105	Q(10,9)= 1.676
Philippines	4	Stc lvl, Irr	Lvl:5.4008(0.0796) Irr:68.383(1.000)		8.5525 <8.5962>	0.501	Q(10,9)= 15.52
Russia	3	Stc lvl, AR(1)	Lvl:1.242(0.025) AR(1):49.553(1.000)	0.222	7.864 <7.929>	0.385	Q(10,8)= 15.65
Africa	6	Stc lvl, Fxd slp, Irr	Lvl:0.0000(0.000) Irr:143.41(1.000)		9.9676 <10.033>	0.5539	Q(10,9)= 10.66
Thailand	5	Stc lvl, Fxd slp, AR(1),	Lvl:0.0000(0.000) AR(1):152.54(1.000)	0.259	10.106 <10.194>	0.379	Q(10,9)= 7.206
Turkey	5	Stc lvl, Fxd slp, AR(1), Irr	Lvl:14.326(0.0387) AR(1):370.60(1.000)		10.064 <10.151>	0.446	Q(10,9)= 2.366
Venezuela	4	Stc lvl, Irr	Lvl:0.0000(0.000) Irr:80.430(1.000)		8.799 <8.843>	0.507	Q(10,9)= 0.602

Table 4.4 Unobserved Component Estimation Result - Syndicated Loan Flows

	Model	Components	Est. SD of error term	AR param.	AIC<BIC>	Coeff. of det.	LB stat
Argentina	4	Stc lvl, Irr	Lvl:79.988(0.126), Irr:637.16(1.000)		13.062 <13.106>	0.516	Q(10,9)= 4.218
Brazil	6	Stc lvl, Fxd slp, Irr	Lvl:69.185(0.1130), Irr:612.30(1.000)		12.979 <13.045>	0.4713	Q(10,9)= 28.79
Bulgaria	4	Stc lvl, Irr	Lvl:0.3971(0.017), Irr:22.978(1.000)		6.309 <6.352>	0.515	Q(10,9)= 5.764
Cameroon	5	Stc lvl, Fxd slp, AR(1)	Lvl:0.0000(0.000), AR(1):14.449(1.000)	0.12	5.393 <5.480>	0.449	Q(10,9)= 1.493
China	3	Stc lvl, AR(1)	Lvl:57.335(0.112) AR(1):512.73(1.000)	-0.03	12.632 <12.697>	0.465	Q(10,8)= 6.398
Colombia	4	Stc lvl, Irr	Lvl:28.535(0.1221), Irr:233.61(1.000)		11.052 <11.096>	0.301	Q(10,9)= 9.382
Hungary	4	Stc lvl, Irr	Lvl:12.426(0.0877) Irr:149.69(1.000)		10.018 <10.061>	0.488	Q(10,9)= 13.74
India	4	Stc lvl, Irr	Lvl:38.946(0.1414) Irr:275.47(1.000)		11.401 <11.444>	0.396	Q(10,9)= 11.69
Indonesia	2	Stc lvl, AR(1), Irr	Lvl:132.32(0.302) AR(1):438.09(1.000) Irr:0.000(0.000)	-0.04	12.528 <12.615>	0.382	Q(10,9)= 13.55
Jamaica	4	Stc lvl, Irr	Lvl:0.000(0.000) Irr:15.411(1.000)		5.494 <5.538>	0.498	Q(10,9)= 7.559
Jordan	6	Stc lvl, Fxd slp, Irr	Lvl:10.955(0.669) Irr:16.386(1.000)		6.281 <6.347>	0.048	Q(10,9)= 191.9
Korea	4	Stc lvl, Irr	Lvl:76.189(0.1970) Irr:386.64(1.000)		12.134 <12.178>	0.44	Q(10,9)= 13.54
Lebannon	6	Stc lvl, Fxd slp, Irr	Lvl:1.454(0.0475) Irr:30.594(1.000)		6.921 <6.984>	0.5134	Q(10,9)= 11.53
Lithuania	6	Stc lvl, Fxd slp, Irr	Lvl:0.000(0.000) Irr:27.189(1.000)		6.642 <6.707>	0.5272	Q(10,9)= 9.935
Malaysia	3	Stc lvl, AR(1)	Lvl:26.913(0.064) AR(1):422.51(1.000)		12.189 <12.255>	0.4328	Q(10,8)= 4.315
Mexico	4	Stc lvl, Irr	Lvl:58.911(0.095) Irr:620.60(1.000)		12.98 <13.024>	0.437	Q(10,9)= 3.62
Morocco	3	Stc lvl, AR(1)	Lvl:2.0327(0.0158) AR(1):129.13(1.000)	0.063	9.774 <9.840>	0.468	Q(10,8)= 1.932
Pakistan	4	Stc lvl, Irr	Lvl:15.143(0.1236) Irr:122.51(1.000)		9.763 <9.806>	0.451	Q(10,9)= 17
Peru	6	Stc lvl, Fxd slp, Irr	Lvl:0.000(0.000) Irr:151.28(1.000)		10.074 <10.140>	0.526	Q(10,9)= 16.18
Philippines	6	Stc lvl, Fxd slp, Irr	Lvl:0.000(0.000) Irr:213.71(1.000)		10.765 <10.831>	0.4516	Q(10,9)= 6.31
Russia	4	Stc lvl, Irr	Lvl:75.829(0.1628) Irr:463.63(1.000)		12.484 <12.528>	0.384	Q(10,9)= 22.67
Africa	4	Stc lvl, Irr	Lvl:31.041(0.068) Irr:510.21(1.000)		12.553 <12.597>	0.533	Q(10,9)= 43.88
Thailand	4	Stc lvl, Irr	Lvl:51.912(0.140) Irr:370.97(1.000)		11.995 <12.038>	0.411	Q(10,9)= 16.18
Turkey	5	AR(1)	Lvl:41.227(0.1021) AR(1):403.91(1.000)		12.144 <12.231>	0.4133	Q(10,9)= 31.06
Venezuela	2	Stc lvl, AR(1), Irr	Lvl:32.441(0.1547) AR(1):12.336(0.0588) Irr:209.97(1.000)	-0.97	10.938 <11.025>	0.474	Q(10,9)= 5.499

Table 4.5 Comparison of Capital Flow Forecasts under Fundamentals and Time Series Based Approach

US$ mn		2000	2001		2002		2003	
Bond	Time-series forecast	70,376	65,954	*-6%*	69,431	*5%*	72,446	*4%*
	Fundamentals based forecast	70,376	79,955	*14%*	81,139	*1%*	79,867	*-2%*
Equity	Time-series forecast	35,473	28,813	*-19%*	29,745	*3%*	30,532	*3%*
	Fundamentals based forecast	35,473	36,648	*3%*	43,485	*19%*	49,148	*13%*
Loan	Time-series forecast	98,525	96,197	*-2%*	98,621	*3%*	101,419	*3%*
	Fundamentals based forecast	98,525	101,816	*3%*	115,466	*13%*	120,138	*4%*
Total	Time-series forecast	204,374	190,964	*-7%*	197,797	*4%*	204,397	*3%*
	Fundamentals based forecast	204,374	218,419	*7%*	240,090	*10%*	249,153	*4%*

Chapter 5

Contagion Factor in Credit Rating Agencies' Assessment of Sovereign Ratings: Evidence from the East Asian Emerging Markets

5.1 Introduction

Credit rating agencies play an important role in the dynamics of international financial markets. This is especially true for transactions in emerging market assets[1]. Developing countries tend to operate less developed domestic financial systems than mature markets, and therefore, investment decisions take place under the setting of highly asymmetric information. Foreign investors who are generally less well informed about the domestic economic climate, face even larger uncertainty than domestic investors. Therefore, financial markets rely on credit rating

[1]Reisen and Malzan (1999) found that the largest credit rating announcement effects were observed for emerging market sovereign spreads.

agencies to reduce the gap in the information as well as for constantly updating credit ratings.

