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Capital Flows to Emerging Markets
Liberalization, Overshooting, and Volatility

Philippe Bacchetta and Eric van Wincoop

3.1 Introduction

3.1.1 Capital Flows in the 1990s

The surge in capital flows toward a group of developing countries in the 1990s is remarkable more because of the nature of these flows than their quantities. Total lending to developing countries has indeed increased compared to the mid-1980s, but is not higher than in the early 1980s. Figure 3.1 shows the current account and net capital flows as a fraction of gross domestic product (GDP) for seventeen emerging market countries.[1] Net errors and omissions have been included in the capital account. This figure describes the broad trend seen over the last two decades: large current account deficits during the late seventies and early eighties, followed by a sharp decline in net capital flows to approximately zero in the mid-1980s, and subsequently another net foreign lending boom.

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1. This group of countries is determined by data availability and is used throughout the paper. They include most major recipients of recent capital flows, except for China. The seventeen countries are Argentina, Brazil, Chile, Colombia, India, Jordan, Korea, Malaysia, Mexico, Pakistan, Peru, the Philippines, South Africa, Sri Lanka, Thailand, Turkey, and Venezuela. The data for this and the other illustrative figures in the paper involving capital flows are from the IMF Balance of Payments Statistics.

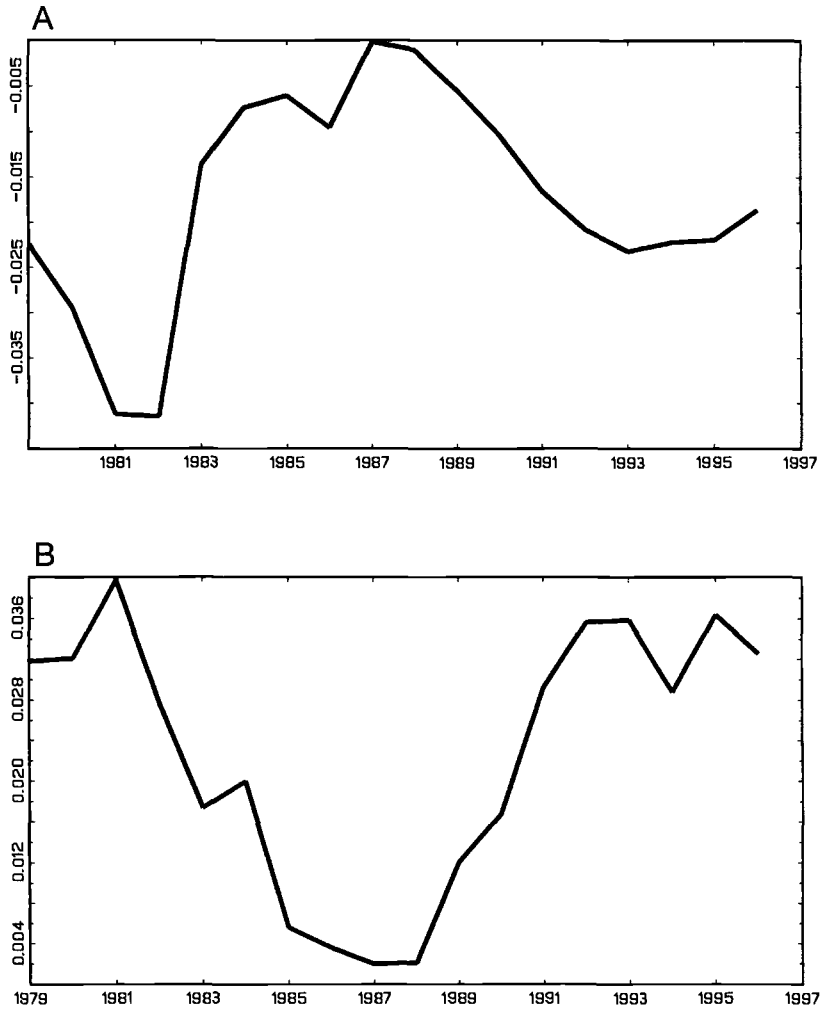


Fig. 3.1 Net current account/GDP (*A*) and net capital account/GDP (*B*) for sum of seventeen emerging markets

During the previous foreign lending boom of the late 1970s, commercial bank lending to developing country governments, firms, and banks was most important. The recent lending boom of the 1990s was quite different in nature. Instead of direct lending to developing countries, portfolio flows and foreign direct investment (FDI) became the dominant source of capital inflows. The governments of developing countries have also come to rely more on issuing debt securities than on foreign commercial bank loans. Most commercial bank lending to developing countries now goes directly to the private sector, often channeled through banks and other

financial institutions. Moreover, syndicated bank loans have become far less important (see Chadha and Folkerts-Landau 1999).

These stylized facts are illustrated in figure 3.2. The figure breaks down capital flows into four components. The first is FDI, which has been by far the smoothest of all components. It rose from about 0.5 percent of GDP in the early 1980s to almost 1 percent of GDP in 1996. The second, portfolio flows, is associated with trade in equity and debt securities. Net portfolio flows rose from practically zero in the mid-1980s to almost 4 percent of GDP in 1993. These flows have been very volatile as well, dropping to less than 1 percent of GDP in 1995 as a result of the Mexican crisis, and rising again to 3 percent of GDP in 1996.

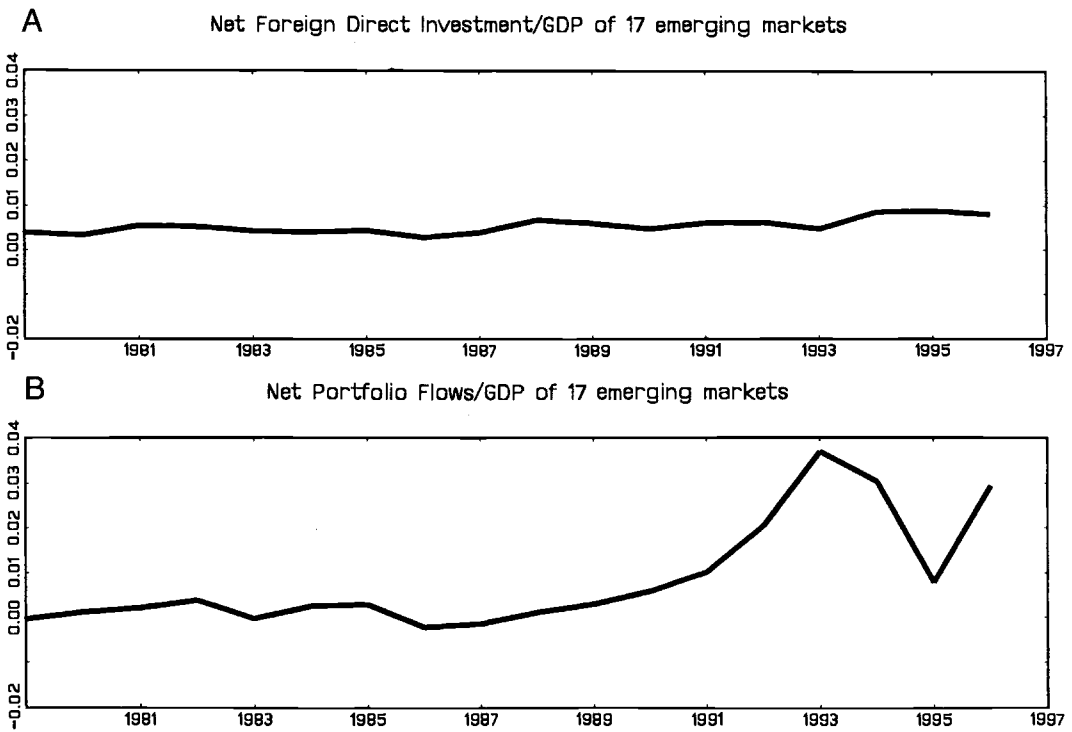
The remaining components are classified under "other investment" by the International Monetary Fund (IMF): loans, currency and deposits, and trade credits. For illustrative purposes we have broken "other investment" up into two components. The first, "nonportfolio net private flows," are net flows to the private sector other than portfolio and FDI flows. The debt crisis of the early 1980s was marked by a sharp drop in net "nonportfolio net private flows" from 3 percent of GDP in 1981 to −2 percent of GDP in 1983. Since the mid-1980s these flows have slowly increased again as confidence was restored and the old debt restructured. The second component, "nonportfolio net government flows," are net flows to the government sector other than portfolio flows, including official loans. These have clearly declined since the early 1980s. During the 1990s total net nonportfolio flows, while volatile, have been close to zero on average.

The remainder of the paper will focus on capital inflows rather than net flows. As illustrated by figure 3.3, almost all the action is associated with inflows. Outflows have been relatively steady at a level fluctuating between zero and 1 percent. Their recent increase may even be overestimated since capital flight seems to have declined (see Schineller 1997). The story of net capital flows is therefore almost entirely a story of capital inflows.

3.1.2 Liberalization, Overshooting, and Volatility

What are the factors behind the increase in lending to emerging economies? This question is crucial as its answer will determine whether the flows pouring into emerging economies can be sustained, and thus be used for their long-term development. It will also help in adopting the right policies in the shorter run. Should these flows be only temporary, they would be of little use for these countries and only create short-run policy management problems. The first empirical studies attempting to uncover the factors causing the increase in flows found that low real interest rates in developed countries play a substantial role.[2] This evidence led some

2. See Calvo, Leiderman, and Reinhart (1996) and Frankel and Okongwu (1996) for surveys of these earlier studies.


A
Net Foreign Direct Investment/GDP of 17 emerging markets
0.04
0.03
0.02
0.01
0.00
-0.02
1981
1983
1985
1987
1989
1991
1993
1995
1997
B
Net Portfolio Flows/GDP of 17 emerging markets
0.04
0.03
0.02
0.01
0.00
-0.02
1981
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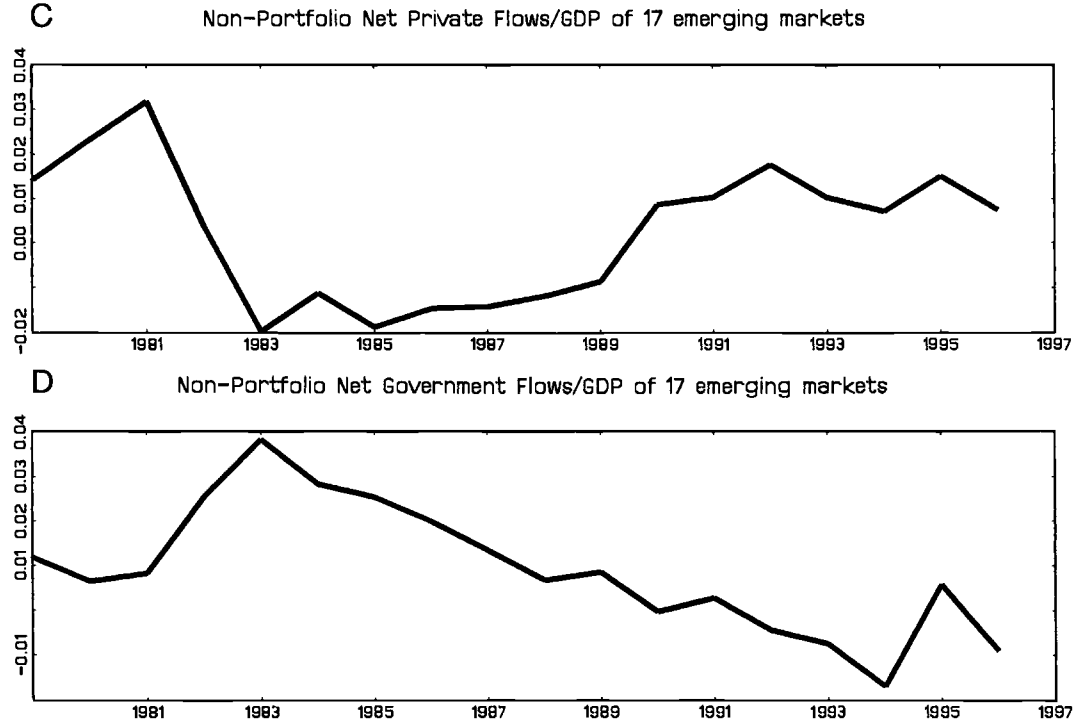


