

# Financial Globalization and Emerging Market Portfolios

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*Although emerging market Asian economies have experienced high growth without crises for close to a decade, many commentators find the large buildup of foreign exchange reserves among these economies both puzzling and evidence of incipient global imbalances. This paper reviews some of the experiences of Asian countries over the last decade. We focus on the degree to which Asian economies have experienced financial globalization, meaning that their gross external asset and liability positions have grown significantly. In particular, while Asian economies have become significant gross creditors in bonds and other fixed income assets, their liability position in equity and foreign direct investment assets has also grown significantly. We show that a simple dynamic general equilibrium model of portfolio choice in an emerging market economy can account for this trend remarkably well.*

Keywords: Asia; Financial globalization; Foreign direct investment; Foreign exchange rate reserves

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## I. Introduction

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Since the crises of the late 1990s, the major emerging Asian economies have experienced close to a decade of uninterrupted growth. Capital inflows from industrial countries in the form of foreign direct investment (FDI) as well as portfolio and bond investment have been strong, while on aggregate, Asian countries have been generating strong current account surpluses with the rest of the world. Sovereign spreads have been low by historic standards for a number of years. In addition, these countries have to a significant extent eliminated their financial vulnerabilities displayed so clearly during the crisis years by correcting the currency and maturity mismatches in their national balance sheets. Some countries have abandoned tight exchange rate pegs and moved toward flexible inflation targeting. More generally, the quality of policymaking in the fiscal and financial domain has improved greatly.

There is no single explanation for this positive trend among Asian emerging market economies. High global saving has led to a prolonged period of low real interest rates, reducing the potential for crises. The buildup of strong positive net external positions as well as large stocks of foreign exchange rate reserves has had the same effect, and more generally has instilled strong confidence in the investment potential of these countries. But in addition, real economic growth has been stimulated by high demand for exports to the industrial world (in particular, the United States), and commodity price booms have generated huge net gains for many emerging countries.

One general feature of emerging economies' recent experience that differs from previous episodes of high capital inflows and economic growth is the degree to which they have been participants in the globalization of financial markets. Rather than simply being recipients of net capital inflows or outflows, many emerging countries have displayed growth in gross external financial assets and liabilities that is much larger than net positions. In this sense, their experience mirrors that of many advanced economies, as documented in the seminal work of Lane and Milesi-Ferretti (2001, 2006). Although recent discussion of global imbalances has concentrated mostly on the size of net external surpluses of China and other emerging economies, reflecting the apparently perverse situation of capital outflows from the developing world to developed economies (or more accurately, the United States), in the background there is a large degree of two-way capital flow. Emerging economies have been accumulating large stocks of U.S. Treasury bills going into official reserve and other fixed income assets, but they have also been receiving large inflows of FDI and portfolio equity investment, as well as private bond market inflows. Lane and Milesi-Ferretti (2006) document this turnaround on the portfolio position of emerging market economies taken as a whole. Compared with the situation in the mid-1990s, when many of these economies were substantial net debtors in non-contingent assets such as bank loans and short-term U.S. dollar bonds, now they have substantial net positive positions in fixed income assets, while being on the whole net debtors in FDI and portfolio equity investment. There is an argument that this is in fact a much more efficient form of financing development lending for emerging market economies, in terms of achieving the most desired degree of international risk sharing.

This paper investigates the impact of financial globalization in emerging market economies, paying particular attention to the determinants of country portfolio positions. We explore the factors underlying the determinants of an optimal risk-sharing portfolio for an emerging market economy that needs to attract investment capital but experiences country-specific macroeconomic risk. This loosely approximates the positions of the fast-growing Asian exporting economies. The question is, how should investment be financed? One possibility is for these countries to borrow substantially in the form of non-contingent foreign bank loans or from international bond markets to finance their own investment. In the mid-1990s, this roughly described the financing patterns of many emerging economies. Another option, however, is to accept FDI and equity investment. As noted, this has become the norm for emerging economies in recent years. In our analysis, we interpret this financing choice as an implication of financial globalization. In an environment where emerging market economies can choose from an enhanced menu of international asset markets, an optimal financing pattern is to accept inflows of FDI and portfolio investment, but to balance this with outflows of investment in fixed-income, non-contingent assets. This offers one way to interpret the buildup of international reserve assets on the part of emerging economies.

Our analysis is built around a dynamic stochastic general equilibrium (DSGE) model of the interaction between an emerging market economy and the rest of the world. We follow Devereux and Saito (2006) in constructing a stochastic continuous time framework with incomplete markets.<sup>1</sup> Our results indicate that financial globalization, wherein an emerging market economy may simultaneously build up positive gross positions in non-contingent international bond assets, and negative positions in FDI and portfolio equity, offers both welfare benefits and a more stable form of financing than what was available in the mid-1990s. In the model, the emerging economy holds nominal bonds of the advanced economy, while issuing FDI-equity claims that are held by the advanced economy. We interpret nominal bond holdings as a measure of foreign exchange reserves. The model delivers explicit solutions for the value of FDI, foreign exchange reserves, and total bond holdings in emerging market portfolios. The FDI position depends upon expected returns in the emerging market, as well as growth risk in both the advanced economy and the emerging market. Foreign exchange rate reserves depend on expected returns, and growth volatility in the emerging market as well as in the advanced economy. In addition, foreign exchange rate reserve holdings are sensitive to the monetary policy followed by advanced economies. If the advanced economy follows a very stable monetary policy, this will significantly boost emerging market foreign exchange rate reserves. At the same time, a rise in the riskiness of the domestic income process in emerging markets will lead to an increase in foreign reserve holdings.

Although the model is extremely rudimentary, we argue that it can give a coherent account of the portfolio structure of emerging market Asian economies. The recent

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1. There has been a rapid growth in the literature on incorporating portfolio dynamics in DSGE models. See Devereux and Sutherland (2006, 2007), Engel and Matsumoto (2006), Evans and Hnatkovska (2005), and Tille and van Wincoop (2007), among other papers, for alternative approaches.

buildup in foreign exchange rate reserves in Asian countries can be rationalized as a response to observed movements in macroeconomic volatility in Asia and advanced industrial economies. In particular, a combination of (1) a higher volatility of GDP in Asian countries, (2) a lower volatility of GDP in advanced economies, and (3) a fall in the volatility of inflation in the United States (a more stable U.S. dollar price level) works to increase foreign exchange rate reserve holdings in Asia. A simple calibration to the U.S.–China case leads to a remarkably close fit between model and data.

One qualification that should be noted is that the paper does not primarily focus on current account imbalances or the size of net capital flows. Rather, we wish to explore the determinants of gross capital flows and the structure of the external portfolio positions for emerging market economies. Although our model does allow for current account imbalances, it can account for a trend in the current account only by allowing for trend differences in savings rates. To jointly account for the scale of global imbalances and the shifting portfolio composition without arbitrary differences in savings propensities would require a more elaborate model than that developed here.

The paper is structured as follows. Section II discusses some recent features of Asian external imbalances and portfolio composition. Section III presents a review of recent literature on global imbalances and Asian reserve holdings. Section IV develops the model and presents a simple quantitative analysis. Some conclusions follow in Section V.

## II. Asian External Balance and Portfolio Structure

We focus on a subset of emerging market countries in Asia. The growing current account surpluses of Asian countries are to a large degree the counterpart to the U.S. current account deficit. For many emerging Asian countries, these current account surpluses date back to the Asian crisis of the late 1990s. A large empirical and theoretical literature has attempted to provide an explanation for these surpluses.

Figure 1 describes the evolution of current account to GDP ratios for a number of Asian economies. All are currently in current account surplus, but this masks distinct differences in their historical records. The fast-growing East Asian Tigers—Korea, Malaysia, Thailand, and to a lesser extent Taiwan—all experienced significant net capital inflows in the early 1990s, but were hit strongly by “sudden stops” during the Asian crisis of 1997–98. Their current accounts swung sharply back into a surplus position. Indonesia had a similar experience. In contrast, China experienced net capital inflow only for one year in the 1990s. It was relatively immune to the direct effects of the Asian crisis. In fact, its current account to GDP position deteriorated somewhat during this period. From 2000–05, however, all countries experienced strong surpluses. In particular, China’s current account surplus grew sharply in 2005 to nearly 7 percent of GDP.