From the perspective of emerging markets, the global securities markets have become an increasingly important source of funding for emerging markets. The credit ratings assigned to sovereign and private sector issuers in developing countries have often had important influences on the demand for emerging market securities, and on capital flows into the region. Indeed, obtaining a sovereign credit rating has often been regarded as a prerequisite for issuing eurobonds; and some institutional investors are constrained to hold securities that have been classified by rating agencies as "investment grade", as a result of official regulation or internal risk management practices.

The sharp adjustment of sovereign credit ratings for many Asian emerging markets in periods since July 1997 have raised concerns about the credit rating process and their inability to predict the East Asian crisis (BIS, 1998; IMF, 1998: World Bank, 1998). Specifically, credit rating agencies were subject to the criticism that they introduced a procyclical element into global capital flows - accelerating inflows to the region during the mid 1990s through improvements in ratings and then provoking a reversal of capital flows by sharply downgrading the sovereign ratings of Indonesia, Korea and Thailand all below-investment-grade. Such rating agencies' actions may exacerbate the emerging markets' cost of borrowing abroad and cause the supply of international capital to evaporate.

This chapter examines empirically whether there was "contagion" in the assessment of Asian emerging market sovereign credit ratings. It tests whether agencies, after failing to predict the emergence of the East Asian crisis, downgraded the rating of Korea, Indonesia, Malaysia and Philippines excessively and contagiously beyond what economic fundamentals would justify, in order to recover from the damage to their reputation. In particular, "contagion" is viewed as a latent but unobservable variable common to the credit ratings of all of these countries. The state space form and the Kalman filter is used to extract the unobserved variable from observed credit ratings. The credit ratings employed in this study are those produced by the two largest credit rating agencies, Moody's and Standard and Poor's (S&P). They include the ratings of Thailand, Philippines, Malaysia, Indonesia and Korea, the countries most severely hit by 1997-98 Asian crisis. Earlier studies have focused on verifying whether credit rating agencies can add to the dynamics of financial crisis (e.g. see Reisen and Malzan, 1999). They also examined the relationship between the changes in sovereign ratings and the changes in the spread between the yields on the US treasury bonds and other assets. However, research on the rating process and agencies' contagious assessment of the health of sovereigns from one country to the next seem limited. Therefore, the aim of this chapter is to examine if such contagious assessment did take place.

The empirical results show that sovereign credit ratings were assessed con-

tagiously and that an event in one country did indeed significantly influence the ratings of other countries beyond what could be explained by the economic fundamentals.

The remainder of this chapter is organized as follows. Section 5.2 discusses the sovereign rating criteria and the rating practices of the agencies. It also considers the role of credit rating agencies during the Asian crises and discusses the failure of agencies to warn the markets of the economic turmoil that was to follow. Section 5.3 describes the data, and examines whether the huge downgrade in Asian emerging markets' sovereign ratings involved contagion. It also proposes a possible explanation behind contagious conservative assessments by credit rating agencies. Section 5.4 presents a conclusion.

5.2 The Credit Rating Process

5.2.1 Sovereign Rating Criteria and Rating Practice

The two major credit rating agencies, Moody's (1998) and S&P (1999,a) argue that they do not regard their ratings as providing either a prediction of the timing of default or an indication of the absolute level of risk associated with a particular financial obligation. Moreover, they declare that an issuer credit rating is not a recommendation to purchase, sell, or hold financial obligation issued by an obligator, as it does not comment on market price or suitability for a particular investor. However, during 1990s, global securities markets have become an in-

creasingly important source of funding for many emerging markets. In this regard, credit rating agencies, such as Standard and Poor's (S&P) and Moody's Investors Service (Moody's) have become institutions which exercise strong impact on both the cost of funding and the willingness of major investors to hold certain types of instruments. The growing reliance on credit ratings in the regulatory process, such as the use of ratings in a revised version of the Basel capital requirement proposed by the Task Force on Future of Capital Regulation of the Basel Committee on Banking Supervision have contributed to placing further weight on the role of credit rating agencies.

Although ratings are inevitably influenced by cyclical factors, rating agencies point out that long-term foreign currency debt ratings try to see through economic, political, credit and commodity cycles. Therefore, a recession or tightening of global liquidity should not, by itself, be tied to fundamental factors such as secular trends (see S&P (1999,b)). The S&P (1998) divides the factors into eight categories (see Table 5.1). Each category relates two key aspects of credit risk, i.e. economic and political risk. Economic risk addresses the governments' ability to repay its debts on time. It is a function of both qualitative and quantitative factors. The transformation of S&P's and Moody's ordinal rating scales into a numerical scale is presented in Table 5.2.

Most of the major credit rating agencies list the relevant economic and political factors they consider in assessing credit ratings, however, they do not reveal the

weights they assign to each factors and the relative importance of non-quantifiable factors such as government stability. Agencies emphasize that they do not use a specific formula to combine the various political and economic factors in deciding an overall rating. However, a number of empirical studies have helped to shed light on factors that have historically received the greatest weights in the decision making process[2], and often indicate the likely direction of the rating change that they anticipate will occur. In Moody's, roughly two thirds of all reviews have resulted in a rating change.

5.2.2 Rating Agencies and the East Asian Crisis: Did they miss the crisis?

In examining whether the agencies failed during the Asian crisis, one possible starting point is to consider whether sovereign ratings were changed on time in response to predictable changes in default risk. Table 5.3 reports the sovereign credit ratings history up to the crisis for Indonesia, Korea, Malaysia and Thailand according to the rating assigned to these countries by Moody's and S&P. Downgradings were performed only in December 1997 for Indonesia and Malaysia. Korea was downgraded in November 1997. Moody's downgraded Thailand at the beginning of April, 1997 as the crisis was starting, but S&P did not downgrade Thailand until September, 1997, well into crisis. Except for Malaysia, all the

[2]Cantor and Packer (1996) and subsequently Juttner and McCarthy (1998) examined the determinants of the levels of Moody's and S&P's ratings for a range of mature and emerging market economies in the mid-1990s.

countries were downgraded from investment to below-investment-grade. Referring to Moody's, Malaysia was downgraded four notches (from A1 to Baa2), and Thailand was downgraded five notches (from A2 to Baa3). The largest downgradings were for Indonesia and Korea (six notches) from Baa3 to Caa3, and from A1 to Ba1. The corrections of sovereign ratings of Asian countries in 1997-98 were, collectively, the largest and the most abrupt changes in the modern history of credit ratings.

Market participants raised criticisms that credit rating agencies were not only lax in foreseeing the vulnerabilities of the countries that eventually succumbed to crises, but also gave the impression that they were judging a general melt-down in this region. Downgrading of this magnitude was not only unusual but was also decided late in the crisis, thereby exacerbating market price movements and increasing instability (IMF (1998)).

5.3 Were Asian Emerging Markets Downgraded 'Contagiously?'

Academics and investors often argue that sovereign ratings trigger pronounced boom-bust cycles (see e.g. Monfort and Mulder, 1999). This means that initially small capital outflows from an emerging market and subsequently widening spreads lead rating agencies to downgrade the country in question. This, in turn, is interpreted by many investors as a signal to withdraw their capital. As a result,

the spreads become even larger and agencies continue to downgrade, forming a vicious spiral that can trigger a massive evaporation of capital in the international financial markets.

If we view this as a vertical process of credit rating correction and capital evaporation, a horizontal process would involve a series of downgradings in sovereign ratings elsewhere in the region, where a downgrading in a country is followed by subsequent downgradings in other countries, leading to massive capital flight from the region. Credit rating agencies, having failed to predict the emergence of the crisis, may have had incentives to become more conservative and downgrade other markets in Asia since failing to predict another crisis, if there were to be another one, would cost them a loss of reputation that would be difficult to restore.