Fig. 3.2 Net foreign direct investment/GDP (*A*), net portfolio flows/GDP (*B*), nonportfolio net private flows/GDP (*C*), and nonportfolio net government flows/GDP (*D*), for seventeen emerging markets

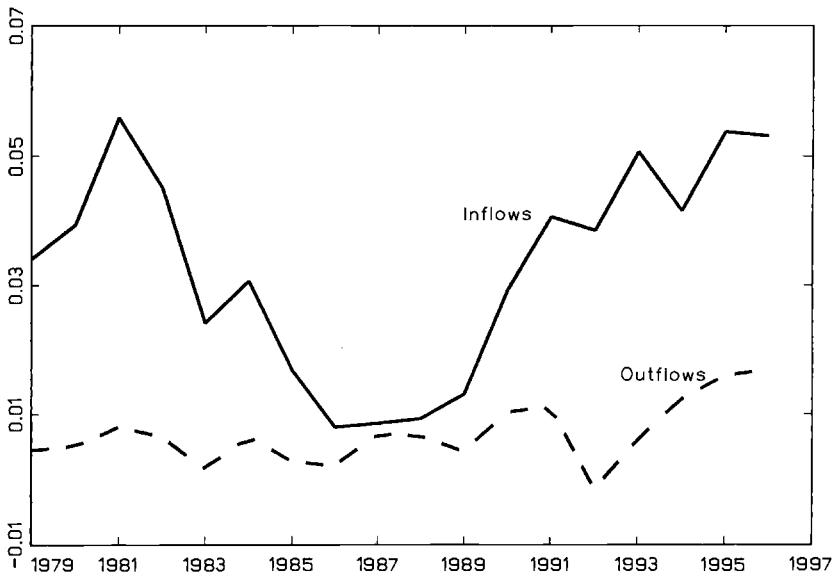


Fig. 3.3 Total capital inflows and outflows/GDP for seventeen emerging markets

analysts to conclude that the increase in inflows to emerging market countries was temporary and would decline with the subsequent increase in world interest rates. Developments in more recent years have shown this prediction to be incorrect.

Our contention is that there is one fundamental factor behind the increase in capital inflows to some developing countries: the wave of financial liberalization and structural reforms undertaken in recent years in emerging as well as industrialized countries. The changes in emerging market countries include the removal of capital controls, the liberalization of the domestic financial system, trade liberalization, macroeconomic stabilization, and privatization. Obviously, the dates, the extent, and the pace of liberalization differ across countries. Typically, liberalization measures were adopted progressively over several years. Moreover, most countries only liberalized partially. For example, Korea kept many restrictions in financial markets. Its partial liberalization measures, however, led to a surge in borrowing by domestic banks and, to a lesser extent, in some categories of portfolio flows.

Nevertheless, there is a clear trend toward liberalization in the 1990s. For example, an indication of capital account liberalization can be found by using the capital controls index computed by Bartolini and Drazen (1997) and based on the IMF Exchange Arrangements and Exchange Re-

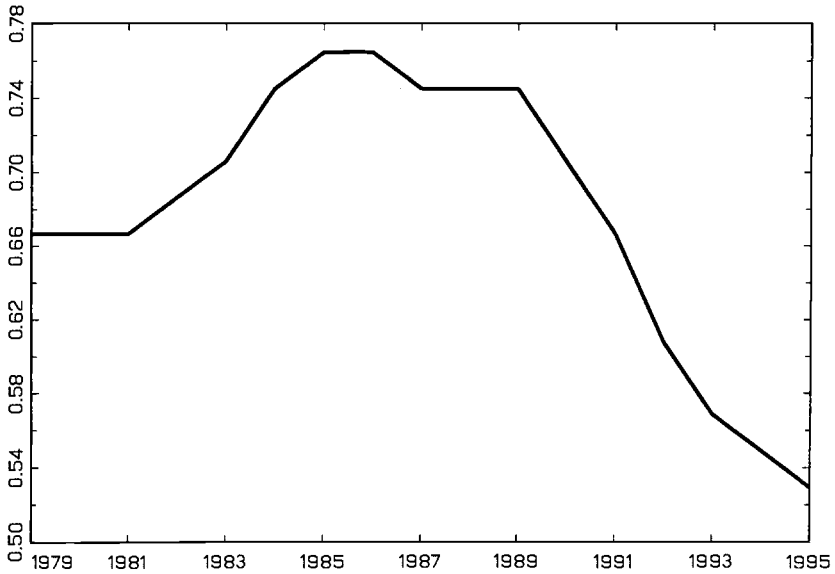


Fig. 3.4 Average capital controls index for seventeen emerging markets

strictions.[3] Figure 3.4 shows the average of this index for the seventeen emerging economies we consider. The degree of capital controls increased in the early 1980s only to decline dramatically in the 1990s. The profile of the capital controls index is strikingly similar to net lending depicted in figure 3.1.

It is also useful to put developments in emerging markets into perspective against the background of increased integration of industrialized countries. During the 1980s and 1990s we have seen a substantial increase in equity and bond flows among industrialized countries. This process, known as "securitization," is a result of domestic and international financial deregulation, financial innovation, and technological advances in communication and computing.[4] Nonetheless portfolio flows to emerging markets have grown even faster. Of total FDI plus portfolio outflows from the sum of twenty-one industrialized countries, we find that 2 percent was allocated toward our seventeen emerging markets in 1986 and 1987. This increased to an average of 16 percent during the 1990s.

Although the impact of the various reforms is not yet well understood, several studies have focused on equity markets and financial liberaliza-

3. We would like to thank Leonardo Bartolini for providing the data. See Bartolini and Drazen (1997) for more details on this index.

4. For further discussion on these developments, see World Bank (1997, ch. 2).

tion.[5] In particular, Henry (2000b) analyzes a group of eleven countries (a subset of our seventeen countries) and shows empirically that stock market liberalization has a significant positive impact on private investment. In a related paper, Henry (2000a) shows that equity prices significantly increase after a stock market liberalization. He also finds, however, that other economic reforms have an impact of the same order of magnitude. More specifically he constructs indexes of four types of reforms: macroeconomic stabilization, trade liberalization, privatization, and easing of exchange controls. This evidence shows that it is necessary to consider the set of all liberalizations and reforms to understand the recent developments (see also Bekaert and Harvey 1997). In this paper we will not attempt to disentangle the various liberalizations or reforms and simply assume that they jointly increase returns and give easier access to financial markets of these countries.

The increased attractiveness of emerging markets to foreign investors obviously preconditions the potential impact of other factors. For example, external developments such as movements in world interest rates are likely to have a larger impact on these economies. Domestic economic events will also have wider consequences. Thus, capital flows potentially become more sensitive to other variables and more volatile. Moreover, since the liberalizations represent in principle a permanent change, the increase in inflows should be seen as ultimately permanent. This should allow for an easier financing of emerging countries' development.

If one adopts the view that domestic liberalizations and reforms play a central role in the recent lending boom, it is important to understand their impact in both the short and the long run. One can easily think of a series of highly relevant questions: How much foreign capital can developing countries expect to receive in the long run? When are capital inflows "too large"? Is there a risk of sharp reversal in flows? Will volatility decline over time?

Before we attempt to address these questions, it is useful to consider figures 3.5 through 3.7 as they provide some interesting insights into the discussion. Figure 3.5 compares the cumulative inflows from 1989 to 1996 of individual countries. For each country it shows its fraction of total cumulative inflows to all the seventeen emerging market countries and compares it to the country's share in the 1992 capital stock of all seventeen countries.[6] When we look at total inflows, the countries that have experienced large inflows in comparison to the relative size of their capital stock are Argentina, Thailand, Korea, and Mexico. These countries have all experienced serious recent crises associated with a sharp drop in inflows. At

5. Stulz (1999) provides a nice survey. See also Bekaert (1995), Bekaert and Harvey (1997), and Henry (2000a, 2000b).

6. The capital stock data is computed by updating the estimates of King and Levine (1994). See section 3.4 for more details.

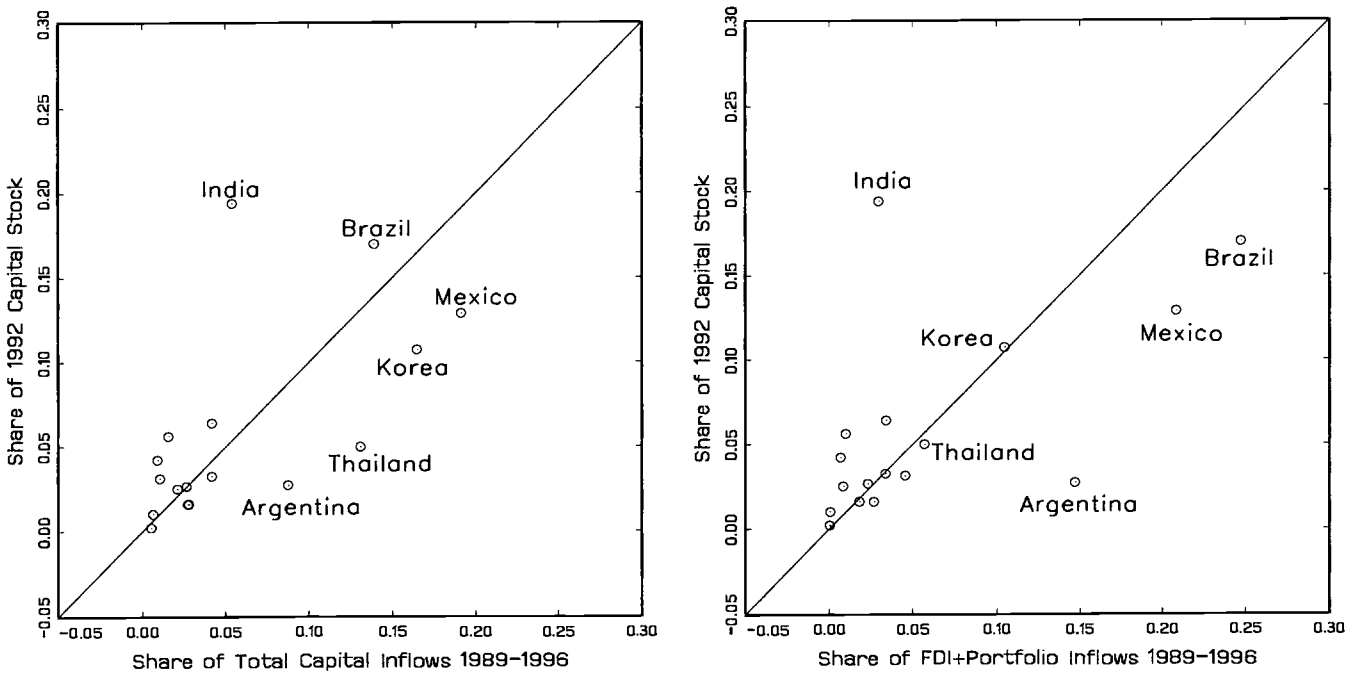


Fig. 3.5 Cumulative capital inflows (*left panel*) and share of FDI plus portfolio inflows (*right panel*) versus capital stock

Note: The share of 1992 capital stock (vertical axis) is the 1992 capital stock of a country divided by the total 1992 capital stock over all seventeen emerging markets. Similarly, the share of total capital inflows over 1989–96 is equal to total capital inflows during that period in a country divided by the sum of all those inflows over all seventeen emerging markets.