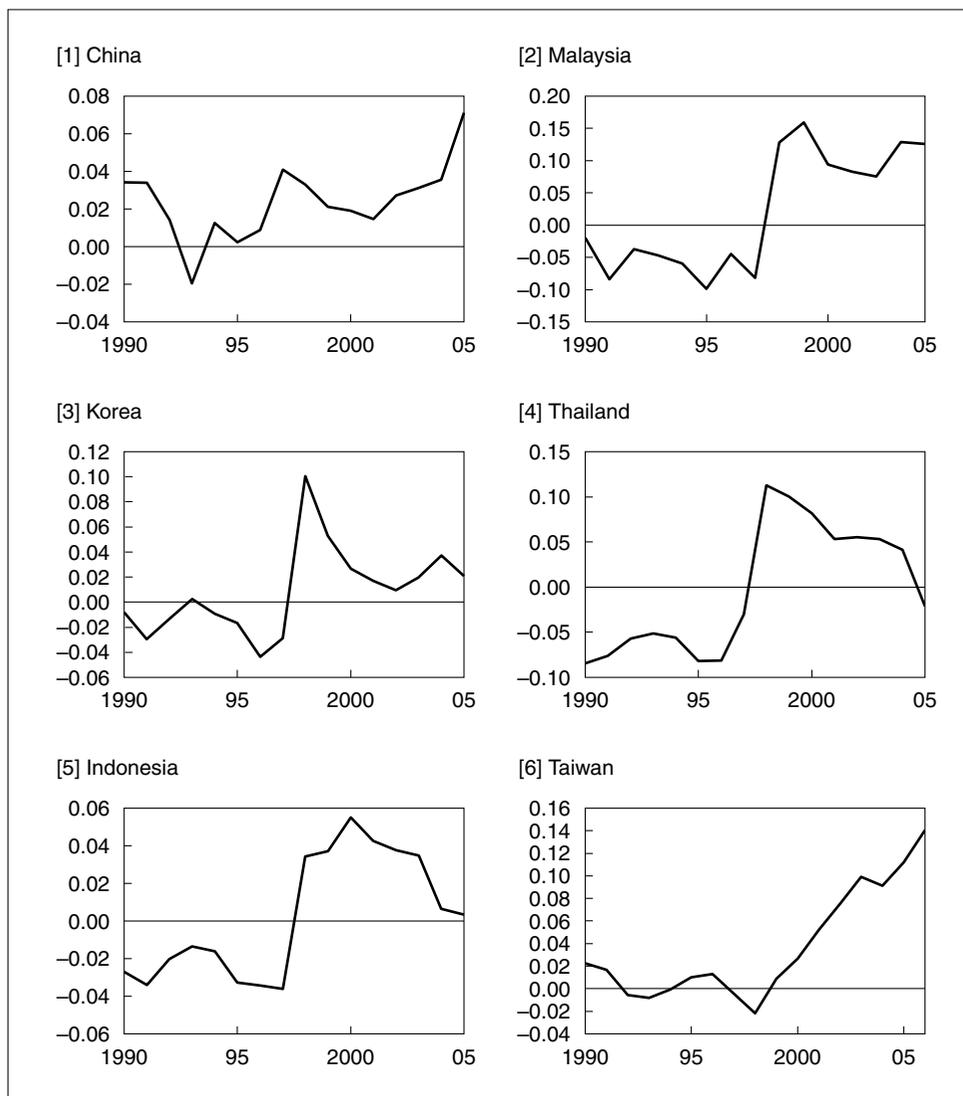
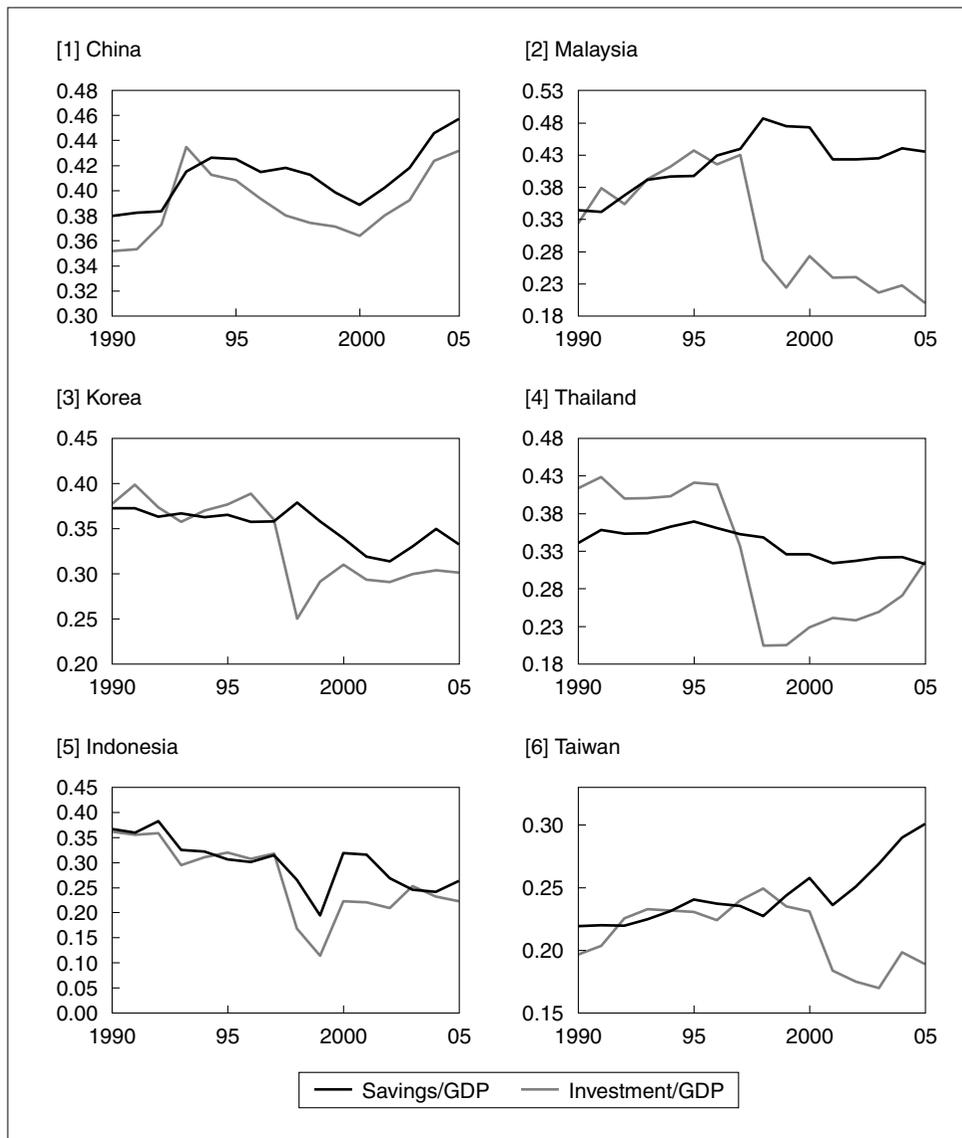
**Figure 1 Ratio of Current Account to GDP**