Ferri, Liu and Stiglitz (1999) demonstrate the evidence from East Asia, using both linear and non-linear cardinalisation methods, that credit ratings assigned during Asian crisis period were procyclical. They show that for Indonesia, Korea, Malaysia and Thailand, the actual ratings assigned to them before the Asian crisis were higher than what economic fundamentals would warrant. However, after the crisis, the actual ratings dropped much more sharply than the model predicted rating, suggesting that the downgrades were larger than economic fundamentals would justify. Therefore, the main objective of this chapter is to examine whether the two major credit rating agencies, Moody's and S&P, made sovereign rating assessments that were not solely based on the list of criteria they provided, but

that they relied on negative sentiment of the whole region and downgraded the countries contagiously. Hence instead of two, there are three types of explanatory variables influencing the ratings; economic risk (usually quantitative factor), political risk (usually qualitative factor), and the contagion factor.

5.3.1 Data

The data used for this research include those identified by Cantor and Packer (1996) as major quantifiable determinants of the sovereign rating: per capita income, GDP growth, inflation, fiscal and external balance, economic development and default history. After the Asian crisis, rating agencies have noted the importance of short-term foreign currency debt in evaluating sovereign risk. Therefore, the ratio of short term debt over foreign currency reserves is used to measure a country's short-term foreign currency liquidity condition. The data reflecting the political risk are difficult to quantify and are excluded from the analysis.

Sovereign ratings include monthly ratings of Thailand, Philippines, Malaysia, Indonesia and Korea by Moody's and S&P. They cover ratings from January 1990 for Thailand, from July 1993 for Philippines, January 1990 for Malaysia, March 1994 for Indonesia and January 1990 for Korea. All the data end in December 2000. Although the two agencies use different symbols in assessing credit risk, every S&P scale has its counterpart in Moody's rating scale. This correspondence permits a linear transformation into numbers (see Kraeusel, 2000).

5.3.2 Isolating the Contagion Factor using the State Space Form and Kalman Filter[3]

5.3.2.1 State Space and Kalman Filtering

The contagion factor in credit rating agencies' rating assignment can be examined by employing the state-space form and unobserved components model suggested by Kalman (1960) and Harvey (1981,1989). A state space model consists of two equations: a measurement equation that describes the relationship between observed variables and unobserved state variables, and the transition equation that demonstrates the evolution of the unobserved variable.

Measurement equation :

$$Y_{it} = X_{i,t-1}A' + H \cdot B_t + \varepsilon_{it} \qquad \varepsilon_{it} \sim iid\, n(0, R) \qquad (5.1)$$

Transition equation :

$$B_t = \widetilde{u} + F \cdot B_{t-1} + v_t \qquad \omega_t \sim iid N(0, Q) \qquad (5.2)$$

$$E(\varepsilon_{it} \cdot v_t) = 0 \qquad (5.3)$$

[3]The discussion is similar to that given in section 2.2.4-2.2.5 in chapter 2, and is included here for completeness.

Y_{it} is a n×1 vector of variable observed at time t, B_t is a k×1 vector of unobserved state variables that evolves in autoregressive form. H is a n×1 matrix that links the observed Y_{it} with unobserved B_t, $\tilde{u}$ is k×1 vector of constants, v_t is k×1. A is a matrix of parameters. If Y_{it} is to represent the sovereign credit ratings of country i at time t, equation (1.2) can be interpreted as sovereign ratings of a country specific economic factor $X_{i,t-1}$, unobserved and slowly decaying temporary contagion B_t, and purely temporary, zero persistent ϵ_{it}. Contagion, B_t, is common for all 5 countries under the study, and evolves in autoregressive[4] form.

The Kalman filter, a recursive procedure for computing an optimal estimate of the unobserved state vector B_t, is then applied. In this way, it is possible to estimate the unobserved component and provide a minimum mean squared error estimate of B_t given the appropriate information set[5]. The unknown parameters in the state space form can be estimated by maximum likelihood Kalman filtering methods (Harvey, 1983; Cubertson et al. 1992), and can be used to predict and update the unobserved state variable B_t at the end of each period.

5.3.2.2 Modelling the Influence of Contagion Factor in Assessment of Sovereign Ratings

The modelling of currency crisis contagion used in this paper is a modified version of basic state space model and Kalman filter. Let Y_{it} be the sovereign ratings

[4]It is not limited to AR(1), but can be AR(n) as long as it is finite.
[5]Information set includes the parameters $\tilde{u}, A, F, R$ and Q.

5 countries (i=1..5) under study by Moody's or S&P, and $\widetilde{\beta}_t$ be the unobserved contagion factor common in all 5 countries.

$$Y_{it} = (X_{i,t-1} \cdot A') + (\gamma_i \cdot \widetilde{\beta}_t) + \varepsilon_{it} \qquad i = 1,2,3,4,5,6 \quad (5.4)$$

$$\widetilde{\beta}_t - \delta = \phi_1(\widetilde{\beta}_{t-1} - \delta) + \phi_2(\widetilde{\beta}_{t-2} - \delta) + \omega_t \qquad \omega_t \sim iidN(0,1) \quad (5.5)$$

$$\varepsilon_{it} = \varphi_{i1}\,\varepsilon_{i,t-1} + \varphi_{i2}\,\varepsilon_{i,t-2} + \epsilon_{it} \qquad \epsilon_{it} \sim iidN(0,\sigma_i^2) \quad (5.6)$$

σ_ω^2 is set to 1 to normalize the common component. The the roots of $(1 - \phi_1 L - \phi_2 L^2)$=0 and $(1 - \phi_1 L - \phi_2 L^2)$=0, $i = 1..5$ lie outside the unit circle, and the shocks are assumed to be independent, i.e. $E(\varepsilon_{it} \cdot v_t) = 0$. The common component, $\widetilde{\beta}_t$ enters each equation of Y_{it} with different weights, γ_i, $i = 1..5$. For each of the 5 series, $(X_{i,t-1} \cdot A') + \varepsilon_{it}$ represents individual, country's economic and political risk factors.

The first population moment for the ith indicator Y_{it} consists of two components.

$$E(Y_{it}) = (X_{i,t-1} \cdot A') + (\gamma_i \cdot \delta) \qquad (5.7)$$

However, from the corresponding sample first moment $\overline{Y_i}$, one can not separately identify $X_{i,t-1} \cdot A'$ and $\gamma_i \delta$. This causes a problem in deriving the maximum likelihood estimator. Such an identification problem can be avoided by demeaning, that is subtracting the mean value from original value.

Let $y_{it} = Y_{it} - \overline{Y_i} = \gamma_i(\widetilde{\beta}_t - \delta) + \varepsilon_{it}$ and define $\beta_t = \widetilde{\beta}_t - \delta$, and $\varkappa_{it} = X_{it} - \overline{X_i}$,

hence we have

$$y_{it} = A_i \varkappa_{it} + \gamma_i \beta_t + \varepsilon_{it} \tag{5.8}$$

$$\beta_t = (\phi_1 \cdot \beta_{t-1}) + (\phi_2 \cdot \beta_{t-2}) + \omega_t \qquad \omega_t \sim iidN(0,1) \tag{5.9}$$

$$\varepsilon_{it} = \varphi_{i1}\, \varepsilon_{i,t-1} + \varphi_{i2}\, \varepsilon_{i,t-2} + \epsilon_{it} \qquad \epsilon_{it} \sim iidN(0, \sigma_i^2) \tag{5.10}$$

The above model in deviation from means is written in the state space form and the Kalman filter is available for maximum likelihood estimation of the model based on the prediction error decomposition, as well as for inference on β_t. The measurement and transition equation are in identical form as section 2.2.5.