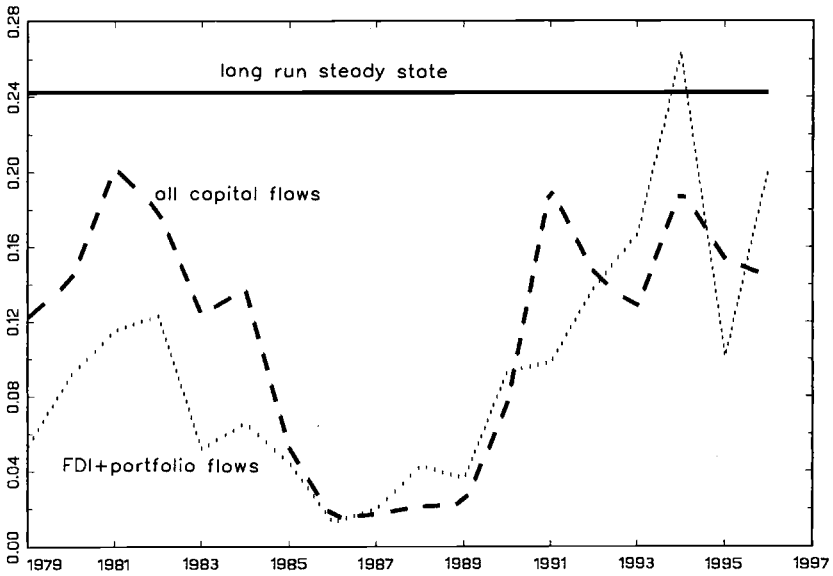


Fig. 3.6 Inflows emerging markets/outflows industrialized countries
Note: The figure shows the share of capital outflows from twenty-one industrialized countries going to the seventeen emerging markets.

the other extreme of the spectrum is India, whose capital stock is about 20 percent of the total emerging market capital stock, but whose inflows are only slightly over 5 percent of total inflows as a result of capital controls. When we only consider FDI plus portfolio flows,[7] Korea and Thailand have experienced "normal" inflows. These two countries received relatively large inflows to the banking sector, and faced reversals of these flows in 1997. It seems indeed that countries with large inflows tend to experience sharp corrections.[8]

Figure 3.6 shows the share of capital outflows from the sum of twenty-one industrialized countries that goes to the seventeen emerging economies. The straight line represents our estimate of the steady-state inflows based on a model that we develop in section 3.4. It corresponds to a scenario whereby the emerging markets are equally well integrated into world capital markets as the industrialized countries. In the 1990s emerging market countries have received somewhat less than 20 percent of total capital outflows from industrialized countries, which is similar to the peak during the previous lending boom. FDI plus portfolio flows peaked at 26 percent

7. Since most of FDI consist of equity claims above 10 percent of a firm's value, we add them to portfolio flows.

8. See Milesi-Ferretti and Razin (1997) for an econometric analysis of the determinants of net lending reversals.

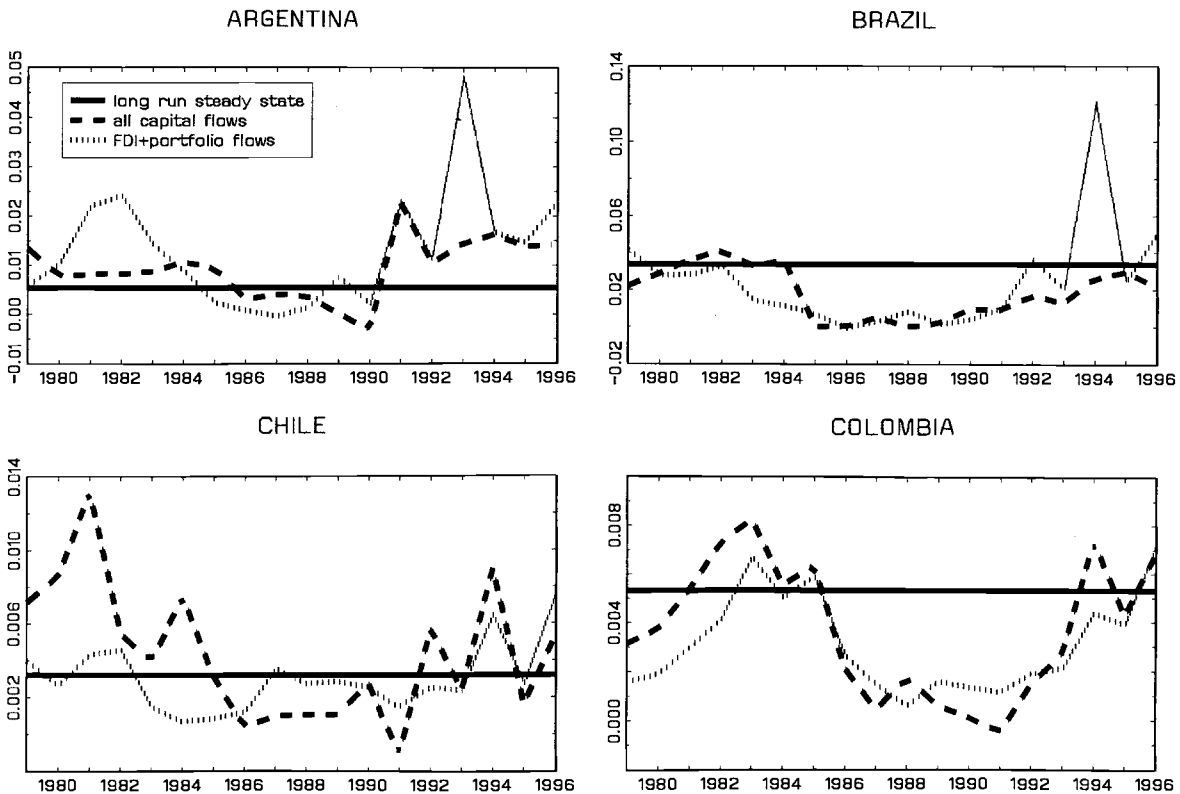
of industrial country outflows during 1994, which is even slightly above our long-run steady-state estimate and far above the peak during the previous lending boom. On average, though, both portfolio and total flows during the 1990s remain below their long-run steady-state level.

Figure 3.7 presents the data in figure 3.6 on a country-by-country basis. For a particular country *i*, it shows the fraction of capital outflows from all other countries that is allocated to country *i*. Several conclusions can be drawn from these illustrations. First, inflows are highly volatile at the country level. Second, in many countries inflows overshoot our estimate of steady-state flows in some years. Third, in most cases the end of the overshooting period coincided with a crisis. This is particularly the case for Chile and Mexico in the early 1980s and for Mexico, Thailand, and Korea in the 1990s. Finally, we observe the overshooting for all different types of capital flows. Argentina, Brazil, and Mexico experienced sharp reversals of portfolio flows. Peru experienced a sharp reduction in FDI flows in 1995. Thailand and Korea faced a large drop in loans and deposits to banks and other financial institutions during 1997.

The countries that have experienced overshooting of capital inflows are also the ones where we have seen substantial capital account and financial liberalization. Argentina is an example of a country that liberalized capital flows at an early stage. Since 1989 foreigners may invest in Argentina without prior approval, on the same terms as investors who are resident in Argentina.[9] Capital flows to Argentina have been substantially above the long-run steady-state level since 1990. In Thailand major capital account liberalization measures were undertaken during 1990–92.[10] Direct investment was encouraged, new closed-end mutual funds were established, tax incentives were granted to foreign mutual funds for investment in the stock market, and authorities approved the establishment of the Bangkok International Banking Facility, which expanded short-term inflows. It is indeed during this period that we see a sharp increase in capital flows to Thailand, reaching above the long-run steady-state level. Korea has maintained significant capital account controls throughout the sample. The liberalizations have been very gradual and selective. In 1992 nonresidents were permitted limited access to the stock market and the limit on foreign direct investment was increased. In 1996 nonresidents were permitted to invest in domestic bonds through country funds. It has also become easier to attract short-term bank deposits from foreigners. Because the liberalizations were more limited and gradual, we see smaller overshooting of capital inflows than in countries that have more aggressively liberalized the capital account. Finally, there are countries such as India, Malaysia, South

9. See the 1990 and 1991 issues of *Exchange Arrangements and Exchange Restrictions* by the IMF.

10. See Johnston, Darbar, and Echeverria (1997) for details.


ARGENTINA
long run steady state
all capital flows
FDI+portfolio flows
0.05
0.04
0.03
0.02
0.01
0.00
-0.01
1980
1982
1984
1986
1988
1990
1992
1994
1996
BRAZIL
0.14
0.10
0.06
0.02
-0.02
CHILE
0.014
0.010
0.006
0.002
COLOMBIA
0.008
0.004
0.000