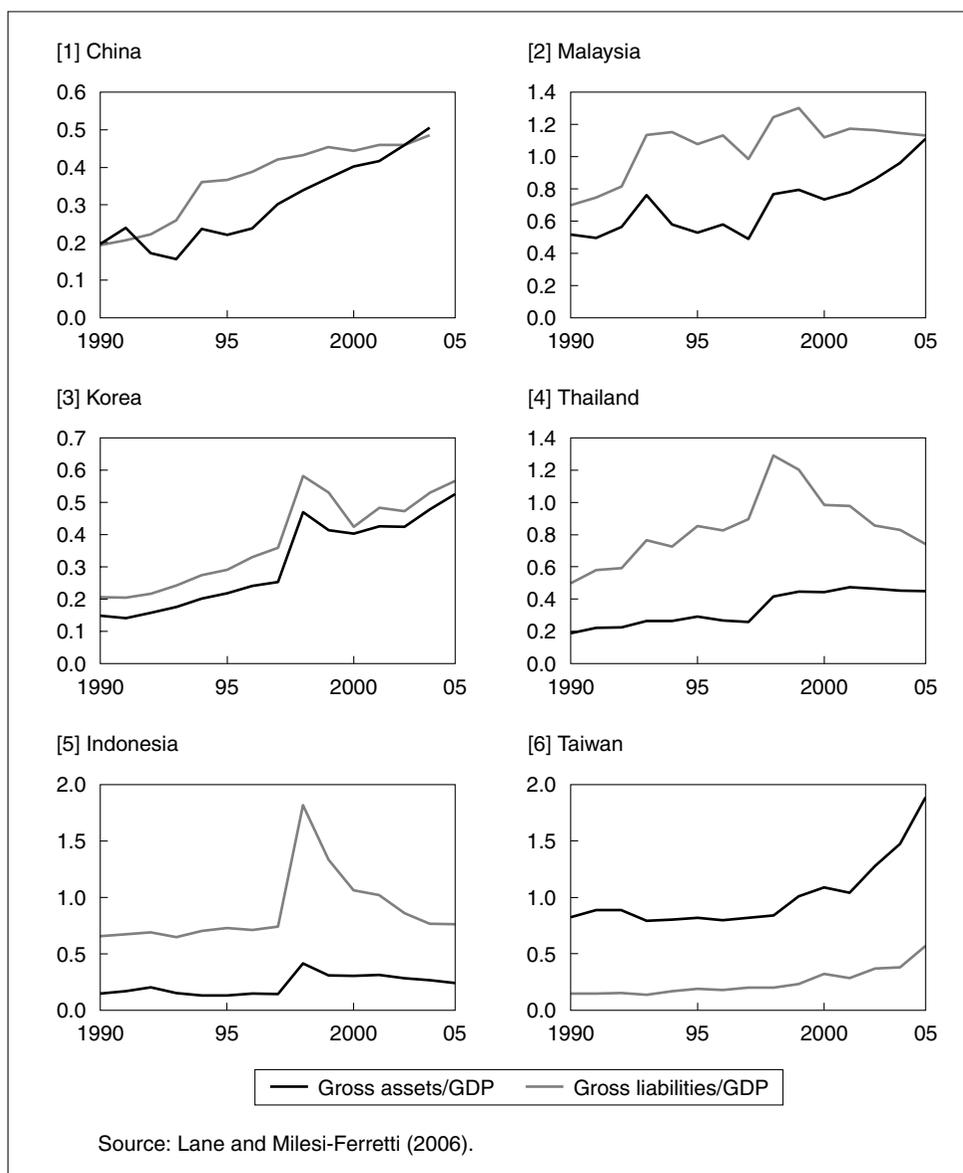
Figure 2 breaks down the current account position into national savings and investment rates, relative to GDP. For Korea, Malaysia, and Thailand, the current account improvement after the Asian crisis is substantially explained by a dramatic fall in investment, with a relatively stable savings rate. Taiwan started with a substantially lower savings and investment rate than the other Asian countries, but then had a surge in its savings and a fall in investment after the Asian crisis. For China, both investment and savings rates were quite stable in the late 1990s, but show a distinct increase after 2000. The absolute savings rate in China is a remarkable 45 percent, but this is also true for Malaysia. The key difference between China and the other East Asian countries lies in the levels of investment. China has investment levels similar to those of the East Asian Tigers in the mid-1990s—above 40 percent of GDP, while the latter

**Figure 2 Ratio of Savings and Investment to GDP**



countries have converged down to investment rates in the range of 20 to 30 percent of GDP, comparable to those of the advanced economies. A similar pattern is seen in the comparative growth rates among countries (not shown here). Growth rates in the East Asian Tiger economies fell sharply after 1997, but recovered quickly. Subsequent growth rates, however, were lower than those of the early 1990s, and in the range of the growth rates of the United States in the recent past. In contrast, China's growth rate increased in the early 2000s to the 9–10 percent range.

Figure 3 is based on the “External Wealth of Nations” database of Lane and Milesi-Ferretti (2006). It shows the level of gross assets and gross liabilities to GDP, following the measurement adjustments made in Lane and Milesi-Ferretti (2006). For the period

**Figure 3 Ratio of Gross Assets and Liabilities to GDP**

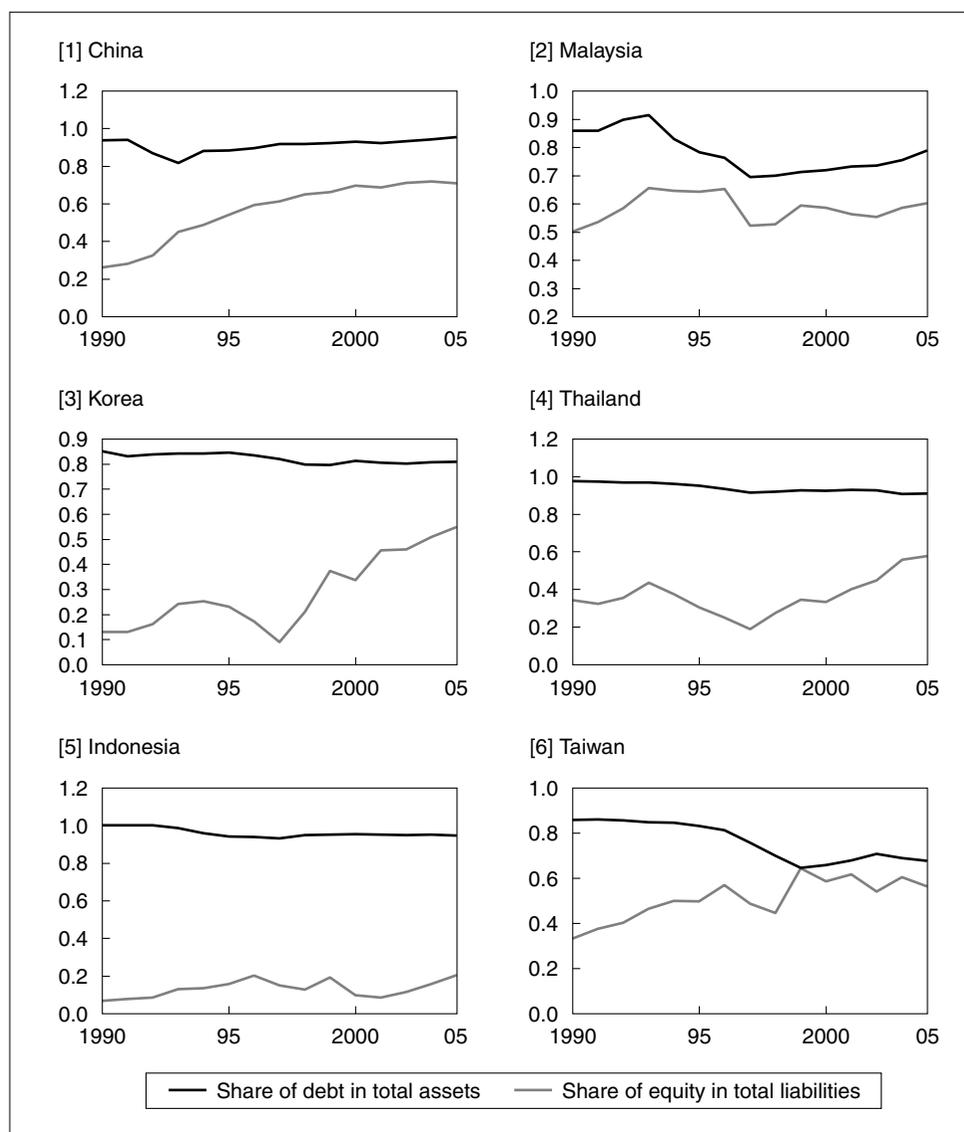
since 1990, all countries have been net debtors except for Taiwan, which is a substantial net creditor, although China's net foreign assets also turned slightly positive in 2002. Net foreign assets for China and Korea are a relatively small share of GDP, while Malaysia and Thailand have higher net debt positions. Although valuation adjustment through equity prices and exchange rates in Lane and Milesi-Ferretti (2006) break the direct link between the current account and net foreign assets, all countries have exhibited an increase in them in the current decade.

Note that Figure 3 emphasizes that all the countries have substantial gross positions on each side. In particular, China, Korea, Malaysia, and Taiwan have experienced

substantial “financial globalization,” in the sense that both gross assets and gross liabilities have approximately doubled, as a proportion of GDP, since the early 1990s. Indonesia and Thailand differ somewhat. They have had a substantial increase in the ratio of gross assets to GDP in the current decade, but liabilities were substantially higher in the mid-1990s, well over 100 percent of GDP for both countries, and have come down considerably since then.