Once the estimates of parameters using maximum likelihood estimation method are calculated, one can run the Kalman filter to get $\beta_{t|t}$, the contagion factor influencing the assignment of sovereign ratings at time t, given information up to

time t.

5.3.3 Estimation Results

Figure 5.2 and 5.3 in the appendix display the estimates of the 'contagion factor' in credit rating assignments by Moody's and S&P respectively. The value of the contagion variable can be interpreted as an index representing the dynamics of credit rating agency's negative sentiment towards the Asian emerging markets as an investment target. More important than the absolute value of the contagion factor is its sudden change in direction during the time of huge downgradings in sovereign ratings. S&P downgraded Thailand in September 1997, and Moody's downgraded Thailand in April 1997. Malaysia and Indonesia were downgraded in December 1997, and Korea on October 1997. The contagion factor also shows a sudden drop during this time, from September 1997 to first half of 1998 for both the Moody's and S&P.

It is important to keep in mind that historically, sovereign ratings have been relatively stable. Indeed, since the agencies argue that they try to see through economic, political, credit and commodity cycles, a recession or tightening of global liquidity should not, in itself, be an occasion for a downgrade. In the period prior to the East Asian crisis, there had been only modest rating actions and most Asian countries had investment-grade rating[6]. Most market participants have

[6]China, Hong Kong SAR, Indonesia, Korea, malaysia, Singapore, Taiwan Provence of China

argued that these rating actions gave only a limited warning of the subsequent market turmoil. Moreover, a number of observers have argued that, in the agencies' report on the Asian countries, there was seemingly a "disconnect" between the often critical and subsequently proven accurate, assessments of the financial sector weaknesses in the Asian economies and the investment-grade ratings that they were assigned.

Why does a crisis in one country lead rating agencies to be excessively conservative in assessing ratings to other countries in the same league? Although there may be more than one explanation, I would like to argue that the contagion factor plays an important role in the assessment of sovereign ratings because of the asymmetric valuation of costs and benefits associated with accuracy in the ratings assignment. That is, the cost the rating agencies must bear when they make inaccurate assessments of sovereign ratings will result in the loss of reputation which is much greater than the benefit they would gain had they made accurate judgements. From the perspective of an analyst in the credit rating agency or any other private institutions, their correct predictions would mean extra bonus on their salaries whereas failure to do so may be as harsh as dismissal from their position. Credit rating agencies missed the emergence of East Asian crisis. Failing to predict another crisis would cause irrecoverable damage to their reputation. They would have incentives to become excessively conservative with other countries in the same league and downgrade their ratings beyond what the

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and Thailand all carried investment-grade ratings at the beginning of July 1997.

economic fundamentals would warrant.

5.4 Conclusion and Policy Implication

This paper has demonstrated that in addition to economic factors and political risks, the "contagion factor" plays an important role in assessment of sovereign credit ratings in Asian emerging markets. The results from state space model and Kalman filtering involving unobserved variables illustrate that during the period of Asian crisis, contagion, which can be interpreted as the negative sentiment over the whole Asian emerging markets as investment targets, contributed to the agencies' huge downgrading of ratings in the region. These sharp downgradings aggravated further outflow of capitals from the region, leading to a costly financial crisis.

Having failed to give a significant warning of the market turmoil in Asian emerging markets, rating agencies would have an incentive to downgrade ratings of other countries in the same league contagiously, and to a level below that which the economic fundamentals would justify, in order to recover from the damage to their reputation. For rating agencies, the cost of inaccurate prediction would outweigh the benefit of correct prediction. Failure to predict a second crisis in another country would cause them irrecoverable reputational damage, therefore agencies would have incentives to become excessively conservative.

Since the crisis, the IMF has criticized the lack of statistical methodology and

the assessment techniques such as extensive scenario analysis, sensitivity analysis and stress testing. In addition to this, the results of this research suggest that agencies should provide further transparency in their rating techniques and processes. Agencies list the factors they consider in sovereign rating assessment, but do not specify how they derive at their rating decisions. As the results show, "contagion" may lead to excessively conservative rating assignments, which causes international capital to evaporate from that region. Providing transparency in their rating process and techniques could prevent contagious risk assessment in other countries.

Table 5.1 S&P's Sovereign Rating Methodology Profile

Political Risk Form of government and adaptability of political institutions Extent of Popular Participation Orderliness of leadership succession Degree of consensus on economic policy objectives Integration in global trade and financial system Internal and external security risks
Income and Economic Structure Living Standards, income, and wealth distribution Market vs. non-market economy Resources endowments and degree of diversification
Economic Growth Prospects Size and composition of savings and investment Rate and pattern of economic growth
Fiscal Flexibility General government operating and total burden balances Tax competitiveness and tax-raising flexibility Spending pressures
Public Debt Burden General government financial assets Public debt and interest burden Currency composition and structure of public debt Pension liabilities Banking, corporate, other contingent liabilities
Price Stability Trends in price inflation Rates of money and credit growth Exchange rate policy Degree of central bank autonomy
Balance of Payments Flexibility Impact of fiscal and monetary policies on external accounts Structure of the current account Composition of capital flows
External Debt and Liquidity Size and currency composition of public external debt Importance of banks and other public and private entities as contingent liabilities Maturity structure and debt service burden Level and composition of reserves and other public external assets Debt service track record

Table 5.2 Transformation of S&P's and Moody's Ordinal Rating Scales into a Numerical Scale

S&P's	Moody's	Scale
AAA	Aaa	20
AA+	Aa1	19
AA	Aa2	18
AA-	Aa3	17
A+	A1	16
A	A2	15
A-	A3	14
BBB+	Baa1	13
BBB	Baa2	12
BBB-	Baa3	11
BB+	Ba1	10
BB	Ba2	9
BB-	Ba3	8
B+	B1	7
B	B2	6
B-	B3	5
CCC+	Caa1	4
CCC	Caa2	3
CCC-	Caa3	2
CC	Ca	1
D	C	0

Table 5.3 Sovereign Rating History for East Asian Crisis Countries

	Indonesia		Korea		Malaysia		Thailand	
Year	Moody's	S&P	Moody's	S&P	Moody's	S&P	Moody's	S&P
1986			A2 Nov					
1988				A+ Oct				
1989					Baa1 Dec	A- Mar	A2 Aug	A- Jun
1990			A1 Apr		A3 Dec			
1992		BBB-July						
1993	Baa3Mar				A2 Nov			
1994						A+ Dec		A Dec
1995				AA-	A1 Mar			
1996		BBBJuly						
1997	Ba1 Dec	BB+ Dec	A3 Nov Ba1 Dec	A+ Oct A- Nov B+ Dec	A2 Dec	A Dec	A3 Apr Baa1 Oct Baa3 Nov Ba1 Dec	A- Sep BBB Oct
1998	B2 Jan B3 Mar	B Jan B- Mar CCC+ May		BB+/B Aug	Baa2 Jul Baa3Sep	A-/A-2 Apr A-2,BBB+ July A-3/BBB- Sep		A-3/BBB Jan BBB- Aug