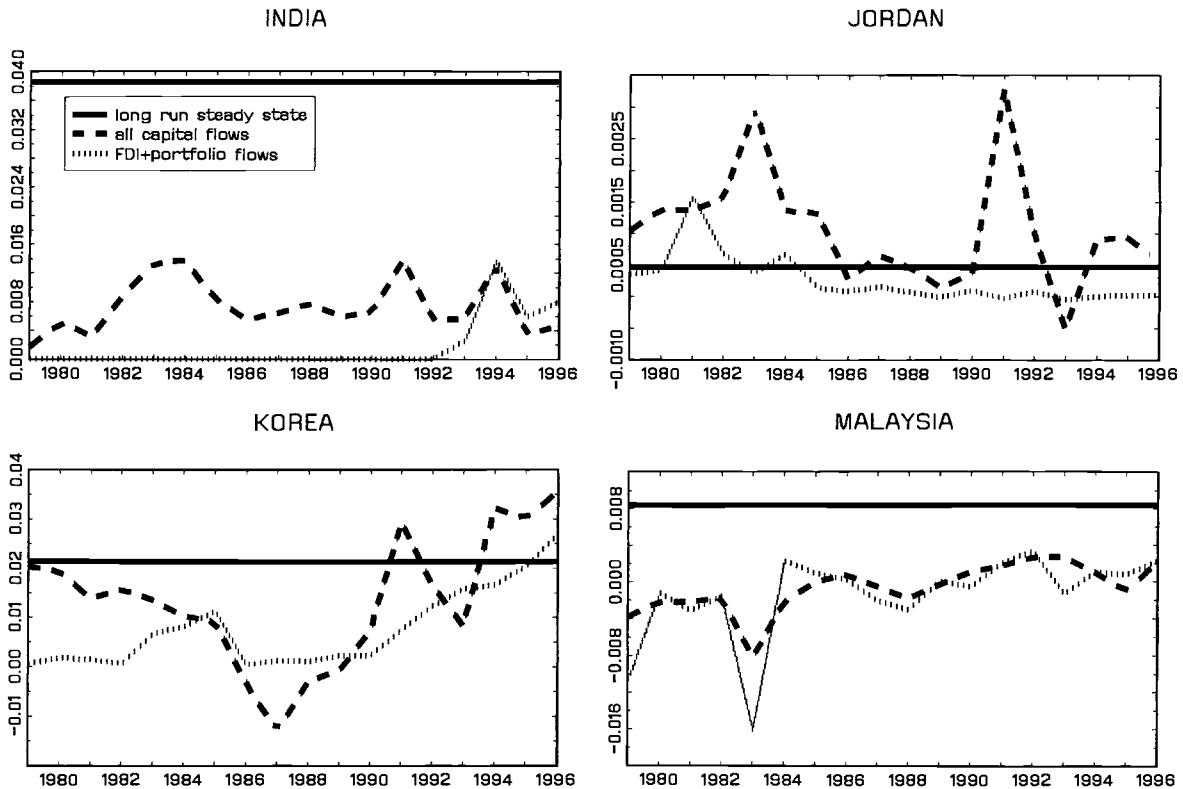
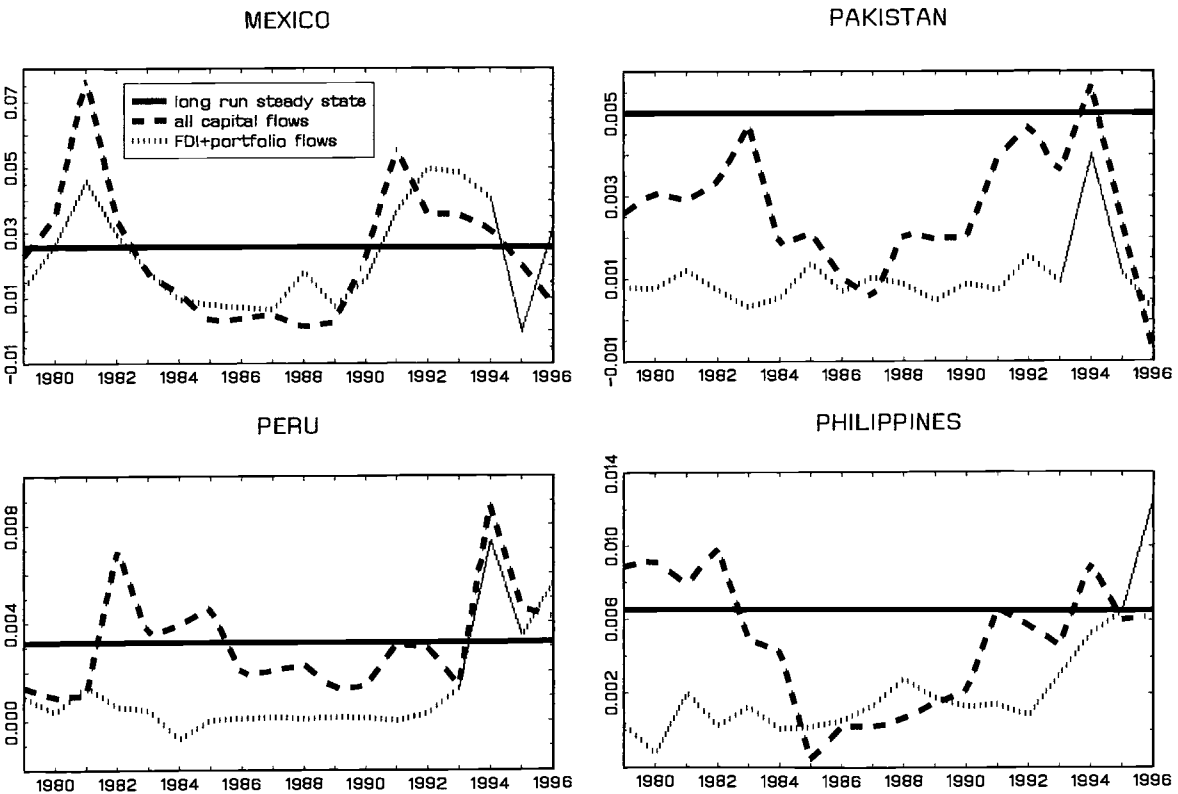


Fig. 3.7 Capital inflows/capital outflows from the rest of the world

Note: For each country, the figure shows the share of capital outflows from the rest of the world invested in that country.


MEXICO
long run steady state
all capital flows
FDI+portfolio flows
0.07
0.05
0.03
0.01
-0.01
1980
1982
1984
1986
1988
1990
1992
1994
1996
PAKISTAN
0.005
0.003
0.001
-0.001
1980
1982
1984
1986
1988
1990
1992
1994
1996
PERU
0.008
0.004
0.000
1980
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1984
1986
1988
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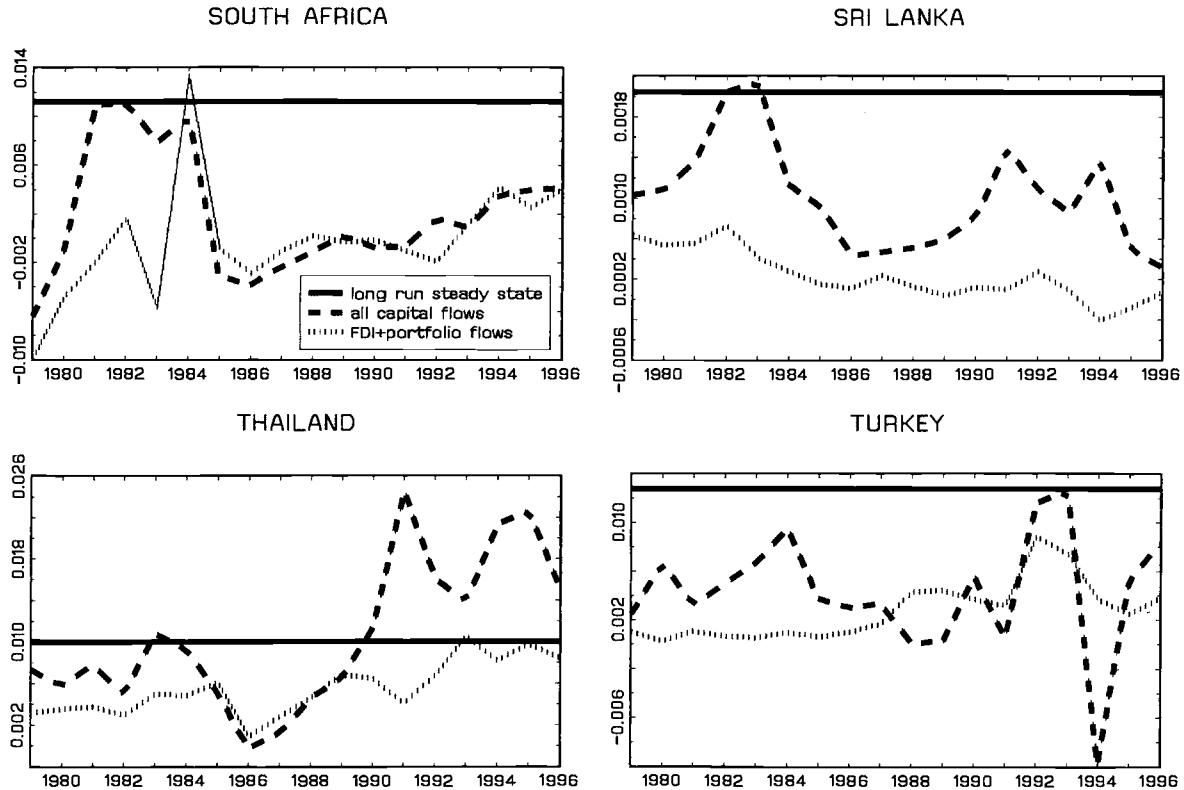
SOUTH AFRICA
SRI LANKA
THAILAND
TURKEY
long run steady state
all capital flows
FDI+portfolio flows
0.014
0.006
-0.002
-0.010
0.0018
0.0010
0.0002
-0.0006
0.026
0.018
0.010
0.002
-0.006
1980
1982
1984
1986
1988
1990
1992
1994
1996

Fig. 3.7 (cont.)

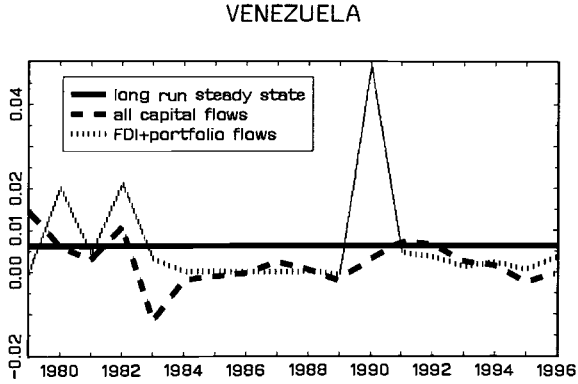
VENEZUELA
long run steady state
all capital flows
FDI+portfolio flows
0.04
0.02
0.01
0.00
-0.02
1980
1982
1984
1986
1988
1990
1992
1994
1996

Fig. 3.7 (cont.)

Africa, and Sri Lanka whose capital markets remain largely closed to foreigners and where capital flows in the 1990s stayed significantly below the long-run steady state.

3.1.3 A Simple Framework

The above evidence shows that beside the general increase in capital flows to emerging market countries, there is a complex dynamic process. The objective of this paper is to shed some light on this process. More specifically, we address three issues: (1) What causes the overshooting? (2) Why can high volatility be associated with a period of liberalization? (3) How large can capital flows to developing countries be in the long run?

Since the impact of the liberalizations and structural reforms on the dynamics of capital flows has not been examined carefully in the previous literature, we study the implications of a simple dynamic model. We first consider a model in which the liberalization is completely deterministic. In other words, investors know when and how much emerging capital markets open up and macroeconomic reforms are adopted. This leads to portfolio adjustments and gives rise to a nonlinear relationship between capital flows and liberalization, with overshooting as a central feature. The nonlinear relationship between fundamentals and capital flows makes analysis of sustainability even more difficult than usually thought.[11]

We subsequently introduce incomplete information, from the point of view of foreign investors, about the extent of liberalization and economic reforms. Since the structural changes happening in reforming countries drastically alter the economic environment and since these countries may be new to investors, information on investment opportunities is often greatly limited. We argue that this incomplete information and the subsequent process of learning may have a substantial impact on the dynamics of capital inflows and can generate high volatility, consistent with that observed in the data. We illustrate this point by incorporating learning in our dynamic model and by simulating it.

Finally, we modify our model to examine the steady state. We compute some heroic estimates of long-run capital inflows in a world where emerging markets are "equally" integrated into world capital markets as industrialized countries.

Several explanations have been proposed in the literature to explain the volatility of capital flows, in particular in the context of the Southeast Asian crisis. These explanations rely on multiple equilibria, herd behavior, bubbles, or even irrational behavior. In contrast, our analysis shows that a simple macroeconomic model with optimal portfolio decisions can explain several important features of capital flows. Nevertheless, our focus

11. See Milesi-Ferretti and Razin (1996) for a discussion of sustainability.

on the impact of liberalizations is compatible with other approaches and should be seen as a complementary view.