Figure 4 illustrates the composition of gross foreign assets and gross foreign liabilities between equity and debt instruments. Here, debt instruments include official reserve assets and portfolio debt. Equity includes FDI and portfolio equity. The figure shows

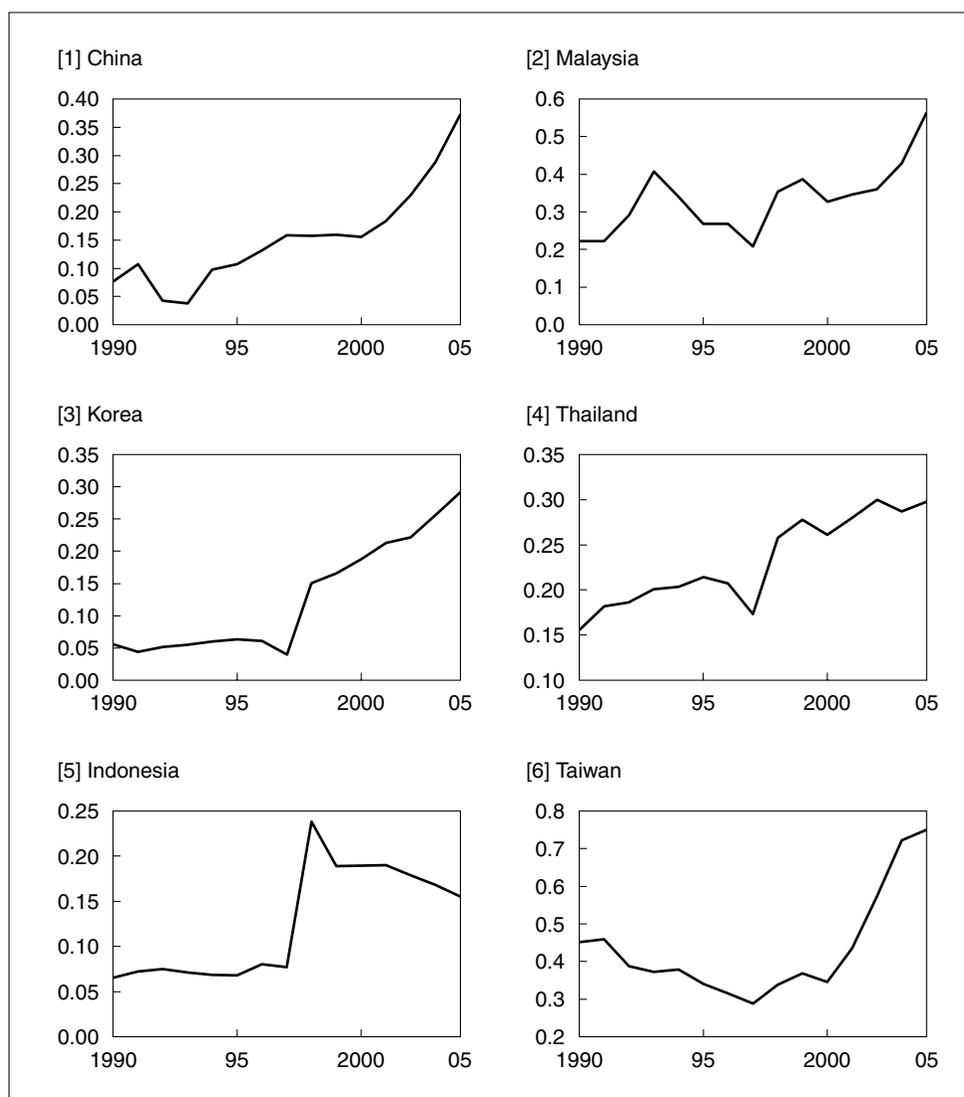
**Figure 4 Composition of Gross Foreign Assets and Liabilities (Debt Instruments versus Equity Instruments)**



that on the assets side, for all countries, the biggest fraction is in debt instruments, with only a small portion in equity and FDI instruments. Figure 4 also highlights a less well-known aspect of recent portfolio behavior for Asian economies. The composition of gross external liabilities has switched strongly toward an increasing share of equity and FDI. For China, at the beginning of the sample, 70 percent of external liabilities were in debt instruments, and only 30 percent were in equity instruments. By the end of the sample, this proportion had been exactly reversed. Korea had an equally dramatic increase in the share of liabilities attributed to equity. A similar though less strong turnaround is seen in Malaysia, Thailand, Indonesia, and Taiwan.

Figure 5 shows that official reserves constitute a growing share of total assets in the current decade, rising to an astonishing 35 percent of GDP for China in 2004.

**Figure 5 Ratio of Official Reserves to Total Assets**



This huge holding of low-yielding assets (mostly in U.S. dollar Treasury bills) has led to an increasing debate in the economics literature in the last few years.

### III. Explaining Asian External Balances

Two strong features of the data emerge from the previous section. First and most prominently, all Asian countries generated large current account surpluses following the Asian crisis, and these have persisted over the last seven or eight years. Second, most countries have also recorded substantial growth in both gross assets and liabilities, and distinct changes in their national balance-sheet composition, generating large stocks on foreign exchange rate reserves on the assets side, and substantial growth in the share of equity and FDI on the liabilities side.

What explains the huge Asian surpluses in this decade? This question has generated a huge amount of literature in the last few years. A number of alternative accounts have been presented. One view is that the persistent current account surpluses represent a form of hedging or precautionary saving against the possibility of future “sudden stops,” or abrupt cut-offs from access to capital markets. Caballero and Panageas (2006) develop a model of a small open economy subject to a risk of sudden stops, and examine the behavior of saving under a variety of alternative possibilities for hedging sudden-stop risk. They note that saving is higher in an economy with the risk of sudden stops. Jeanne and Ranciere (2006) and Jeanne (2007) interpret the buildup in foreign exchange reserves in Asian economies as a form of collective insurance against sudden stops, where the public sector has an advantage in providing resources to smooth out the consumption effects of sudden stops. Mendoza, Quadrini, and Ríos-Rull (2007) develop a model of precautionary saving in response to non-insurable idiosyncratic income risk, and show that it can account for substantial foreign exchange reserve accumulation of the kind seen in the data. They argue that either financial liberalization or hedging against sudden stops can provide an explanation for the recent growth in emerging economies’ foreign exchange reserves.

One problem with these theories of precautionary saving is that they all work on the savings side, and therefore do not provide an adequate explanation for one of the main features apparent in Figure 2: that a large part of the Asian current account expansion can be attributed to a fall in investment, rather than a rise in savings. As we noted, for Korea, Malaysia, and Thailand, current account surpluses were substantially driven by an investment collapse, with savings relatively unchanged. An alternative model of “global imbalances,” developed in Caballero, Fahri, and Gourinchas (2006), attributes the joint process of savings and investment in emerging markets to the absence of financial markets by which savings may be converted into profitable assets. They argue that a key feature of emerging economies is an “asset shortage.” Even though these economies may have high growth rates, real domestic returns may be low because of the absence of adequate instruments for saving, leading them to invest in advanced economies, which can offer a supply of assets unavailable in emerging markets. Caballero, Fahri, and Gourinchas (2006) show that such financial distortions in emerging markets can explain why such countries could run current account

surpluses with advanced economies. Moreover, they show that the same financial distortions may lead to low rates of investment in emerging economies.

Relatively few commentators have focused on the nature of two-way capital flows between emerging markets and advanced economies. Dooley, Folkerts-Landau, and Garber (2004) argue that emerging market current account surpluses represent a collateral payment for the risk of FDI in emerging markets, but do not offer an explicit model of this process. Ju and Wei (2007) argue that there is a “bypass” process of capital flows, whereby informational imperfections in financial markets in emerging economies make it desirable for residents to invest in advanced economies and then receive FDI from these economies. Neither of these papers, however, takes a general equilibrium portfolio approach, as is done here. We now turn to the explicit portfolio model.

## IV. A Portfolio Model of Reserve Accumulation

In this section, we develop a simple dynamic portfolio model to determine the joint determination of optimal reserve holdings and FDI accumulation. The model is adapted from Devereux and Saito (2006). There is an advanced economy and an emerging market economy. There is a single world good, which can be consumed or invested by agents in each country. Two structural features differentiate the advanced economy (home) from the emerging market economy (foreign). In the advanced economy, there is a single risky technology for producing output, while in the emerging economy there are two risky technologies, which we could think of as a “traditional” and a “modern” sector. Investors in the home country can invest in the modern sector of the foreign country. We refer to this as FDI. The second key distinction between the two economies concerns the form of international traded assets. We assume that bonds denominated in the home-country currency (e.g., the “dollar”) are traded between countries, but there is no trade in foreign currency-denominated bonds. This captures the empirical feature that world bond markets are still dominated overwhelmingly by a few major currency denominations, with the U.S. dollar still the dominant acceptable denomination. In the model, foreign holdings of home-currency bonds are defined as foreign exchange reserves of the foreign country. The equilibrium of the model may be used to illustrate the joint dynamics of home-country FDI and foreign exchange reserve accumulation of the foreign country. The difference between the two determines the evolution of the foreign countries’ net foreign assets.