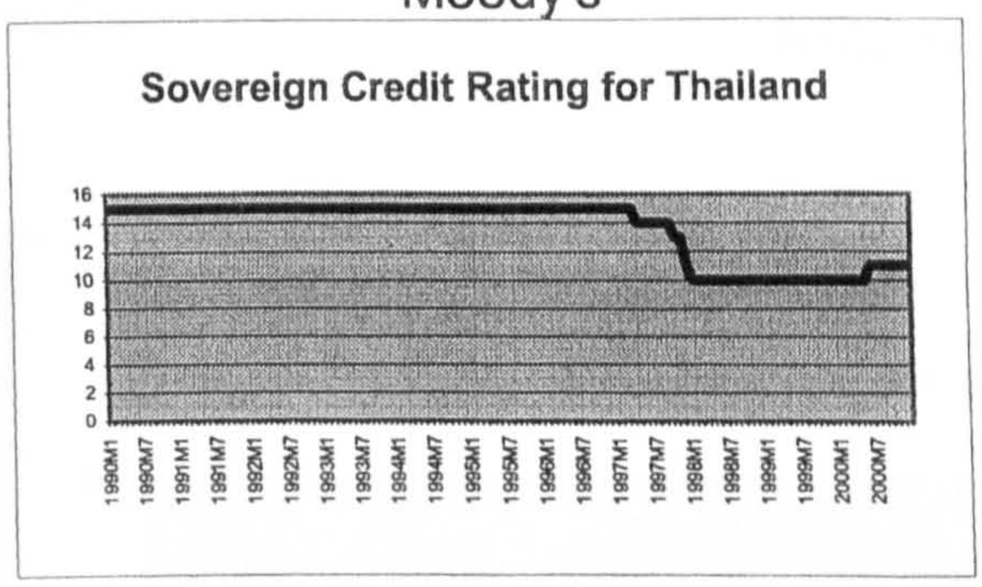
Table 5.4 Estimations and Standard Errors of Parameters

	Moody's		S&P	
	Estimation	Std.Error	Estimation	Std.Error
phi 1	0.543	0.185	0.384	0.223
phi 2	-0.581	0.231	0.001	0.315
psi 11	0.073	0.216	0.028	0.179
psi 12	-0.004	0.138	-0.014	0.331
psi 21	0.305	0.166	0.501	0.239
psi 22	-0.027	0.421	-0.163	0.411
psi 31	-0.533	0.622	0.418	0.395
psi 32	0.017	0.016	-0.002	0.089
psi 41	0.095	0.085	0.084	0.174
psi 42	-0.001	0.114	-0.011	0.119
psi 51	-0.283	0.187	-0.115	0.219
psi 52	-0.002	0.312	0.002	0.39
sigma 1	0.684	0.651	0.345	0.745
sigma 2	0.513	0.439	0.437	0.551
sigma 3	0.741	0.784	0.611	0.631
sigma 4	0.398	0.325	0.318	0.614
sigma 5	0.448	0.576	0.403	0.514
gamma 1	0.355**	0.221	0.516***	0.289
gamma 2	0.347***	0.314	0.232***	0.144
gamma 3	0.493*	0.202	0.422**	0.267
gamma 4	0.482**	0.238	0.497**	0.258
gamma 5	0.713*	0.189	0.411**	0.321

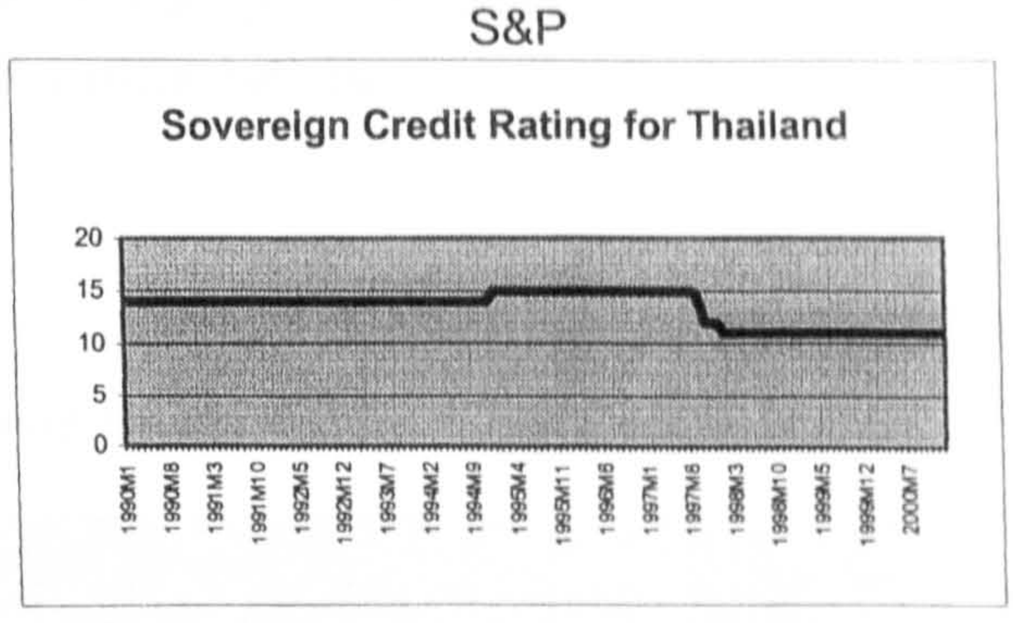
1. Gamma 1-5 are coefficients of the contagion factor for Thailand, Philippine, Malaysia, Indonesia and Korea respectively.
2. * , ** and *** in table 4 indicate 1%, 5% and 10% of significance respectively.

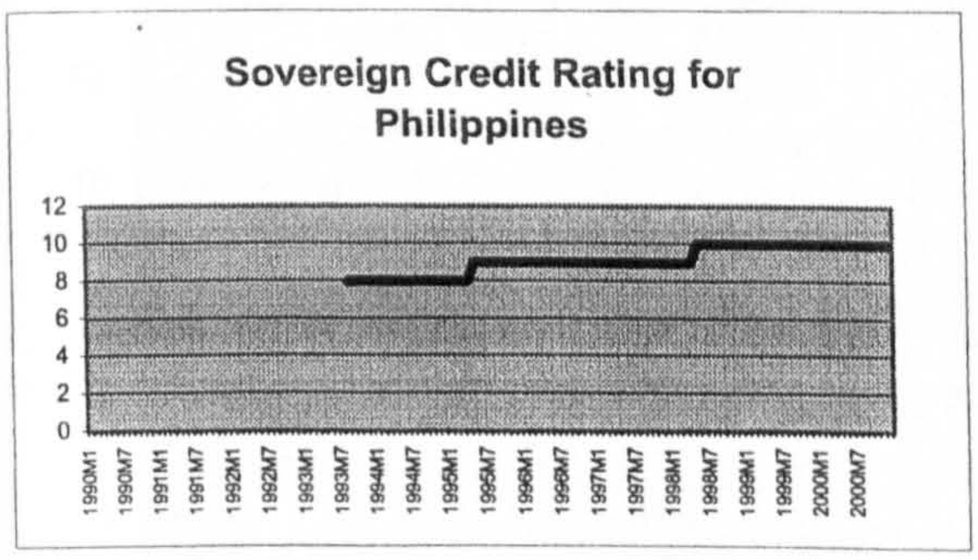
Figure 5.1 Sovereign Credit Ratings by Moody's and S&P