3.2 A Model of Capital Flows

The impact of liberalizations and reforms is a complex issue that has been analyzed from different perspectives. McKinnon (1993) provides an interesting overview of many of the issues. In this paper, we argue that the dynamic implications of these structural changes are nonlinear and can explain some of the volatility of capital flows. Our approach is somewhat related to that of Bacchetta (1992), who uses an overlapping generation model to look at a joint liberalization of capital flows and of the domestic financial system. The latter is represented by a reduction in margins charged by the domestic financial system that implies both an increase in return to domestic savers and a decrease in the cost of capital for firms. It is shown that a joint liberalization generally leads to an initial period of large net capital inflows. Over time, however, net inflows decline and may be replaced by net outflows. Moreover, there is an overshooting in share prices. Nevertheless, Bacchetta's analysis only considers a small open economy, does not incorporate uncertainty, and only analyzes once-and-for-all liberalizations.

In this section, we consider a world economy with an arbitrary number of developed and emerging economies. We introduce uncertainty and the explicit portfolio decisions of investors.[12] We analyze both once-and-for-all and gradual liberalizations and study the impact on the dynamics of capital inflows. We also examine the impact of liberalization occurring simultaneously in all emerging markets. On the other hand, to keep the analysis tractable, we introduce some simplifying assumptions. In particular, we abstract from intertemporal consumption decisions[13] and assume that there are no capital outflows from emerging markets.[14] We also assume that capital can be costlessly moved across countries, although we do introduce an adjustment cost reflecting bottlenecks. Most of these assumptions can be relaxed in more complex and realistic models without altering the basic insights.

3.2.1 Basic Setup

Assume that the world is made up of N identical developed countries and J identical emerging economies. There is one capital good, which can

12. Calvo and Mendoza (1996, chap. 1 in this volume) also consider explicit portfolio decisions in a model of international capital flows.

13. Thus, we do not consider consumption booms that have been observed in some countries.

14. Figure 3.3 shows that this is not a bad approximation as most of the increase in the net inflows are due to gross inflows.

be invested in any country. At time 0 individuals in developed and emerging economies own respectively W^* and W capital goods. While capital goods depreciate at a constant rate δ, each year individuals receive a new endowment of capital goods equal to δW^* in developed countries and δW in emerging economies. Thus the endowment of capital goods in each country remains constant over time. The capital goods are lent to firms that produce a nonstorable consumption good in the following period. Firms have a random technology and shocks are country specific. Individuals receive the consumption good in proportion to their investment and consume it. Hence, this economy does not allow intertemporal substitution and individuals simply maximize each period the risk-adjusted return from their investment. This allows us to focus on the portfolio diversification aspect of capital flows to emerging markets.

It is assumed that emerging-country individuals invest only in domestic firms, while rich-country investors can diversify internationally. Allowing emerging-country residents to hold well-diversified portfolios does not qualitatively alter the results. It is therefore a simplifying assumption that allows us to focus on capital inflows, and, as figure 3.3 shows, it is also broadly consistent with the data. The return on investment in developed country i is $\mu_{it}^* \sim N(\bar{\mu}^*, \sigma^{*2})$. This means that with capital stock K_{it}^* production of the consumption good is $\mu_{it}^* K_{it}^*$. The return r_{it} on investment in emerging market i is composed of three elements:

$$r_{it} = \mu_{it} - \tau_{it} - c(I_{it}),$$

and the expected return is $\bar{r}_{it} = \bar{\mu} - \tau_{it} - c(I_{it})$. The variable $\mu_{it} \sim N(\bar{\mu}, \sigma^2)$ denotes the return from firms' production. We denote the correlation between returns in two countries by ρ_{EE} for two emerging economies, ρ_{DD} for two developed economies, and ρ_{ED} for a developed and an emerging economy. A tax τ_{it} is imposed on foreign investors. This tax captures the various barriers or costs to investment faced by investors (capital controls, illiquid markets, taxation, etc.). A liberalization is simply modeled by a decrease in τ_{it}.

Finally, there is an installation cost $c(I_{it})$ that is incurred when the capital stock is increased. A major element influencing capital inflows is that the liberalizing economies have difficulties absorbing large flows for various reasons. There may not be an efficient structure to channel funds to the most productive uses, in particular because of a weak financial system or thin markets.[15] Other reasons include incomplete information, lack of infrastructure or skilled labor, and various other bottlenecks. Without an installation cost the portfolio adjustment in response to a change in the tax is immediate. This would lead to an excessive, and unrealistic, realloca-

15. Gavin and Hausman (1996), World Bank (1997), and several others stress the role of weak domestic financial markets.

tion of resources between developed and emerging countries in response to a shock. We assume $c(I) = cI$, with c being a constant.[16]

Asset prices also fluctuate in presence of the installation cost $c(I)$. If we interpret $\mu - \tau$ as the return on installed capital, one can show that the price of installed capital in emerging market i minus the price of installed capital in industrialized countries, both at time $t - 1$, is equal to $c(I_{it})$ discounted at the implicit risk-free interest rate. An investment boom in emerging markets therefore leads to a rise in the relative price of emerging markets' capital. Asset price booms and busts associated with foreign capital inflows and outflows are indeed commonly seen in emerging markets and play a particularly important role in the Asian crisis. For simplicity, however, we do not introduce asset prices explicitly.

The basic decision variable is the proportion α_{it} that an individual in a rich country invests in country i. When the investment allocations are determined, the capital stock in emerging country i is given by

$$K_{i,t} = W + N\alpha_{it}W^*, \tag{1}$$

while investment is given by

$$I_{it} = K_{it} - (1 - \delta)K_{i,t-1}. \tag{2}$$

A liberalization, captured by a decline in τ_{it}, implies a change in portfolio allocations α_{it} and consequently in investment and the capital stock.

3.2.2 Portfolio Allocation

It is first necessary to derive the optimal portfolio allocation before determining the capital stock, investment, and capital inflows. Since there is no intertemporal allocation, individuals from developed countries maximize their utility each period through the optimal investment allocation across countries. Assuming an exponential utility function $U(C) = e^{-\theta C}$, and given that consumption is equal to portfolio return R_t times W^*, rich-country investors' optimization problem is

$$\max_{\alpha_{jt}} E(R_t) - \frac{\gamma}{2}\operatorname{var}(R_t), \tag{3}$$

where

$$R_t = \sum_{j=1}^{J}\alpha_{jt}r_{jt} + \sum_{i=J+1}^{J+N}\alpha_{it}\mu_{it}^*, \qquad \sum\alpha_{jt} = 1, \qquad \text{and } \gamma = \theta W^*.$$

16. We could also make the installation costs a function of I/K. But qualitatively this makes no difference for the results. We could have added an installation cost to the return in developed countries as well, but again omit it for the sake of simplicity. What is important is that the bottlenecks are greater for emerging markets than for industrialized countries.

The appendix derives the optimal investment allocations. Here we only consider the case where the correlation of returns across all countries is zero and $\sigma = \sigma^*$. The average expected return in emerging markets is denoted $\bar{r}_t = \Sigma_{j=1}^{J} \bar{r}_{jt}/J$. Then, the investment share in emerging country j is given by:

$$\alpha_{jt} = \frac{1}{N+J} + \frac{\bar{r}_{jt} - \left[\frac{J}{N+J}\bar{r}_t + \frac{N}{N+J}\bar{\mu}^*\right]}{\gamma\sigma^2}. \tag{4}$$

The portfolio share depends on the expected excess return between emerging country j and the world return (equally weighting all countries).

The impact of a liberalization can readily be derived from equation (4). If the liberalization occurs in country j only we find:

$$\frac{\partial \alpha_j}{\partial \tau_j} = -\frac{N+J-1}{(N+J)\gamma\sigma^2}.$$

If the liberalization occurs simultaneously in all emerging economies:

$$\frac{\partial \alpha_j}{\partial \tau_j} = -\frac{N}{(N+J)\gamma\sigma^2}.$$

Obviously the impact is larger when a country liberalizes alone because it has fewer competitors for the foreign capital. The difference increases with J. To attract a certain amount of foreign capital, the incentive to liberalize is greater the larger the number of other emerging countries that open up their markets. A larger reduction in τ is needed.

3.2.3 The Dynamics of Capital Flows

Once portfolio shares are known, capital flows can be derived. First consider the case where all countries liberalize simultaneously and have the same $\tau_{it} = \tau_t$. In that case we can write:

$$\alpha_{jt} = x_0 + x_1(\bar{r}_t - \bar{\mu}^*), \tag{5}$$

where $x_0 = 1/(N+J)$ and $x_1 = N/[(N+J)\gamma\sigma^2]$. Using the definition of $\bar{r}_t$, the evolution of the capital stock is given by substituting equation (5) into equation (1):

$$K_{it} = W + N(x_0 + x_1(\bar{\mu} - \bar{\mu}^*))W^* - Nx_1W^*(\tau_t + cI_{it}). \tag{6}$$

Here we used the fact that all emerging countries have the same investment rate. Combining with equation (2) gives us a stable linear difference equation for the capital stock:

$$K_{it} = f(\tau_t) + \frac{Nx_1W^*c}{1 + Nx_1W^*c}(1 - \delta)K_{i,t-1}, \tag{7}$$

where

$$f(\tau_t) = \frac{N(x_0 + x_1(\bar{\mu} - \bar{\mu}^*))W^* + W - Nx_1W^*\tau_t}{1 + Nx_1W^*c}$$

is a negative function of τ_t. Since investment by domestic residents is a constant δW, capital inflows are equal to total investment minus δW. Using equation (2) this gives

$$\text{Inflows}_{it} = f(\tau_t) - (1 - \delta)\frac{1}{1 + Nx_1W^*c}K_{i,t-1} - \delta W. \tag{8}$$

We can use these equations to determine the impact of a joint liberalization. We will also consider the case where only one country liberalizes. The equations are qualitatively similar. Assuming that the average tax rate across all emerging markets remains constant, it follows from aggregating equations (1), (2), and (4) that the aggregate capital stock, investment, and $\bar{r}_t$ remain constant. In that case, from equation (4),

$$\alpha_{jt} = x_2 + x_3(\bar{r}_{it} - \bar{\mu}^*), \tag{9}$$

where

$$x_2 = \frac{1}{N + J} - \frac{(\bar{r}_t - \bar{\mu}_t)J}{(N + J)\gamma\sigma^2} \quad \text{and } x_3 = \frac{1}{\gamma\sigma^2}.$$

Substituting equations (9) and (2) into equation (1), the differential equation for the capital stock, and equation (8) for capital inflows, remain unchanged, with x_0, x_1, and τ_t replaced by x_2, x_3, and τ_{it}.

3.2.4 The Response to a Financial Liberalization

The dynamic impact of a liberalization can readily be derived. From equation (7) a permanent financial liberalization, as captured by a permanent decrease in the tax rate τ_{it}, leads to a gradual rise in the capital stock to a higher level since $f(\tau_t)$ increases. From equation (8) it follows that there will be an immediate rise in capital inflows, followed by a gradual decline to a higher steady-state level. Capital inflows therefore overshoot their new steady-state level after a liberalization. It can be easily verified that the overshooting is smaller, although more persistent, when the installation cost is larger. The precise dynamics of capital flows obviously changes with the form of installation costs, but even with a nonlinear cost function the qualitative results are the same.