### A. The Model

The model is explained in more detail in Devereux and Saito (2006), so we give just a very brief description here. In the home country, there is a risky linear technology that uses capital and generates expected instantaneous return  $\alpha_D$  with standard deviation  $\sigma_D$ . In the foreign country, there are two technologies: a traditional and a modern technology, with returns  $\alpha_T$ ,  $\alpha_M$  and standard deviations  $\sigma_T$ ,  $\sigma_M$ , respectively. Capital can be turned into consumption without any cost. The return on the home technology (in terms of the homogeneous good) is given by

$$\frac{dQ_i}{Q_i} = \alpha_D dt + \sigma_D dB, \quad (1)$$

where  $dB$  is the increment to a standard Weiner process. For simplicity, we assume that the returns on all three technologies are independent, and that the covariances between  $dB$ ,  $dB_T^*$ , and  $dB_M^*$  are all zero.

International financial markets are incomplete. This is captured by the fact that foreign-country residents cannot directly purchase shares in the technology of the home country, and home residents can only buy shares in the modern sector of the foreign country (FDI). Again, we do not explicitly endogenize this constraint, but see it as reflecting the inability of residents of large emerging market countries such as China to invest directly in external equity markets. We do, however, allow for trade in the home-currency nominal bond, and a real risk-free bond.

Nominal bonds are denominated in the home currency by assumption. Although nominal bonds are risk-free in dollar terms, their real returns are subject to inflation risk. Home-country inflation is modeled as follows:

$$\frac{dP_i}{P_i} = \Pi dt + v dM.$$

Thus, inflation has mean  $\Pi_i$  and standard deviation  $v$ .  $dM$  represents the increment to a standard Weiner process. We assume that  $dM$  and  $dB$  have covariance given by the parameter  $\lambda$ , but  $dB_T^*$  and  $dB_M^*$  are independent of  $dM$ . Hence,  $\lambda$  will be a critical parameter, capturing the way in which returns on nominal bonds co-vary with real returns on the home technology. If  $\lambda < 0$ , as most of our discussion below presumes, then real bond returns are procyclical. We discuss the evidence for this assumption below.

Let the instantaneous nominal return on currency  $i$  bonds be  $\hat{R}_i$ . Then the real return on bond  $i$  is

$$(R_i - \Pi_i)dt - v_i dM_i,$$

where  $R_i = \hat{R}_i + v_i^2$  is an adjusted nominal interest rate. This will be determined endogenously as part of the world bond market equilibrium.

The budget constraint for the home country may be written as

$$\begin{aligned} dW = & W[\omega_D(\alpha_D - r) + \omega_N(R_b - \Pi_b - r) + \omega_M(\alpha_M - r) + r]dt \\ & - Cdt + W(\omega_T\sigma_D dB - \omega_N v dM + \omega_M\sigma_M dB_M), \end{aligned} \quad (2)$$

where  $W$  is home-country wealth, and  $\omega_D$ ,  $\omega_N$ , and  $\omega_M$  are the portfolio shares, respectively, of the domestic technology, home-currency nominal bonds, and FDI. Hence,  $1 - \omega_D - \omega_N - \omega_M$  represents the share of the real risk-free bond.

The foreign-country budget constraint is written symmetrically as

$$dW^* = W^*[\omega_T^*(\alpha_T - r) + \omega_N^*(R_b - \Pi_b - r) + \omega_M^*(\alpha_M - r) + r]dt - C^*dt + W^*(\omega_T^*\sigma_T dB_T - \omega_N^*v dM + \omega_M^*\sigma_M dB_M), \quad (3)$$

Each country is populated by a continuum of identical agents with preferences given by

$$E_0 \int_0^\infty \exp(-\rho t) \ln C_i(t) dt, \quad (4)$$

where  $\rho$  is the rate of time preference.

### B. Optimal Consumption and Portfolio Rules

With logarithmic utility, consumers follow the myopic consumption rule:

$$C = \rho W, \quad C^* = \rho W^*.$$

Optimal portfolio rules for the home country may be obtained as the solution to

$$\begin{bmatrix} \omega_D \\ \omega_N \\ \omega_M \end{bmatrix} = \begin{bmatrix} \sigma_D^2 & -\lambda\sigma_D v & 0 \\ -\lambda\sigma_D v & v^2 & 0 \\ 0 & 0 & \sigma_M^2 \end{bmatrix}^{-1} \begin{bmatrix} \alpha_D - r \\ R - \Pi - r \\ \alpha_M - r \end{bmatrix}. \quad (5)$$

For the foreign country, the equivalent conditions are

$$\begin{bmatrix} \omega_T^* \\ \omega_M^* \\ \omega_N^* \end{bmatrix} = \begin{bmatrix} \sigma_T^2 & 0 & 0 \\ 0 & \sigma_M^2 & 0 \\ 0 & 0 & v^2 \end{bmatrix}^{-1} \begin{bmatrix} \alpha_T - r \\ R_b - \Pi - r \\ \alpha_M - r \end{bmatrix}. \quad (6)$$

### C. Asset Market Equilibrium

At any moment in time, an equilibrium in the market for nominal bonds determines the nominal rates of return  $R_b$ . The nominal bond market clearing condition requires that the sum of home and foreign demand for nominal home-currency bonds is zero:

$$\omega_N W + \omega_N^* W^* = 0. \quad (7)$$

Note that the assumption here is that home-currency nominal bonds are in zero world net supply. We could explicitly model a fiscal agency that issues home-currency bonds, but this would have no impact on the equilibrium foreign holdings of these bonds.

We have also allowed for trade in a real indexed bond, again in zero net world supply. The market clearing condition for the real bond is described as

$$(\omega_D + \omega_N + \omega_M - 1)W + (\omega_T^* + \omega_N^* + \omega_M^* - 1)W^* = 0. \quad (8)$$

Using (5), these two conditions may be solved for  $R$  and  $r$ . Define  $\theta = W^*/(W^* + W)$  as the ratio of foreign wealth to world wealth. To simplify the presentation, we will assume for the rest of this section that  $\alpha_T = \alpha_M$  and  $\sigma_T = \sigma_M$ . That is, the two sectors in the emerging market country have identical returns and volatilities. Then we can derive the solutions:

$$R(\theta) = Z(\theta)R_D + (1 - Z(\theta))R_M, \quad (9)$$

$$r(\theta) = H(\theta)r_D + (1 - H(\theta))r_M. \quad (10)$$

where  $R_D = r_D + (\sigma_D^2 \lambda) / (\sigma_D^2 + \sigma_M^2) (\alpha_M - \alpha_D - \sigma_M^2) + \Pi$ ,  $r_M = \alpha_M - \sigma_M^2$ ,  $R_M = r_M + \Pi$ , and  $r_D = (\sigma_M^2 \alpha_D + \sigma_D^2 \alpha_M - \sigma_D^2 \sigma_M^2) / (\sigma_D^2 + \sigma_M^2)$ . Here  $R_D(R_M)$  denotes the equilibrium nominal return on home-currency bonds when the home (foreign) country is arbitrarily wealthy, that is,  $\theta \rightarrow 1$  ( $\theta \rightarrow 0$ ), and  $Z(\theta)$  is a function of parameters and  $\theta$  such that  $Z(0) = 1$ , and  $Z(1) = 0$ . Likewise,  $r_D$  ( $r_M$ ) denotes the equilibrium risk-free return when the home (foreign) country is arbitrarily wealthy, that is,  $\theta \rightarrow 1$  ( $\theta \rightarrow 0$ ), where  $H(\theta)$  is a function of parameters and  $\theta$  such that  $H(0) = 1$ , and  $H(1) = 0$ .

Thus, solutions (9) and (10) indicate that the equilibrium world nominal and real rates of return are time-varying weighted averages of the rates of return that would hold were either country to become arbitrarily large, and the weights depend on the relative size of each country in world wealth. Note that  $R_D$  is a function of both home and foreign technology parameters, because home-country residents can invest directly in the foreign technology, while  $R_M$  depends only on the foreign technology. In addition, because home inflation is independent of foreign technology,  $R_M$  is independent of  $\lambda$  and  $v$ . On the other hand, for values of  $\alpha_D \approx \alpha_M$  and  $\lambda < 0$ , we have  $R_D > r_D$ . This is because for  $\lambda < 0$ , the real return on the home-currency bond co-varies positively with the home portfolio. For home agents to hold the home-currency bond, it must pay a higher rate of return than  $r_D$ .

Using (9)–(10) in (5), we may derive the equilibrium portfolio holdings. Define  $\Delta = \sigma_M^2(1 - \theta) + \sigma_D^2(1 + \theta)(1 - \theta\lambda^2) > 0$ . Then we can compute the equilibrium home-country FDI holding as

$$\tilde{\omega}_D = \frac{(\alpha_M - \alpha_D)(1 - \theta) + \sigma_D^2(1 - \theta\lambda^2)}{\Delta}. \quad (11)$$

The FDI share of the portfolio is increasing in the return on the foreign modern sector, but decreasing in the volatility of this sector. FDI is also affected by the volatility of the home sector. When  $\alpha_D \approx \alpha_M$ , an increase in  $\sigma_D^2$  increases FDI, but this may be reversed when  $\alpha_M > \alpha_D$ .