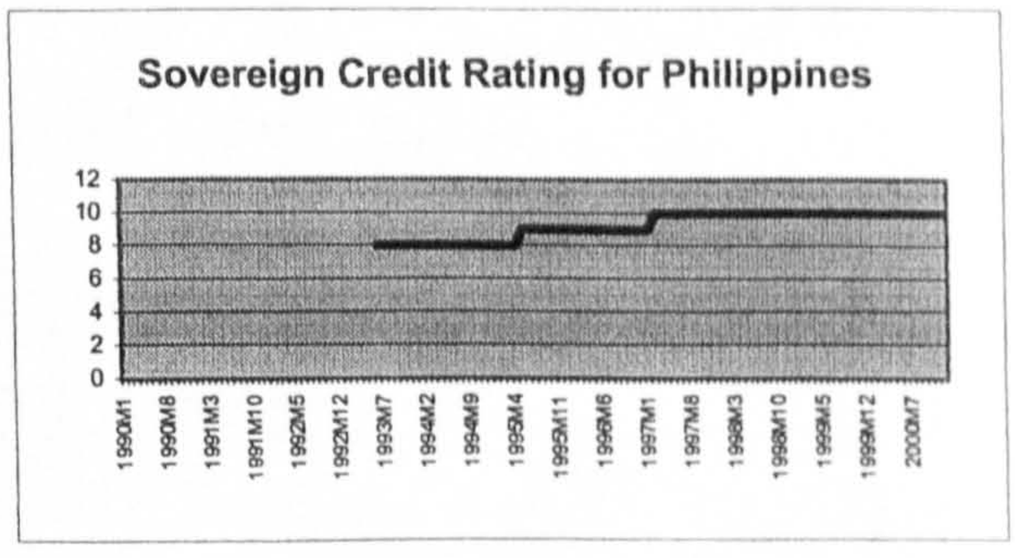
Moody's

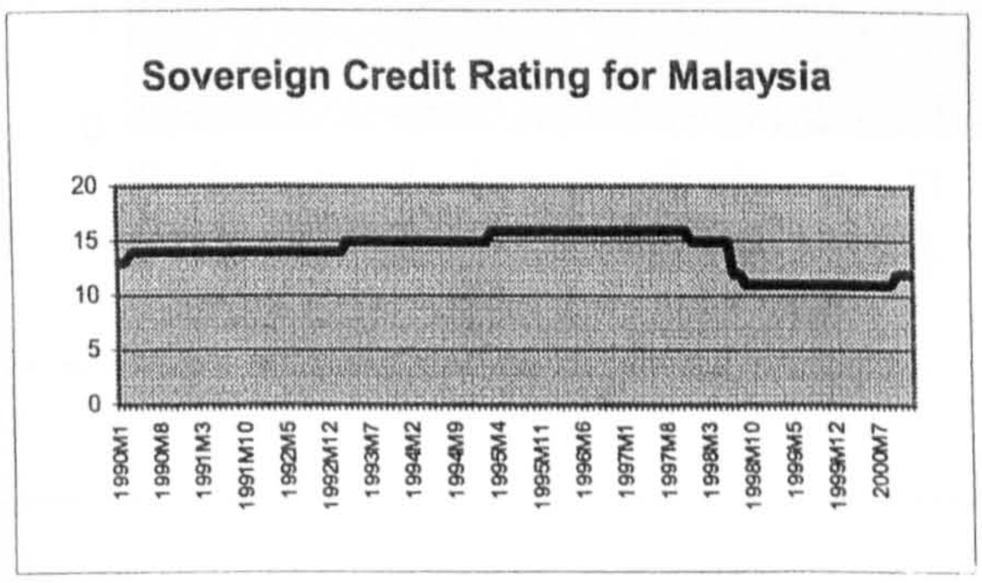


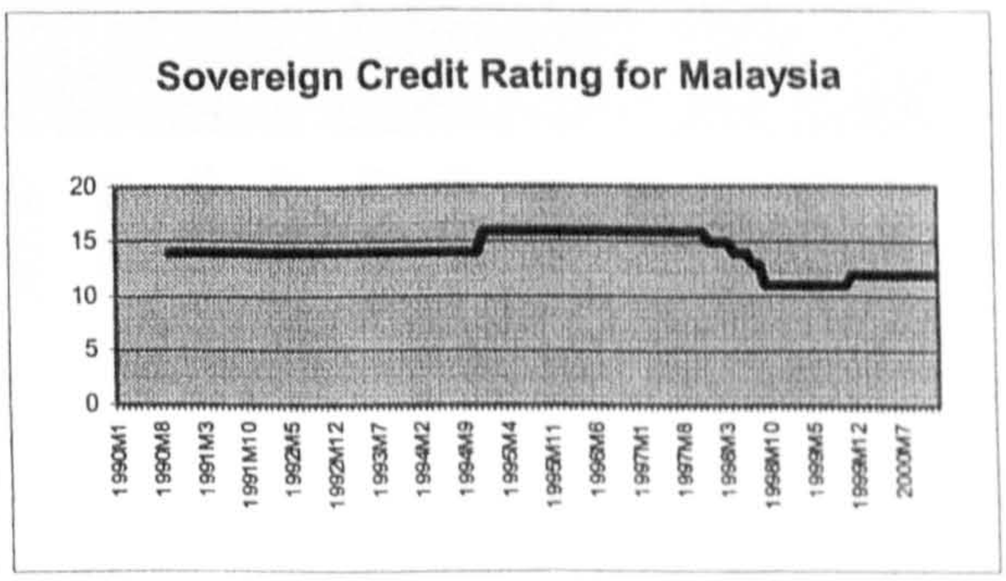
S&P

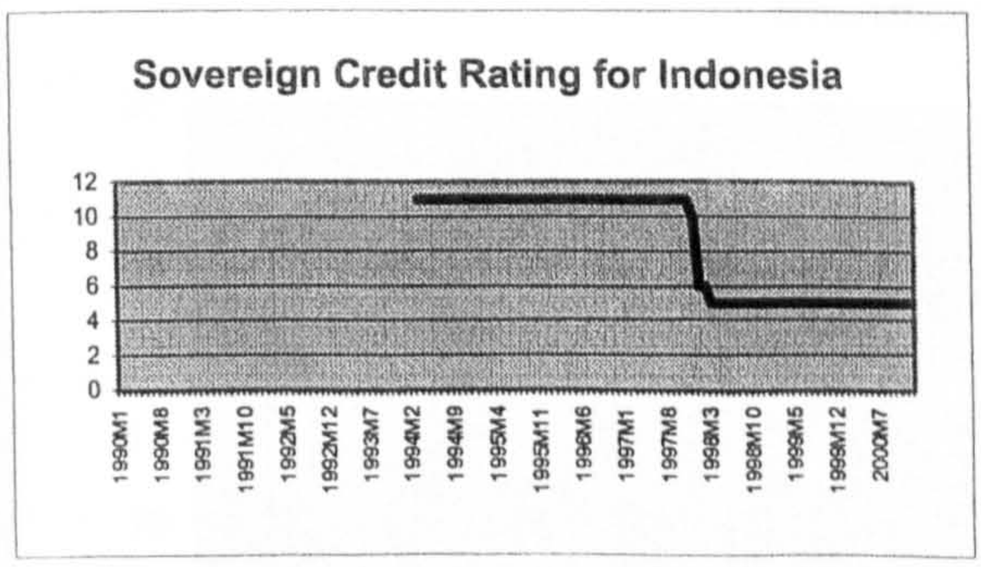