However, examining a once-and-for-all liberalization does not appear

very realistic. First, as we argue in section 3.1, it is a combination of various liberalizations and reforms that makes investment more attractive. They typically do not occur simultaneously. Second, even specific reforms are often gradual. For example, consider the stock market liberalizations that have been analyzed empirically. A useful measure of the stock market openness to foreign investors is the investability index computed by the International Finance Corporation (IFC). For each stock an investability index between 0 and 1 is computed, measuring the ease with which foreign investors can buy and sell the stock. The aggregate investability index is a weighted average of the index for each stock, with weights based on market capitalization. This index has been used in particular by Bekaert (1995) and Henry (2000a, 2000b) to measure liberalization. Figure 3.8 shows the evolution of this index for a subset of six countries.[17] While stock market liberalizations in Chile, India, and Mexico can best be characterized as once-and-for-all permanent liberalizations, those in Brazil, Pakistan, and Venezuela are more gradual.

Consequently it seems interesting to consider a gradual liberalization. The dynamic impact of such a liberalization obviously depends on its profile over time. In the next subsection we calibrate the model and numerically simulate a simple gradual liberalization.

3.2.5 Numerical Simulation

The gradual liberalization we consider is the case where the tax rate declines exponentially. We assume that τ_t decreases at a rate of 10 percent per year: $\tau_t = e^{-0.1t}\tau_0$. We set the model parameters as follows. First $\sigma = 0.05$ is the average standard deviation on a broad measure of capital return for the four industrialized countries in Baxter and Jermann (1997). Such a broad measure of capital return is not available for emerging markets. Harvey (1995) reports average returns on equity for industrial countries and emerging markets. The latter is on average 80 percent larger, so that we set $\sigma^* = 0.09$. We set $\mu = 0.07$, and $\mu^* = 0.106$ is set such that investment in emerging markets by industrialized countries is zero before the liberalization. The assumed correlations are $\rho_{EE} = 0.06$, $\rho_{ED} = 0.12$, and $\rho_{DD} = 0.35$. These are based on correlations for equity returns reported by Harvey (1995). We set $W = 1$ and $W^* = 4$. This reflects the fact that per capita capital stock in industrialized countries is on average about four times that of emerging markets.[18] We set the number of developed and emerging countries, N and J, both equal to 20. This implies that emerging markets hold 20 percent of global wealth. This corresponds closely to the share of emerging country capital stocks in the global capital stock. We set γ such that the rate of relative risk-aversion is 3 at the preliberalization

17. The other countries have either fewer observations or little change in the index.
18. This is based on the 1992 capital stock data discussed in section 3.1.

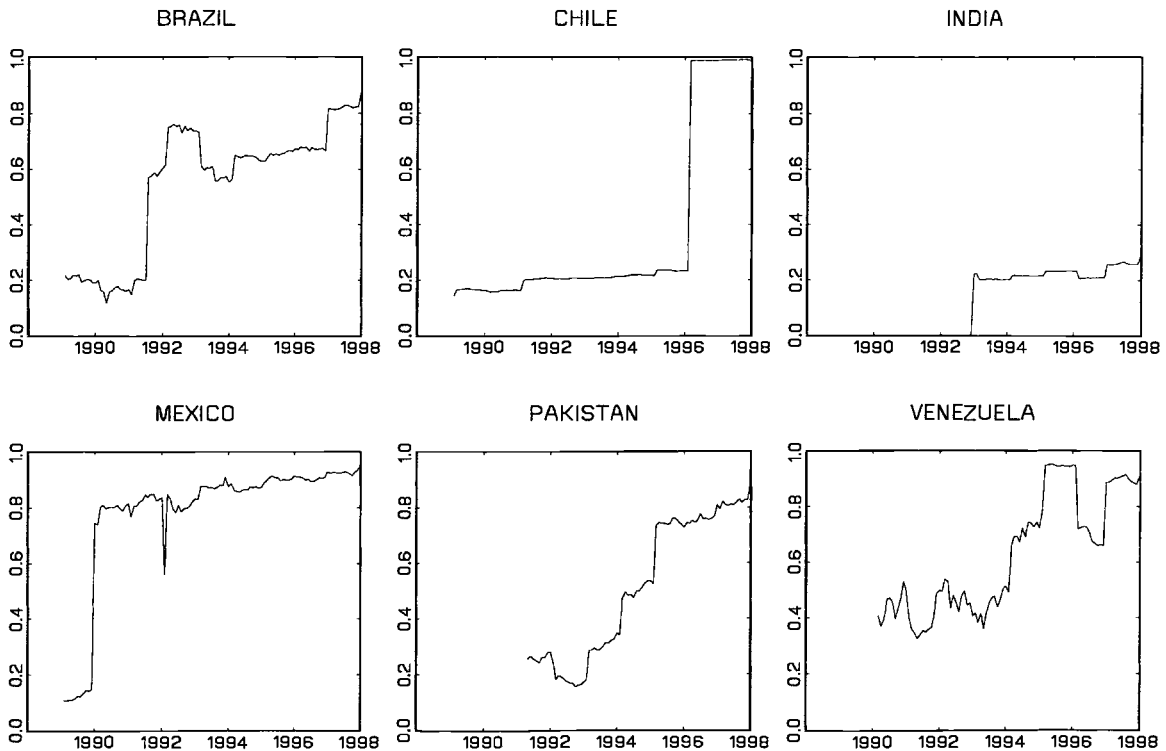

Fig. 3.8 IFC investability index

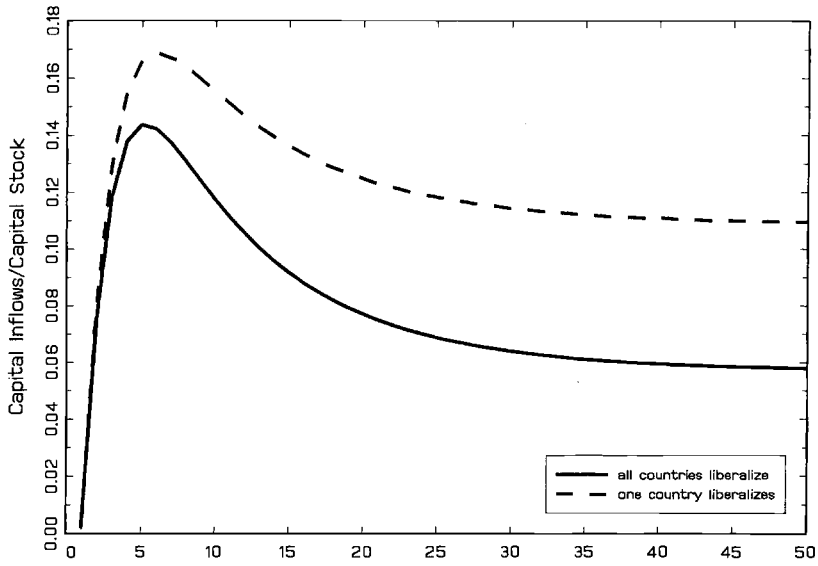

Fig. 3.9 Dynamic response to gradual liberalization

average level of industrial country consumption. The adjustment cost parameter c is set at 0.05. Finally, we set $\delta = 0.07$ to be consistent with the depreciation rate assumed by King and Levine (1994) to compute the capital stock data we use.

Figure 3.9 shows the dynamic response of capital inflows relative to the capital stock when the tax rate decreases exponentially at a rate of 10 percent per year, starting from a rate τ_0 of 0.05. The figure shows both the case where only one country liberalizes and where all emerging market countries liberalize. We clearly see an overshooting of the inflows in both cases. The basic economic intuition is that there is a portfolio adjustment that needs to take place once the tax rate drops. This is a stock adjustment that requires relatively large flow adjustments in the short run. Foreign investors buy a lot of emerging market equity in the short run to raise exposure to that part of the world. Once most of the portfolio adjustment has taken place, the portfolio flows decline. If the full liberalization takes places instantaneously (permanent drop in the tax rate), inflows overshoot immediately and then gradually fall back to their higher steady-state level. In figure 3.9 portfolio flows rise during the first five years, after which they gradually decline. The gradual rise of portfolio flows before they peak is a result of the gradual liberalization. As discussed above, capital flows rise more when only one country liberalizes. The difference is larger for the new steady state than for the short-run response. In the short run there are high adjustment costs, which prevent excessive overshooting.

The dynamics of capital flows presented in figure 3.9 depend on the

specific profile assumed for τ_t. Other profiles obviously give different dynamics, but an overshooting is generally present. This overshooting is consistent with the data presented in figure 3.7. This result has potentially important implications. First, it shows that capital flows may be falling even when fundamentals are improving. Second, it shows that periods of large inflows and investment are likely to be followed by a downward correction.[19] This implies that periods of large inflows cannot be extrapolated. This considerably complicates policy decisions as they must take into account a potential future reversal. Edwards (chap. 7 in this volume) analyzes in detail the policy issues associated with overshooting. Third, the overshooting of capital flows will also give rise to an overshooting of asset prices because, as discussed above, the price of installed capital depends positively on the rate of investment. Asset price overshooting after a burst of capital inflows is commonly observed in emerging markets.

3.3 Incomplete Information and Learning

A crucial element in liberalization and reforms is incomplete information. Since the environment changes dramatically, investors do not have immediate full information on their new investment opportunities. The problem of incomplete information is likely to become less acute over time, however, as investors learn about their new environment. In this section we show that the presence of incomplete information can generate considerable volatility. We also argue that it can explain contagion across countries.

Incomplete information is obviously a pervasive phenomenon, but it can be far more acute in the case of liberalizing emerging economies. Foreign investors may have less information than domestic investors as these markets are new to them,[20] and there may only be incomplete information available to domestic investors and entrepreneurs. Further, there may be a large degree of uncertainty about how firms will succeed in the new environment. Bacchetta and Dellas (1997) and Fernandez and Rodrik (1991) consider examples where entrepreneurs are uncertain about their chances to succeed after a trade liberalization. Substantial liberalization and macroeconomic reforms imply a regime change. This creates an environment of uncertainty for foreign and domestic investors alike. Particularly in the beginning there is uncertainty both about the extent of the reforms and their success. In time, however, investors will learn and most of the initial uncertainty will be resolved.[21]

19. Notice that this is also consistent with the evidence present by Milesi-Ferretti and Razin (1997), who show empirically that high investment and large net inflows are significant in predicting reversals in net lending.

20. Frankel and Schmukler (1996) provide evidence of asymmetric information in the case of Mexico, while Coval (1995) and Brennan and Cao (1997) analyze its implications.

21. In a different context, but in a similar spirit, Lewis (1989) analyzes the process of learning about a shift in money demand.