Using (9) and (10), we may also compute the share of reserves and risk-free bonds in the foreign country portfolio as

$$\tilde{\omega}_N^* = -\frac{\lambda\sigma_D}{v} \left[ \frac{-(\alpha_M - \alpha_D)(1 - \theta^2) + \sigma_M^2(1 - \theta)}{\Delta} \right], \quad (12)$$

$$\tilde{\omega}_R^* = -\tilde{\omega}_N^* + (1 - \theta) \left[ \frac{2(\alpha_D - \alpha_M) + \sigma_M^2 - \sigma_D^2(1 - \lambda^2\theta)}{\Delta} \right]. \quad (13)$$

For  $\alpha_D \approx \alpha_M$  and  $\lambda < 0$ , foreign exchange reserves are always positive, but holdings of risk-free real bonds may be positive or negative. The total holdings of bonds (the sum of risk-free bonds and nominal bonds) is positive when  $\alpha_D \approx \alpha_M$  and  $\sigma_M^2 \approx \sigma_D^2$ .

What determines demand for reserves? From (12), total reserve holdings are negatively related to the excess return on the foreign technology,  $\alpha_M - \alpha_D$ , and negatively related to the volatility of inflation in the home country,  $v$ . When  $\alpha_D \approx \alpha_M$ , demand for reserves is increasing in the volatility of the foreign technology,  $\sigma_M^2$ .

Note that both FDI, reserve holdings, and overall bond holdings will be time-varying, moving as the share of the foreign country in world wealth changes. The dynamics of  $\theta$  are determined by variations in relative wealth levels, driven by the budget constraints (2) and (3) in combination with each country's saving and portfolio allocation decisions.<sup>2</sup>

To illustrate this process, take the special case where  $\alpha_D = \alpha_M$  and  $\sigma_M^2 = \sigma_D^2$ . Then FDI and reserves may be written as

$$\tilde{\omega}_D = \frac{(1 - \theta\lambda^2)}{2 - \theta\lambda^2(1 + \theta)} > 0, \quad (14)$$

$$\tilde{\omega}_N^* = -\frac{\lambda\sigma_D}{v} \left[ \frac{(1 - \theta)}{2 - \theta\lambda^2(1 + \theta)} \right] > 0. \quad (15)$$

In this case, equilibrium FDI holdings are independent of the return and volatility of technology risk in each country, and depend only on  $\theta$  and  $\lambda$ . For a given value of  $\theta$ , FDI is declining in the absolute value of  $\lambda$ . This is because having a short position in home-currency bonds allows some risk sharing for the home country (when  $\lambda < 0$ ), which acts as a substitute for investing in FDI.

In the symmetric case of (14) and (15), total reserve holdings are higher, the greater the technology volatility. Reserves are increasing in (the absolute value of)  $\lambda$ . As  $\lambda$  rises in absolute value, home-currency bonds become a better hedging asset for the foreign country.

How do FDI and foreign exchange reserves depend on  $\theta$ ? From (15), the relationship between  $\theta$  and the FDI share is non-monotonic. For very low values of  $\theta$ , indicating that the home country is relatively wealthy, the foreign country has a high share in FDI, while when  $\theta$  is in an intermediate range, this share is somewhat lower. Foreign exchange reserve holdings are negatively related to  $\theta$ . When the home country is very large, foreign exchange reserves are a large fraction of the foreign portfolio of the foreign country. These diminish as the foreign country wealth rises.

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 2. Devereux and Saito (2006) discuss the conditions for the stability of the  $\theta$  process.

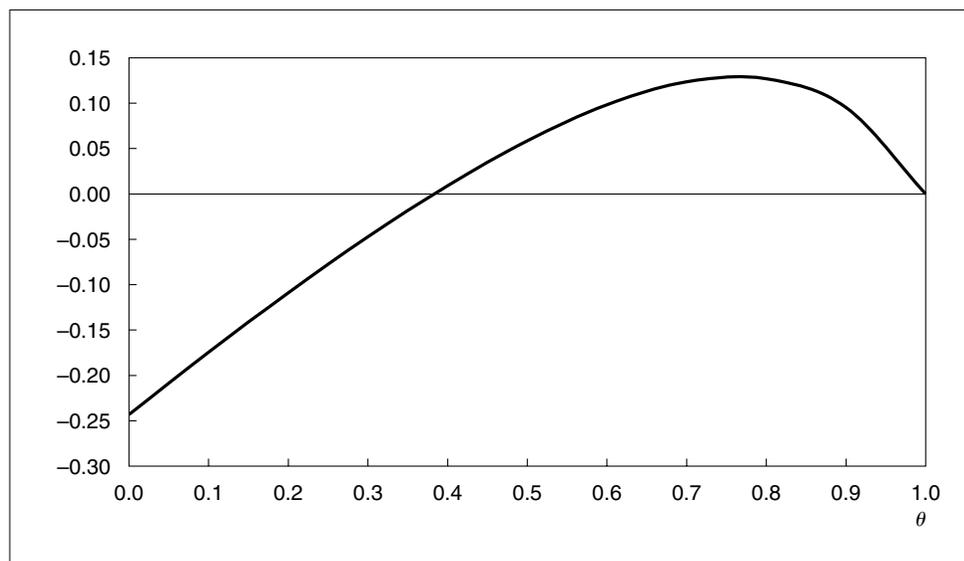
The foreign country has a gross asset position equal to  $(\tilde{\omega}_N^* + \tilde{\omega}_R^*)W^*$ , its total bond claims against the home country, and a gross liability position equal to  $\tilde{\omega}_D W$ , the FDI holding of the home country. We can then define net foreign assets of the foreign country, relative to world wealth, as  $nfa = (\tilde{\omega}_N^* + \tilde{\omega}_R^*)\theta - \tilde{\omega}_D(1 - \theta)$ . Using the above solutions, we obtain

$$nfa = (1 - \theta) \frac{[(\alpha_D - \alpha_M) - \sigma_D^2(1 - \lambda^2\theta)](1 + \theta) + \sigma_M^2\theta}{\Delta}.$$

This may be positive or negative. Net foreign assets are higher, the higher the return on the home technology relative to the foreign technology and the higher the volatility of the foreign technology. Net foreign assets are lower, the higher the volatility of the home technology. Again, net foreign assets will be time-varying in response to movements in  $\theta$ .

Figure 6 illustrates the relationship between  $\theta$  and net foreign assets of the foreign country. The dynamics of  $\theta$  are driven by relative growth rates and the underlying technology shocks of the two countries. For a low  $\theta$ , the foreign country is relatively poor, and it is a net debtor, as the value of its FDI liabilities is large relative to its external bond holdings. As  $\theta$  rises, this situation is reversed, as it builds up a large nominal and real bond claim on the rest of the world. As  $\theta$  tends to unity, the foreign country would become dominant in the world economy, and its net foreign assets, relative to world wealth, would trend to zero.<sup>3</sup>

**Figure 6 Ratio of Net Foreign Assets to GDP**



3. The long-run mean of  $\theta$  will be determined by the underlying parameters and volatility of technologies and the inflation rate process.

#### D. Quantitative Assessment

For the general case, Table 1 provides a rough quantitative assessment of the size of FDI, foreign exchange reserve holdings, and total bond holdings implied by the model. For this calculation we use the following calibration, based partially on U.S. data. Assume that the real risk-free rate of return on capital is 6 percent, approximately the long-run return to equity in the U.S. economy. The average real GDP growth rate of consumption since 1980 is approximately 3 percent, with a standard deviation of 1.7 percent. In a symmetric steady state, the real risk-free interest rate is  $\alpha - (\sigma^2/2)$ , and the expected consumption growth rate is  $\alpha - (\sigma^2/2) - \rho$ . Setting  $\sigma = 0.017$ ,  $\alpha - (\sigma^2/2) = 0.06$ , and  $\alpha - (\sigma^2/2) - \rho = 0.03$  requires that  $\alpha = 0.0601$  and  $\rho = 0.0301$ . The volatility of U.S. inflation since 1980 is 1.3 percent, which guides our choice of  $v = 0.013$ . For the foreign country, we assume that  $\alpha$  and  $\rho$  are the same as the United States, but we assume a more volatile GDP process, setting  $\sigma_M = 0.03$ , to match China's GDP volatility over the 1980–2004 period. In addition, we set  $\theta = 0.5$  for the baseline case. Finally, a value of  $\lambda = -0.6$  is used, following the estimate of Kydland and Prescott (1990). We then illustrate the model's implications for alternative values of  $\sigma_D^2$ ,  $\sigma_M^2$ , and  $v$ .