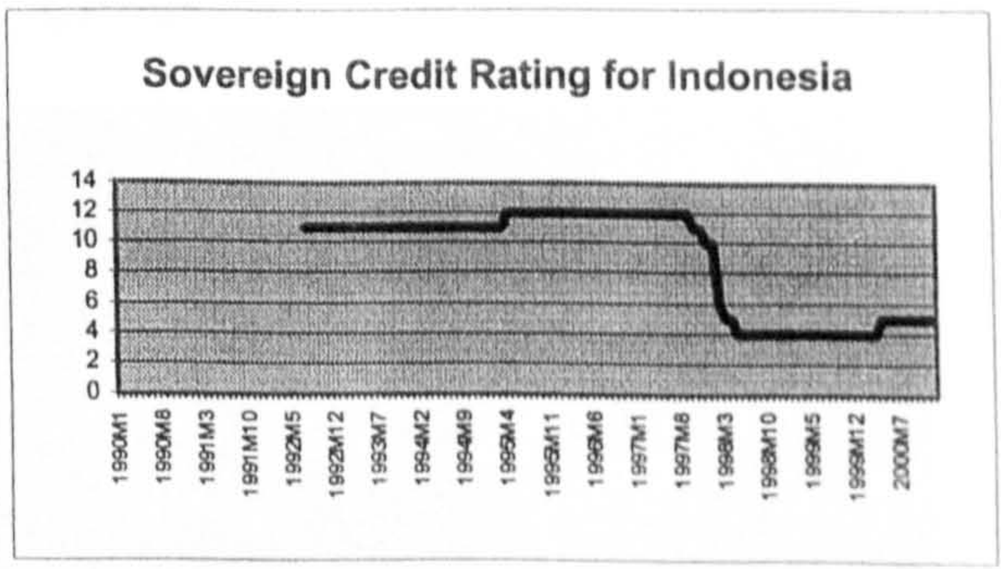


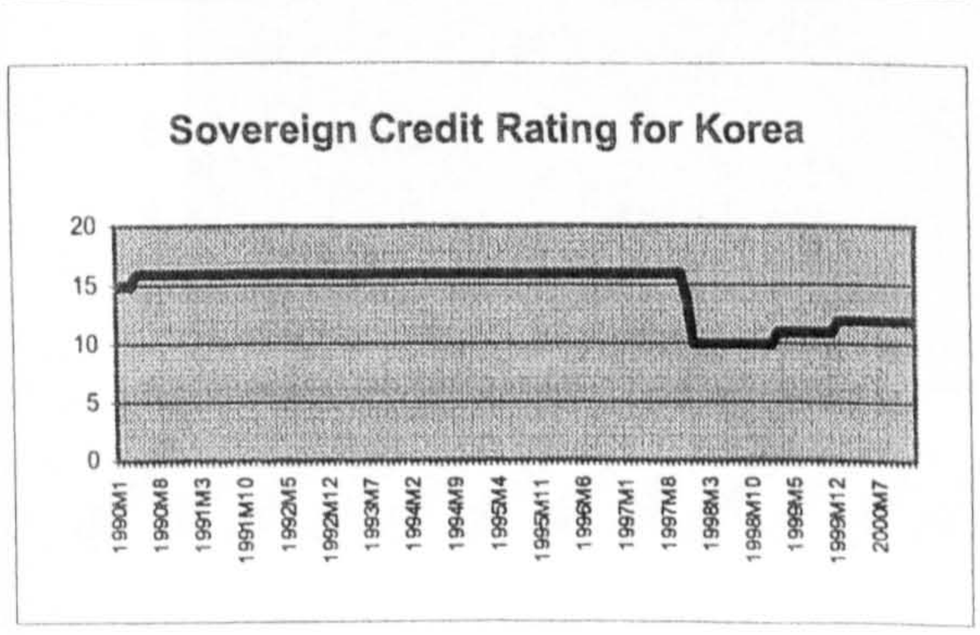












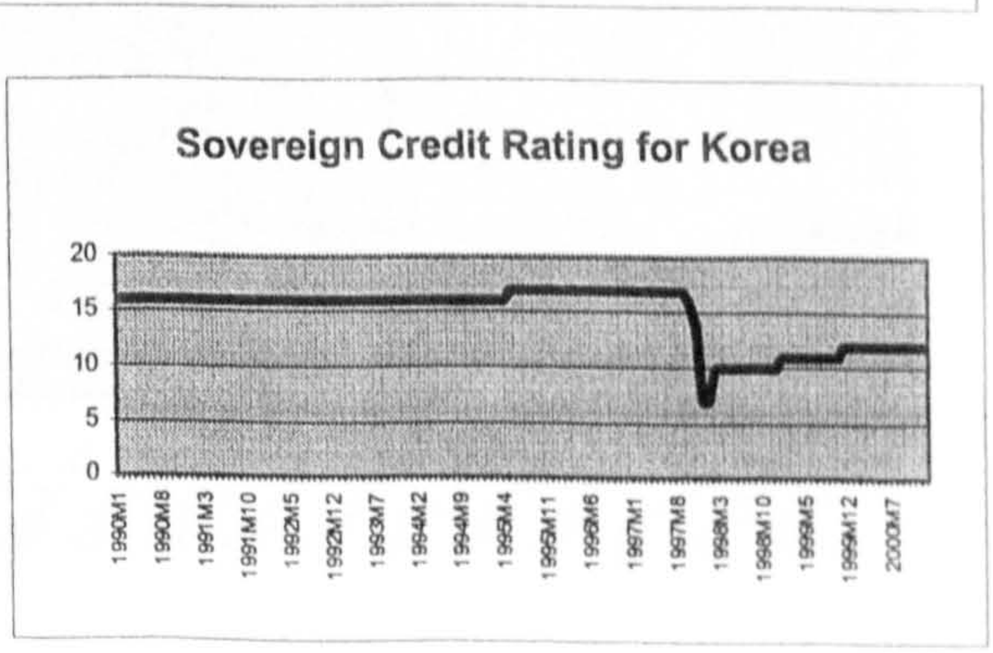
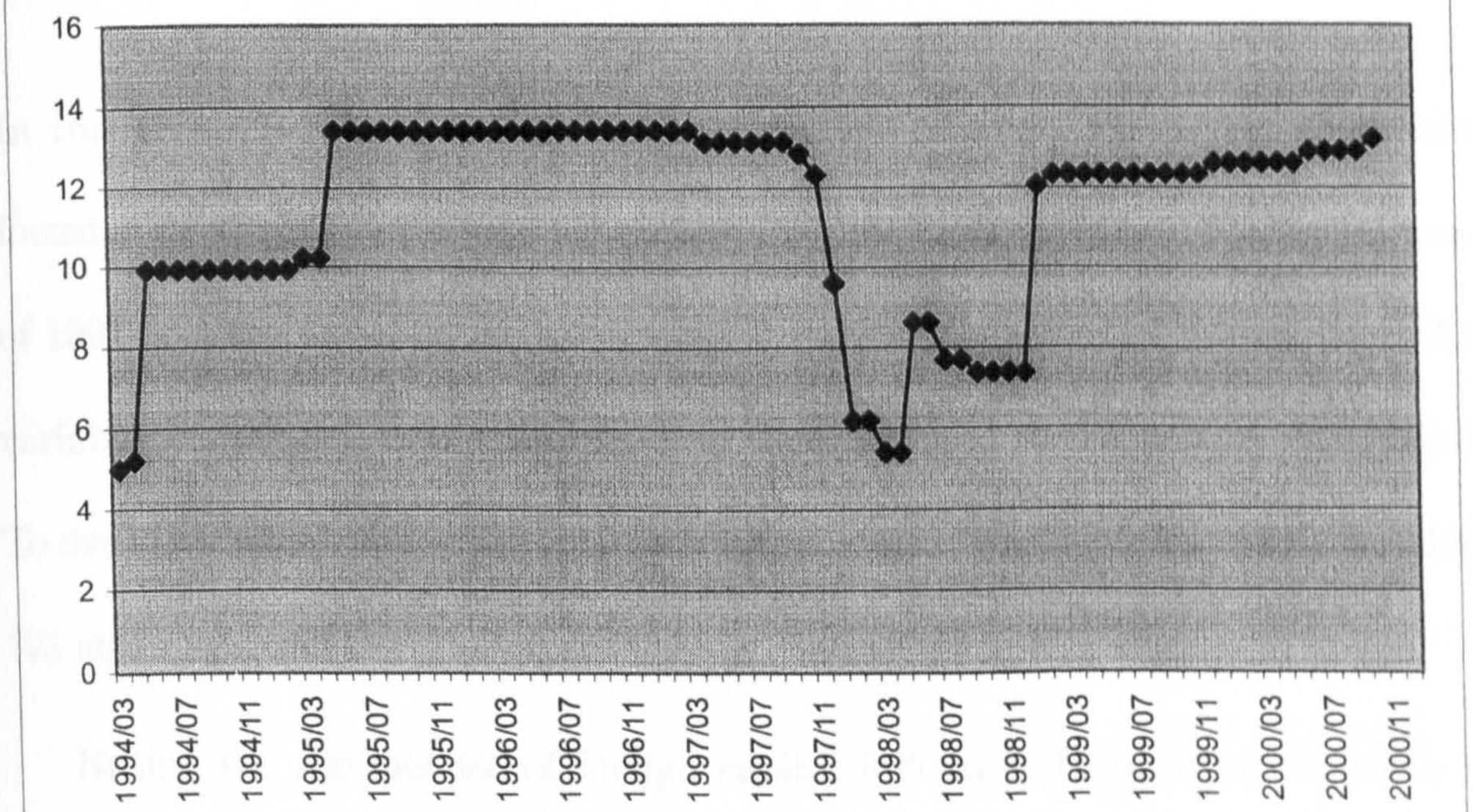
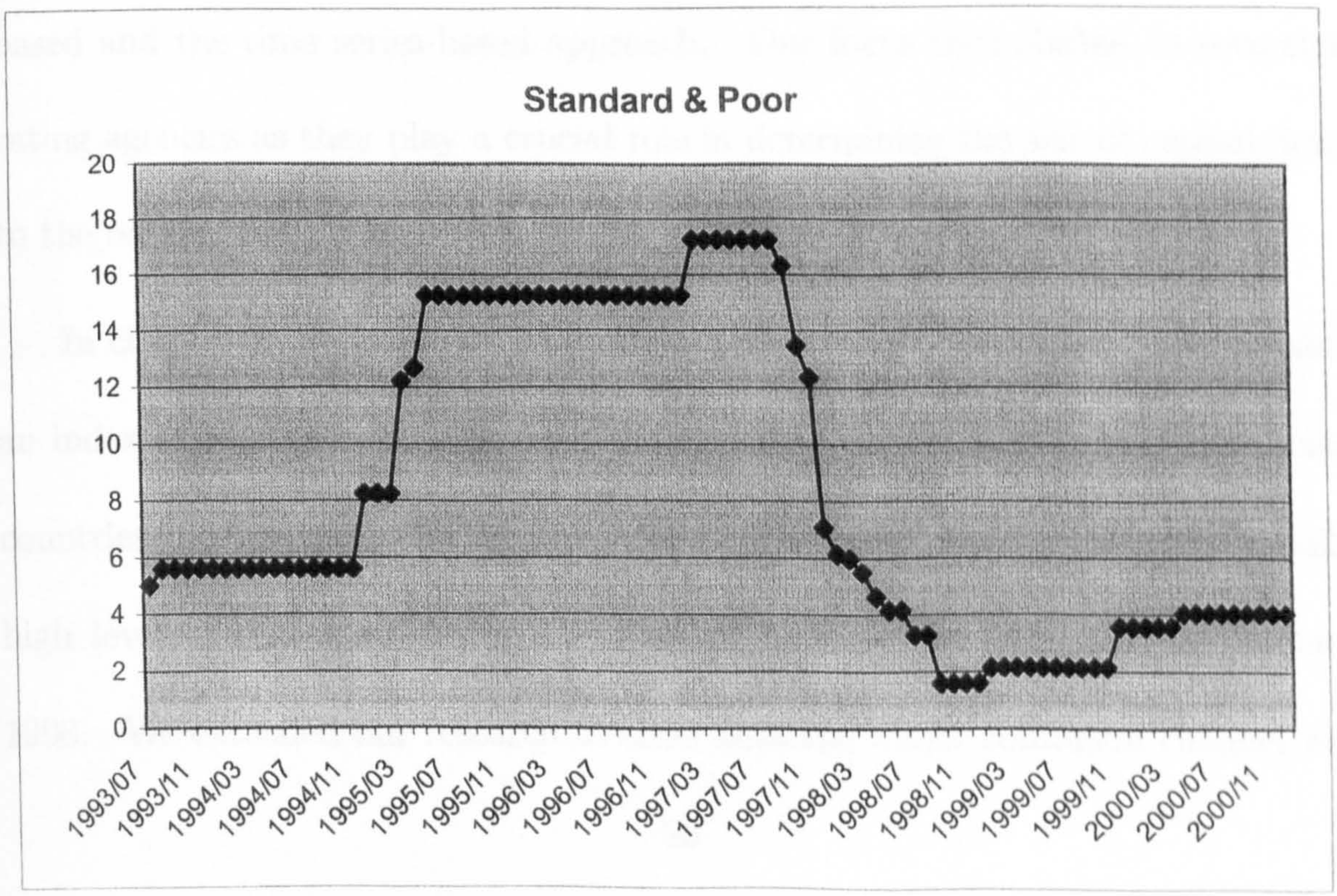