In general there could be incomplete information about all components of total return: the underlying distribution of μ, the level of the tax τ, and the installation cost c. Although it does not matter much which of these is the source of incomplete information, we focus on uncertainty about τ. This could come from a lack of knowledge about the extent of economic reforms and liberalization, or uncertainty about the success of macroeconomic reforms. Although the government may announce that it has adopted far-reaching reforms, this may not fully convince foreign investors due to credibility problems. Given that investors only observe r_t, they cannot infer precisely the level of τ. Over time, however, investors continuously update their perception of τ by observing r_t. They find out the actual value of τ in the long run. This is similar to models of monetary policy credibility, whereby credibility is gradually established based on observed inflation rates, although there the government's policy is not always exogenous and changes with its reputation.[22]

Consider the following experiment. Assume that the tax rate in the emerging market is reduced permanently from $\tau = \bar{\tau}$ to $\tau = 0$ at time 0.[23] The government announces the reduction, but investors only give partial credibility to the announcement. Their prior is that with probability 0.5 τ has dropped to zero and with the same probability 0.5 it remains $\bar{\tau}$. Based on actual returns investors continuously update these probabilities. We introduce this feature in the model described above and assume that there is only one emerging market and one industrialized country, so $J = N = 1$.[24]

Let p_t be the probability investors attach to $\tau = 0$. At time t investors observe $x = \mu_t - \tau$. Through Bayesian learning, they update the probability that $\tau = 0$ as follows:

$$
\begin{aligned}
(10) \quad p_{t+1} &= P(\tau = 0 | \mu_t - \tau = x) = \frac{P(\tau = 0, \mu_t - \tau = x)}{P(\mu_t - \tau = 0)} \\
&= \frac{p_t P(\mu_t - \tau = x | \tau = 0)}{p_t P(\mu_t - \tau = x | \tau = 0) + (1 - p_t) P(\mu_t - \tau = x | \tau = \bar{\tau})} \\
&= \frac{p_t \psi((x - \bar{\mu})/\sigma)}{p_t \psi((x - \bar{\mu})/\sigma) + (1 - p_t)\psi((x + \bar{\tau} - \bar{\mu})/\sigma)},
\end{aligned}
$$

where $\psi(\cdot)$ is the density function of the $N(0,1)$ distribution.

22. See for example Backus and Driffill (1985a, 1985b). Persson (1988) and Rogoff (1987, 1989) provide surveys. In the context of international capital flows, Chari and Kehoe (1997) also consider a model with imperfect government credibility to explain capital flow volatility. But they rely on heterogeneity giving rise to herding. Investors decide sequentially whether to lend or not, which can give rise to informational cascades. We assume instead a simple representative agent framework, where everyone decides simultaneously how much to lend.

23. It would be far more difficult to analyze a gradual liberalization with learning.

24. Alternatively, we could examine the case where τ remains at $\bar{\tau}$ and investors give a probability of 0.5 to $\tau = 0$.

For a given probability p_t investors maximize their utility

$$(11) \quad -Ee^{-\theta C} = -Ee^{-\gamma R} = -Ee^{-\gamma(\alpha\mu+(1-\alpha)\mu^*-c\alpha I)}Ee^{\gamma\alpha\tau}$$
$$= -e^{-\gamma(\alpha\bar{\mu}+(1-\alpha)\bar{\mu}^*-c\alpha I)+0.5\gamma^2\,\mathrm{var}(R)}[p_t + (1 - p_t)e^{\gamma\alpha\bar{\tau}}].$$

Here we have used the fact that uncertainty about τ is independent of uncertainty about μ and μ^*. The first order condition with respect to α is

$$(12) \quad [-\gamma(\bar{\mu} - \bar{\mu}^* - cI) + 0.5\gamma^2(2\alpha\sigma^2 - 2(1 - \alpha)\sigma^{*2})](p_t + (1 - p_t)e^{\gamma\alpha\tau})$$
$$+ (1 - p_t)e^{\gamma\alpha\bar{\tau}}\gamma\bar{\tau} = 0.$$

Substituting

$$(13) \quad I_t = K_t - (1 - \delta)K_{t-1} = W + \alpha W^* - (1 - \delta)K_{t-1}$$

into equation (12) we have a nonlinear equation in α. We solve this numerically. Equation (13) then gives us the investment rate, and therefore next period's capital stock. By subtracting δW we derive capital inflows.

An interesting feature of the model is that investors tend to pull out of a market that has faced a bad return as this signals a possibly high value of τ. Without incomplete information this is not what we would expect to happen. In that case a low return today (low value of μ) does not lead to a lower expected return tomorrow. The opposite could even be the case. During the recent Asian crisis we have seen a sharp drop in asset prices. To the extent that these prices dropped more than based on expected future dividends (the bursting of a bubble), it would lead to even higher expected returns for investors, which should lead to capital inflows. But instead we have witnessed large capital outflows. Our incomplete information story may play an important role here.

We simulate by drawing randomly from the normal distributions of μ and μ^*. After each draw the probability p_t is updated according to equation (10). Subsequently α_t and I_t are solved from equations (12) and (13). We still set $\bar{\tau} = 0.05$, $c = 0.05$, $\delta = 0.07$, $\sigma = 0.05$, $\sigma^* = 0.09$, and $\mu^* = 0.07$. We assume that $W = 20$ and $W^* = 80$, so that total wealth is still 100. The expected return on emerging market capital is set at $\mu = 0.083$, so that again investment in emerging market equity is zero before the liberalization.

Each random draw gives a different profile of capital flows. In figure 3.10 we show two random simulations. The behavior of capital flows is strikingly similar to the actual experience of various countries as shown in figure 3.7. Beyond this general impression, we can draw several conclusions from these results. First, incomplete information reduces the extent of overshooting. Without uncertainty about τ there should be an instantaneous increase in capital inflows followed by a gradual decline to the new

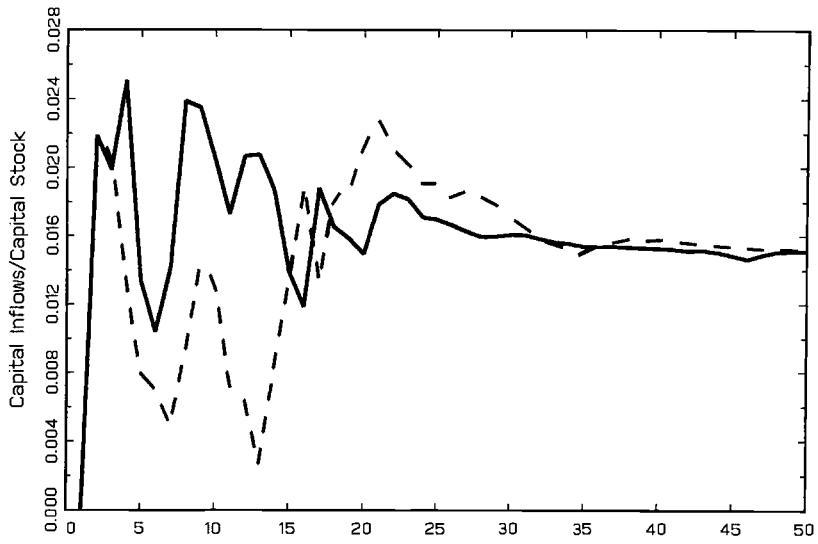

Fig. 3.10 Dynamic response to once-and-for-all liberalization with learning (two simulations)

steady-state value. In both simulations the initial increase is much smaller than it would be without uncertainty about τ. The reason is that investors are not sure in the beginning that τ has actually dropped, while in steady state they know that it has dropped to zero. Second, incomplete information can generate substantial volatility. A series of negative outcomes for r_t followed by a series of positive outcomes implies huge swings in the first periods. Third, volatility declines over time as investors learn. This is reassuring for liberalizing economies as more stability ahead can be expected, as long as the other sources of uncertainty are not increasing. A fourth conclusion is that a simple model with a representative rational investor can easily explain the observed volatility, so that it is not necessary to rely on more sophisticated stories or models, such as informational cascades (see, e.g., Chari and Kehoe 1997) or multiple equilibria stories. Finally, the two simulations show that it is very easy to generate various profiles of capital flows. One should therefore not take too seriously specific simulations, including ours.

The model with incomplete information can easily be extended to generate contagion across countries.[25] Consider the same experiment as above of a partially credible decrease in τ, but assume that several emerging

25. See Chuhan, Perez-Quiros, and Popper (1996), Calvo and Reinhart (1995), or Eichengreen, Rose, and Wyplosz (1996) for some evidence on contagion. See also Agénor (1997) and Agénor and Aizenman (1997) for models consistent with the observed contagion.

countries liberalize at the same time. Moreover, assume that investors think (rightly or not) that events in one emerging country provide information about other countries. Thus, a very low return r_{it} in country i will lead to a decline in the subjective probability that $\tau_i = 0$, but it will also lead to declines in other countries. In this case we may observe a large decline in inflows to country i accompanied by declines in other countries. The extent of the declines in other countries will depend on the informational value attributed by investors to country i's return. This value will probably vary across countries. For example, a negative shock in Thailand may provide more informational value (in the eyes of the investors) about other Southeast Asian countries than a shock in Mexico.

3.4 Steady-State Capital Flows

An important question is to what extent developing countries can rely on foreign capital in the long run. Another natural question is how current capital inflows compare with their long-run values. These issues have been raised in section 3.1, where we used our estimates of long-run flows in figures 3.6 and 3.7. In this section we derive the steady-state values by considering a very simple model in the same line as the one presented in the previous sections.

By "steady state" we mean that emerging economies are perfectly integrated into international capital markets, or at least as much as industrialized countries are (defined below). This implies that, in contrast to the previous sections, there are also capital outflows from emerging market economies. Moreover, we assume no net capital flows and focus on gross capital inflows to emerging economies. First, consider a situation where all investors, of both emerging markets and industrialized countries, hold perfectly diversified portfolios. Assuming for simplicity that there is only one good, so that the real return of an asset is the same for all investors, and that there is no nontradable human capital, everyone holds the same portfolio.[26] Since the demand for assets equals supply, it follows that the fraction of each investor's portfolio allocated to a particular country is equal to the capital stock of that country relative to the world capital stock.

This benchmark of perfect diversification, however, is grossly violated in the data due to the well-known home bias. Figure 3.11 shows for four industrialized countries the fraction of their equity portfolio currently invested at home and what fraction they would have invested at home under the perfect diversification benchmark.[27] Based on the equilibrium under

26. See Bottazzi, Pesenti, and van Wincoop (1996) and Baxter and Jermann (1997) for an analysis of the effects of human capital on portfolio choice; and see Pesenti and van Wincoop (1998) and Baxter, Jermann, and King (1998) for the role of nontraded goods. Here we abstract from these complications.

27. The data are from Tesar and Werner (1997).

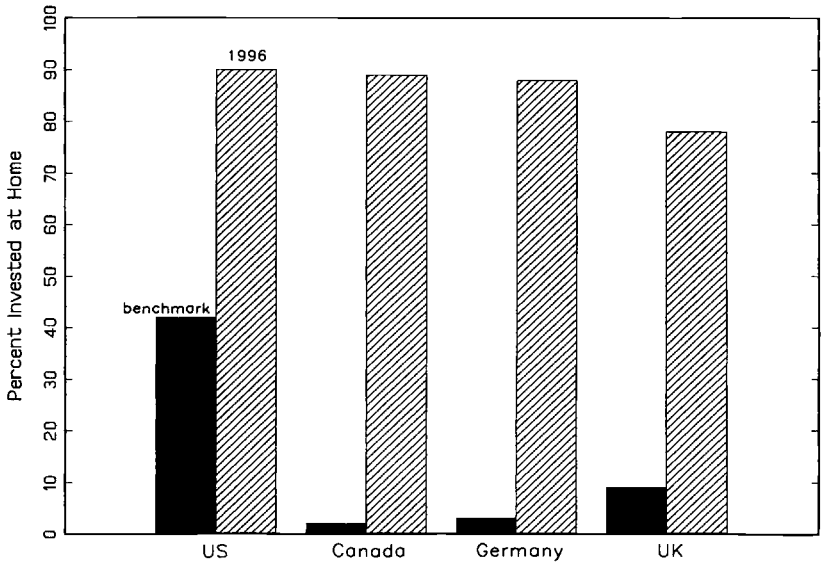

Fig. 3.11 Equity portfolio share invested at home
Note: Benchmark is the value of the domestic stock market divided by the value of the global stock market.

perfect diversification discussed above, the benchmark fraction invested at home is equal to the value of the domestic stock market divided by the value of the global stock market. It is clear that we are still very far from a world of perfect diversification. In 1996, U.S. investors allocated 90 percent of their portfolio toward domestic shares. This would have been only slightly over 40 percent under perfect diversification. British investors currently allocate 78 percent toward domestic assets, but would have invested 10 percent at home under the benchmark. The bias is even stronger for German and Canadian investors.