Table 1 measures the share of GDP held in each portfolio category. We compare this to the measured shares of equity and FDI liabilities, reserve assets, total bond assets, and net foreign assets for China in 2004, obtained from Lane and Milesi-Ferretti (2006). The baseline case in fact does a remarkably good job at matching the observed asset and liability positions of China. The ratio of implied reserve assets to GDP is 38 percent, almost exactly that in the data, and the ratio of FDI liabilities to GDP is 29 percent, very close to the observed 33 percent in the data. The ratio of bond assets to GDP is 41 percent in the model, and 39 percent in the data, while the overall net foreign assets in the model are 6 percent, slightly less than the 8 percent in the data.

Table 1 also reports the implications of a higher volatility of foreign technology, and a lower volatility of home-country technology, as well as a lower volatility of home-country inflation. An increase in  $\sigma_M$  increases reserve assets, bond assets, and net foreign assets, while decreasing FDI liabilities of the home country. Intuitively, a rise in  $\sigma_M$  increases the demand for home-country fixed-income assets, reducing the rate of return  $R$  and reducing the equilibrium FDI liabilities of the home country. A fall in  $v$  leads to a substitution out of real indexed bonds toward nominal bonds for the foreign country, while leaving FDI liabilities, overall bond assets, and net foreign assets unchanged. Finally, a fall in  $\sigma_D$  leads to a fall in FDI liabilities, and a rise in reserve assets, real bond assets, and net foreign assets of the foreign country.

**Table 1 China: Assets and Liabilities Relative to GDP**

Percent

	FDI liabilities	Reserve assets	Bond assets	Net foreign assets
Data	33	37	39	8
Baseline	29	38	41	6
High $\sigma_M$	21	47	59	19
Low $v$	29	57	41	6
Low $\sigma_D$	14	31	71	29

In summary, the model implies that a growth in reserve holdings of emerging market countries might be attributed to (1) a rise in volatility of emerging markets, (2) a fall in GDP volatility in advanced economies, or (3) a fall in the volatility of inflation in advanced economies. In each case, there is a rise in reserve holdings of emerging economies, as well as a rise in the net foreign asset position of these countries.

In summary, we may conclude that in terms of accounting for the qualitative and to some extent quantitative features of portfolio shares for emerging market economies, a simple model driven by aggregate macroeconomic risk alone is reasonably successful.

## V. Conclusions

Emerging market economies in Asia have experienced a remarkable episode of high and stable economic growth during the current decade. One view is that this stability is generated by these countries' persistent current account surplus positions and the implicit "hedging" potential that this provides against sudden stops. In this paper, we have emphasized a different mechanism, based on portfolio diversification principles and the growth of equity-based financing of Asian investment. A simple portfolio allocation model can provide an interpretation of this phenomenon. A complete explanation of gross and net capital flows in Asian economies, however, would require combining this model with an account of the high savings rates in Asia. We leave this issue for future research.

### References

- Caballero, R., E. Fahri, and P.-O. Gourinchas, "An Equilibrium Model of 'Global Imbalances' and Low Interest Rates," NBER Working Paper No. 11996, National Bureau of Economic Research, 2006.
- , and S. Panageas, "Hedging Sudden Stops and Precautionary Contractions," NBER Working Paper No. 9778, National Bureau of Economic Research, 2006.
- Devereux, M. B., and M. Saito, "A Portfolio Theory of International Capital Flows," CEPR Discussion Paper No. 5746, Center for Economic Policy Research, 2006.
- , and A. Sutherland, "Solving for Country Portfolios in Open-Economy Macro Models," CEPR Discussion Paper No. 5966, Center for Economic Policy Research, 2006.
- , and ———, "Monetary Policy and Portfolio Choice in an Open Economy Macro Model," *Journal of the European Economic Association*, 5 (2–3), 2007, pp. 491–499.
- Dooley, M., D. Folkerts-Landau, and P. Garber, "The Revived Bretton Woods System: The Effects of Periphery Intervention and Reserve Management on Interest Rates and Exchange Rates in Center Countries," NBER Working Paper No. 10332, National Bureau of Economic Research, 2004.
- Engel, C., and A. Matsumoto, "Portfolio Choice in a Monetary Open-Economy DSGE Model," NBER Working Paper No. 12214, National Bureau of Economic Research, 2006.
- Evans, M., and V. Hnatkovska, "International Capital Flows, Returns and World Financial Integration," NBER Working Paper No. 11701, National Bureau of Economic Research, 2005.
- Jeanne, O., "International Reserves in Emerging Market Countries: Too Much of a Good Thing?" *Brookings Papers on Economic Activity*, 1, 2007, pp. 1–55.
- , and R. Ranciere, "The Optimal Level of International Reserves for Emerging Market Countries: Formulas and Applications," IMF Working Paper No. 06/229, International Monetary Fund, 2006.
- Ju, J., and S.-J. Wei, "Domestic Institutions and the Bypass Effect of Financial Globalization," NBER Working Paper No. 13148, National Bureau of Economic Research, 2007.

- Kydland, F., and E. Prescott, "Business Cycles: Real Facts and a Monetary Myth," *Quarterly Review*, Federal Reserve Bank of Minneapolis, 14, 1990, pp. 3–18.
- Lane, P. R., and G. M. Milesi-Ferretti, "The External Wealth of Nations: Measures of Foreign Assets and Liabilities for Industrial and Developing Countries," *Journal of International Economics*, 55, 2001, pp. 263–294.
- , and ———, "The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970–2004," IMF Working Paper No. 06/69, International Monetary Fund, 2006.
- Mendoza, E., V. Quadrini, and J. V. Ríos-Rull, "Financial Integration, Financial Deepness, and Global Imbalances," NBER Working Paper No. 12909, National Bureau of Economic Research, 2007.
- Tille, C., and E. van Wincoop, "International Capital Flows," NBER Working Paper No. 12856, National Bureau of Economic Research, 2007.

## Comment

**GEORGES PINEAU**  
**European Central Bank**

I would like to thank in particular the organizers of the conference for having invited me. I should stress from the start that these are my personal views. They do not commit my own institution.

My comments will first examine some elements of the model, which as you know is an extension of a portfolio optimization framework to emerging markets. The important feature is financial market incompleteness to rationalize gross international capital flows among mature and emerging economies, which makes it also relevant from the perspective of global imbalances. (I will come back to this.) The second part of my comments will focus on international financial risk-sharing as far as emerging markets are concerned. I will try to show differences with mature economies, the role of market incompleteness and exchange rates, and I will have a short conclusion on policy implications. The question of optimality, in particular as reflected in the way the model is incorporating or accommodating market inefficiencies, will be touched on as well as the implications this could have for the assessment of risks associated with global imbalances. In this respect, I would tend to think that the current situation might be less benign than the model might suggest.

On the model itself, the paper is concerned with the participation of emerging markets in international financial risk-sharing, mainly through increased balance-sheet size, and through portfolio optimization, although under constraints. (I will come back to this.) The implicit policy message is that global imbalances are seen as the outcome of a balance-sheet optimization process. The net external position is a rather benign outcome of optimal balance-sheet leveraging and portfolio diversification, under constraints, and I think these constraints are important in this respect.

As already mentioned by the author, today's paper is an extension of Devereux and Saito (2006). An important point here is that Devereux and Saito (2006) assume complete financial markets, because there is effective financial risk-sharing among mature economies. Today's paper is looking at an emerging market in relation to a mature economy, and as stressed by the author, the important assumption is market