Figure 5.2 & 5.3 Estimated Contagion Factor in Sovereign Credit Rating Assessments





Chapter 6

Conclusion

In this thesis, we have examined the dynamics of emerging market economies focusing on their interactions vis-a-vis global financial markets. Taking the case of 1997-98 East Asian crisis, we created a quantitative index of the unobservable variable 'contagion', and examined how it contributed to the market turbulence. To our knowledge, ours is the only attempt to isolate "contagion" as a sole variable. We also identified the crisis transmission channel using this contagion index.

Noting the significance of foreign capital inflows in financing the growth in Asian economies, we forecast capital inflows to the region using both fundamentals-based and the time series-based approach. Our focus then shifted to sovereign rating agencies as they play a crucial role in determining the size of capital flows to the region.

In chapter 2, we isolated the unobservable variable "contagion" and created an index of level of contagion from the exchange market pressures of five Asian countries most severely hit by the crisis. The index manifested exceptionally high level of contagion during the peak of Asian crisis, July 1997 to January 1998. We extended our research to show that the major contagion channel was

macroeconomic similarity in financial variables rather than trade linkages. That is, crisis spread to other countries that shared macroeconomic similarities rather than to those who were linked by bilateral trade or trade competition in the third market. Specifically, the high level of domestic credit proved to be most important variable explaining the transmission of crisis in the Asian countries.

As the domestic credits were mostly financed by foreign capitals in Asian emerging markets, chapter 3 and 4 project capital flows to 32 emerging markets in the world using the fundamentals-based and the time series-based approach respectively. Forecasts under the worst case scenarios showed that the global real variable, namely the growth rate in the US, had a significant influence on determining size of flows to developing countries. It was also revealed that the increase in capital flows to the region was closely linked with corresponding upgradings in sovereign ratings of the countries under study.

In relation to the importance of sovereign credit ratings on demand for emerging market securities, chapter 5 investigated whether the major credit rating agencies downgraded sovereign ratings of countries excessively and contagiously from one country to another during the Asian crisis period. The results of the analysis supported the view that credit rating agencies downgraded sovereign ratings in order to restore their reputation. Having failed to predict the emergence of crisis, agencies became increasingly conservative and downgraded other emerging markets, because failing to predict another crisis would render their reputation

irrecoverable.

Three broad policy implications emerge from this thesis. The first is that currency crisis may occur or become magnified by events in other countries through contagion. Therefore, it is important that policy makers in international financial institutions monitor carefully the movements in international capital markets, and assess the risks of a country together with global financial specialists. From the emerging markets' point of view, it is essential that they practice stricter financial supervision and regulation to control the excessive inflow and outflow of "hot money".

The second is that emerging markets need to focus on developing their domestic capital markets. This will enable them to widen the loan sources and to avoid excessive short-term financing, in order to minimize negative shocks in the case of rapid capital outflow.

The third is that the new international financial structure should encourage the credit rating agencies to provide further transparency in their rating techniques and processes. Agencies list the factors they consider in sovereign rating assessment, but do not specify how they arrive at their rating decisions. The results of this thesis showed that "contagion" may lead to excessively conservative rating assignments, which causes international capital to evaporate from that region. Therefore, enforcing the rating agencies to provide transparency in their rating process and techniques could prevent excessive and contagious sovereign

downgradings in other countries.

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