It is therefore necessary to take the home bias into account. Without trying to understand what drives this bias, we simply assume that a fraction ϕ of each country's capital stock is nontradable and owned by domestic investors. The remainder of their wealth is perfectly diversified. The portfolio of the "tradable" wealth is the same for all investors, so that for a country i in equilibrium

$$(1 - \phi)K_i = \sum_{j=1}^{J} \alpha_i(W_j - \phi K_j). \tag{14}$$

Here J now refers to the total number of countries, not just emerging markets, and W_j is the wealth of country j. Since $\Sigma W_j = \Sigma K_j = K^w$ is the world capital stock, it follows that

$$\alpha_i = \frac{K_i}{K^w}. \tag{15}$$

So even when we allow for home bias, for the well-diversified component of portfolios we still find that the fraction invested in country i corresponds to the ratio of that country's capital stock to the world capital stock. We will focus on this ratio instead of the actual quantity of inflows as it is independent of the home bias coefficient ϕ. This is somewhat less informative, but we still have little understanding of the potential evolution of the home bias in the long run.

Now consider a particular emerging market i and the sum of claims on the rest of the world by all countries other than i. We would like to know what fraction of those claims is invested in country i. Making the additional assumption that $W_i = K_i$, which holds approximately in the data, we find that the fraction of external claims by other countries that is invested in country i equals

$$\frac{\left(1 - \frac{K_i}{K}\right)K_i}{\sum_{j \neq 1}\left(1 - \frac{K_j}{K}\right)K_j}. \tag{16}$$

We only need a measure of the capital stock of all countries in order to compute this fraction for individual countries. We obtain this measure by extending the estimates of King and Levine (1994) for all seventeen emerging markets plus twenty-one industrialized countries.[28] We assume our "world" is made up of the sum of these thirty-eight countries.

It is hard to directly compare this to the data since for many countries, particularly the emerging markets, we do not have good data on the outstanding stocks of assets and liabilities. However, we can apply the same measure to flow data as well. If we assume, as we did in sections 3.2 and 3.3, that the rate of depreciation δ is the same for all countries, in steady state all flows are proportional to the corresponding stock, with proportionality factor δ. Therefore in steady state equation (16) should also be equal to capital inflows into country i divided by all capital outflows from countries other than i. This is shown in figure 3.7, where the horizontal line in each of the graphs is the steady state measure equation (16). Figure 3.6 shows the steady state for the sum of all emerging markets.

These estimates are clearly based on a set of strong assumptions. For

28. King and Levine (1994) estimate capital stock data until 1988 based on Summers and Heston (1991) investment data and using a perpetual inventory method. We use the same methodology and the updated Summers and Heston data (Mark 5.6) to extend the capital stock data until 1992. In a couple of countries we estimated the 1991 or 1992 investment data as they were not available.

example, we assume that all countries grow at the same rate. It would be useful to refine the analysis and extend the basic model in various directions. In any case, two conclusions arise from figures 3.6 and 3.7. First, at the aggregate level only FDI plus portfolio flows briefly rose above the steady-state level during the recent lending boom. Although the picture is perfectly consistent with the overshooting story of section 3.2, capital flows remain below the steady state. We can think of this as lowering τ, but not to zero. Many countries still have significant restrictions on capital flows. Moreover, all the liberalizations did not take place at the same time. Alternatively, there may have been uncertainty about τ as in section 3.3. Second, figure 3.7 shows that for many of the individual countries the inflows reached significantly above the steady-state level and then returned to close to that level. Examples are Argentina, Brazil, Mexico, Peru, and Thailand.

3.5 Conclusions

The recent increase in capital flows to emerging markets and its associated volatility generates difficulties for policy makers and academics alike. In this paper we hope to have contributed to a better understanding of the issues. We adopt a global perspective of capital flows, considering the whole set of industrialized and emerging countries, rather than focusing on a specific set of countries. We take the view that there has been a wave of financial liberalizations and other reforms making it much more attractive to invest in emerging markets. We show that by using a simple and rather standard model, we can easily reproduce the main features of capital inflows to emerging markets: overshooting, volatility, and contagion. The model can also account for the overshooting of asset prices. Our results show that it is not necessary to rely on irrational or herding behavior of investors to explain these features. Moreover, we provide estimates of long-run capital inflows and compare them with actual flows, which provides useful information about crisis situations.

While our analysis identifies some basic mechanisms related to capital flows, it abstracts from many other important factors. First, we need to better understand the problems associated with the absorption of the capital inflows. In this context the role of the financial sector, ignored in our model, is particularly important. Several of the issues mentioned in the debate about the Southeast Asian crisis could be incorporated in our analysis. For example, capital flow volatility may be exacerbated in presence of mechanisms leading to "overlending" by financial institutions, as in McKinnon and Pill (1997) or Dooley (1997). Another source of exacerbation would come from the role of maturity transformation of financial intermediaries as in Diamond and Dybvig (1983) (see Goldfajn and Valdés 1997 for such an approach).

Second, the capital inflows and outflows themselves generate significant turbulence in emerging market economies, affecting, among other things, asset prices, economic activity, and the exchange rate. This turbulence in turn affects capital flows. We have ignored such feedback channels in our model. For example, Aghion, Bacchetta, and Banerjee (1999) show that the interaction of capital flows and real exchange rate movements can generate considerable volatility in presence of capital markets imperfections. Finally, it would be useful to distinguish between the various types of liberalization and reform and more explicitly model the behavior of the government in this context.

Combining some of the above elements with our analysis may help elucidate why capital flow reversals are most often associated with a crisis. For example, is it due to policies that are inconsistent with a decline in inflows, such as a fixed exchange rate? Or is it due to some other fundamental characteristics linked for example to financial intermediation and lending to emerging markets firms? Finding an answer to these questions is obviously highly relevant to policymaking. Our understanding of these issues remains limited, however, and much further work should be done.

Appendix

This appendix derives the optimal investment in an emerging market based on equation (3). For convenience we omit the time subscript. With α_j the proportion of the portfolio invested in emerging market j, the total proportion invested in emerging markets is $\alpha = \Sigma_{j=1}^{J}\alpha_j$. Define the vectors $\mathbf{a}' = (\alpha_1, \alpha_2, \ldots, \alpha_J)$ and $\mathbf{r} = (r_1, r_2, \ldots, r_J)$. Then total return R can be written as

$$R = \mathbf{a}'\mathbf{r} + (1 - \alpha)\mu^*, \tag{A1}$$

and its expectation is

$$E(R) = \mathbf{a}'\bar{\mathbf{r}} + (1 - \alpha)\bar{\mu}^*,$$

where $\bar{\mathbf{r}} = E(\mathbf{r})$. Define the following $J \times J$ variance-covariance matrix:

$$\Sigma = \begin{pmatrix} \sigma^2 & \rho_{EE}\sigma^2 & \ldots & \rho_{EE}\sigma^2 \\ \rho_{EE}\sigma^2 & \sigma^2 & & \rho_{EE}\sigma^2 \\ \ldots & & & . \\ \rho_{EE}\sigma^2 & \rho_{EE}\sigma^2 & \ldots & \sigma^2 \end{pmatrix}.$$

The portfolio variance is then given by

$$\text{var}(R) = \mathbf{a}'\Sigma\mathbf{a} + (1 - \alpha)^2\sigma_D^2 + 2\alpha(1 - \alpha)\rho_{ED}\sigma\sigma^*,$$

where $\sigma_D^2 = (1/N)\sigma^{*2} + (1 - (1/N)\rho_{DD}\sigma^{*2}$.

Using

$$\frac{\partial \mathbf{a}'\Sigma\mathbf{a}}{\partial \alpha_i} = 2\{\alpha_i(1 - \rho_{EE}) + \rho_{EE}\alpha\}\sigma^2,$$

the first order conditions to equation (3) for all i are

$$\bar{r}_i - \bar{\mu}^* - \gamma\{\alpha_i(1 - \rho_{EE})\sigma^2 + \rho_{EE}\alpha\sigma^2 - (1 - \alpha)\sigma_D^2 + (1 - 2\alpha)\rho_{ED}\sigma\sigma^*\} = 0.$$

Hence

$$\alpha_i = \beta_0 + \beta_1(\bar{r}_i - \bar{\mu}^*) + \beta_2\alpha, \tag{A2}$$

where

$$\beta_0 = \frac{1}{\gamma\sigma^2(1 - \rho_{EE})},$$

$$\beta_1 = \frac{\sigma_D^2 - \rho_{ED}\sigma\sigma^*}{\sigma^2(1 - \rho_{EE})},$$

$$\beta_2 = \frac{-\sigma_D^2 + 2\rho_{ED}\sigma\sigma^* - \rho_{EE}\sigma^2}{\sigma^2(1 - \rho_{EE})}.$$

Aggregating equation (A2), we have

$$\alpha/J = x_0 + x_1(\bar{r} - \bar{\mu}^*), \tag{A3}$$

where $x_0 = \beta_1/(1 - J\beta_2)$ and $x_1 = \beta_0/(1 - J\beta_2)$. Substituting back into equation (A2),

$$\alpha_i = x_2 + x_3(\bar{r}_i - \bar{\mu}^*), \tag{A4}$$

where $x_2 = \beta_1 + \beta_2\alpha$ and $x_3 = \beta_0$. When the tax rate is the same across emerging markets, the differential equation for the capital stock (equation [7]) and the solution (equation [8]) for capital inflows are still the same, now using the more general expressions for x_0 and x_1. As before, when one emerging country changes its tax rate, holding the average tax rate constant, x_0, x_1, and τ_t replaced by x_2, x_3, and τ_{it}.

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Comment Carmen M. Reinhart

The aim of this paper is to assess the impact of financial liberalization in emerging markets on the dynamics of capital flows to these countries. By positing a cost of absorbing these flows, the authors explain how liberalization can give rise to an "overshooting" of capital inflows and asset prices. In addition, the authors examine whether incomplete information can give rise to a high degree of volatility in capital flows as well as to contagion. They also suggest that deviations in capital inflows from their steady-state levels can be used as a potential signal of future crises.

These are important questions to ask in light of the close linkages between capital flows and financial crises. Furthermore, financial crises, particularly in the domestic banking sector, seem to be closely entwined with financial liberalization and asset price bubbles (see Kaminsky and Reinhart 1999). The Asian crises of 1997–98 certainly attest to the relevance of these issues. Financial liberalization, full or partial, did appear to help explain the cycle of capital inflows and the prolonged lending boom that left these economies highly leveraged and, thus, vulnerable to financial crises. During the boom phase of the capital flow cycle, the ex post evidence is also consistent with an asset price overshooting of the type discussed in this paper.

In what follows, I will suggest that the analytical framework presented in this paper is extremely useful in understanding foreign direct investment (FDI) and portfolio equity flows to emerging markets in the 1990s. It is also useful for delineating how efforts to liberalize capital markets may have contributed to the boom phase of the capital flow cycle and its ultimate overshooting. The model also provides insights into FDI's compar-

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