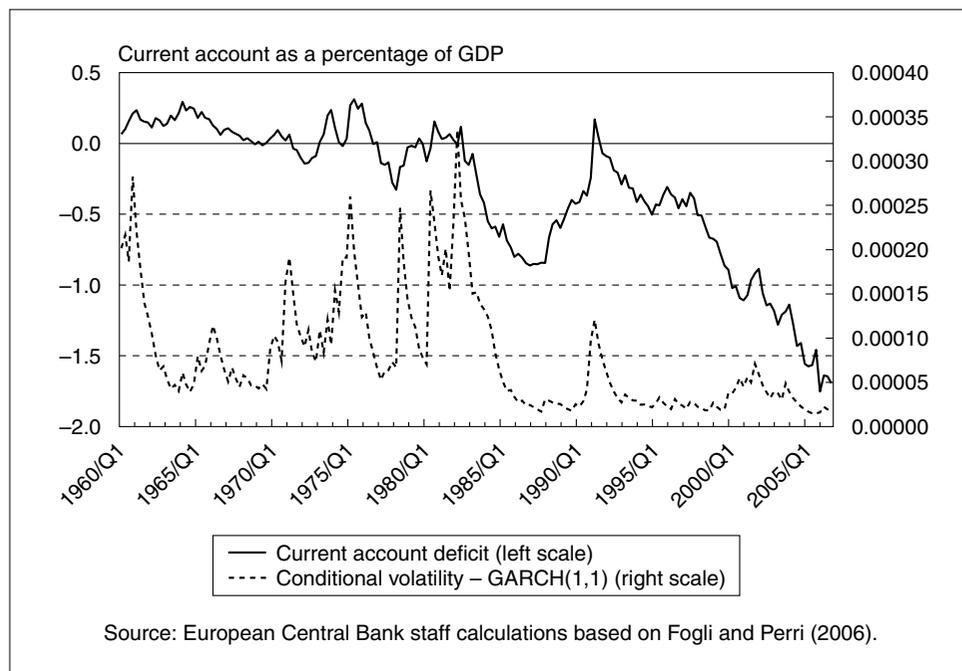
incompleteness. As I said, one of the specific contributions of the paper is that it is a general equilibrium approach, so in a way there is some reference to Dooley, Folkerts-Landau, and Garber (2004), except that those authors do not use a general equilibrium model to account for this distribution of assets and liabilities as far as mature economies and emerging economies are concerned. Today's paper addresses both the mature economies and the emerging economies in one global approach, which differs from the approaches taken by Tille (2005) or Jeanne and Ranciere (2006).

I will try to comment on some of the features of the model. As I already mentioned, the savings and investment net positions are not accounted for by the model, but the model focuses on the composition of gross assets and liabilities. At the same time, one may want to recall that savings-investment net positions are relevant for capital flows as shown in Prasad, Rajan, and Subramanian (2006). I will return to this in a moment.

In Devereux and Saito (2006), the main diversification driver is the cyclical or differences in cyclical in inflation and real returns, that is, the fact that in the United States price developments tend to be countercyclical, while in other mature economies it is not the case, which means that monetary policy, as well as nominal exchange rates, are important for cross-border financial risk-sharing.

In today's paper, the main driver relates to differences in technology, in particular, disparity in volatility of real returns. There is no role for the cyclical of prices in relation to GDP, and one possible reading is that the exchange rate does not have any bearing either. On this issue of volatility, in particular of the business cycle in the United States, which is an important driver for the emerging economy to invest in bonds in the United States, Figure 1 just shows that it is true when one looks at the

**Figure 1 U.S. Business Cycle Volatility and Current Account**



conditional volatility of the business cycle that there has been a significant decline in the United States, and this has been associated with the widening of the current account deficit in the United States. Of course, one interpretation of this development is also that this lower volatility of the business cycle or the “great moderation” might imply lower precautionary savings in the United States, which is reflected in the negative current account position. The interpretation in today’s paper is that it is also an incentive for the foreign country to invest in the United States, because it provides stability or a good hedge compared with the volatility of technology or returns in the foreign country.

I will now try to focus more specifically on certain assumptions or parameters of the model. The first one is whether the incomplete market assumption is too restrictive, in a way. The question there is that by imposing such strong restrictions, in other words, the fact that the emerging country can invest only in bonds while the domestic country can invest only in equity or contingent liabilities, the author might affect negatively the meaningfulness of the portfolio optimization model. Specifically, as said in the paper, the risk-return trade-offs are not endogenized because these restrictions are imposed.

Related to that, one question is whether this assumption—that is, this rather strong limitation on opportunities for investment by the home country or the foreign country—is in line with actual constraints in terms of capital account restrictions, or in terms of actual capital flows. One may just consider that of course there is not only the possibility for mature economies to invest in foreign direct investment (FDI) with the development of emerging economies’ local bond markets, and at the same time it is also possible for emerging markets to invest in types of mature economies’ securities other than sovereign bonds. One thinks of the setting up of sovereign wealth funds by emerging economies, and this is an empirical issue that is important to keep in mind.

The exchange rate is pegged, at least implicitly, because what is important for the foreign country is the conduct of stability-oriented monetary policy by the home country. This also might be seen as a consequential restriction, because it reduces risk diversification opportunities. Another question is the equivalence between policy-motivated preferences by the official-sector investors and profit-oriented portfolio optimization decisions by private-sector agents.

Another interesting feature is the assumption that returns on home assets depend on both home and foreign technologies, while returns on foreign assets are related only to foreign technology. Then the question is whether U.S. interest rates are more influenced by developments in the emerging markets than the reverse. At least this would be one implication of this assumption in the model.

The last point is about the simulation itself. The wealth share of the foreign country, 50 percent, seems to be retained to replicate the current foreign exchange reserves and FDI ratios in the United States and China. It seems that the actual share might be lower, and this would imply that we have not yet reached a steady state, and then this would entail further increase in global imbalances or balance sheets.

I come to the international financial risk-sharing issue. I will be quick on that, just to recall that dynamic stochastic general equilibrium (DSGE) models have been

predicting stronger international financial risk-sharing in emerging economies than is supported by evidence. This is the so-called “quantity anomaly,” and the main factor behind it relates to incomplete international financial markets in emerging economies. This is confirmed empirically. There is a recent paper—which was mentioned this morning—by Kose, Prasad, and Terrones (2007), showing that even the recent increase in the size of balance sheets of emerging markets has not improved their ability to share risk internationally. There is no consumption smoothing, and the reason is a so-called threshold effect, that is, the underdevelopment of domestic financial markets.

Linked to that is the question of whether there is optimality, since it is unclear to what extent emerging markets are benefiting from portfolio diversification/optimization. The question is whether they should not address first market imperfections as far as their domestic financial sectors are concerned.

The other question is the sign of net external positions and use of foreign savings by emerging countries. Prasad, Rajan, and Subramanian (2006) show that there is no negative correlation between GDP growth and current account position in emerging markets, in contrast to developments observed in mature economies. Again, it is due to either incomplete domestic financial markets or undervalued exchange rates. Just to take an example, the case of more complete financial markets is illustrated by the new member states of the European Union (EU), which have negative net external positions in line with the standard assumption that capital flows are going downstream. Also, positive FDI into those countries is reflecting a lack of domestic savings and the absence of capital account restrictions. In addition, strong credit growth in those countries, partly funded from external sources, enables consumption smoothing.

Keeping this example of the new EU member states in mind, the last point is about the issue of exchange rate level, which is also a factor mentioned by Prasad, Rajan, and Subramanian (2006). A point to stress is that if one looks at the International Monetary Fund estimates of equilibrium exchange rates for relevant new EU member states and relevant Asian emerging market economies, you see that the EU member states have aligned or overvalued exchange rates while 50 percent of Asian emerging markets have undervalued exchange rates.

Next, policy implications. I would say that there is an ambiguous outcome of financial globalization in emerging markets, since it reflects in part market distortions/inefficiencies, which constrain full use of portfolio optimization. There is a need for emerging markets to develop (more) complete domestic financial markets to mitigate distortions and reap the benefits of more efficient domestic and international resource allocation. Also, with domestic financial deepening there would be less need to manage capital flows and exchange rates, while emerging countries would be better able to rely on foreign savings to enhance domestic absorption. The last point is that another welfare-enhancing outcome of addressing these domestic distortions in emerging markets, as far as financial sectors are concerned, would be to reduce the risk of disorderly market developments associated with persisting global imbalances.

## References

- Devereux, M., and M. Saito, "A Portfolio Theory of International Capital Flows," CEPR Discussion Paper No. 5746, Center for Economic Policy Research, 2006.
- Dooley, M., D. Folkerts-Landau, and P. Garber, "The Revived Bretton Woods System: The Effects of Periphery Intervention and Reserve Management on Interest Rates and Exchange Rates in Center Countries," NBER Working Paper No. 10332, National Bureau of Economic Research, 2004.
- Fogli, A., and F. Perri, "The Great Moderation and the U.S. External Imbalance," *Monetary and Economic Studies*, 24 (S-1), Institute for Monetary and Economic Studies, Bank of Japan, 2006, pp. 209–225.
- Jeanne, O., and R. Ranciere, "The Optimal Level of International Reserves for Emerging Market Countries: Formulas and Applications," IMF Working Paper No. 06/229, International Monetary Fund, 2006.
- Kose, M., E. Prasad, and M. Terrones, "How Does Financial Globalization Affect Risk Sharing? Patterns and Channels," Conference on New Perspectives on Financial Globalization held by the International Monetary Fund in Washington, D.C., on April 26–27, 2007.
- Prasad, E., R. Rajan, and A. Subramanian, "Patterns of International Capital Flows and Their Implications for Economic Development," *Proceedings*, Federal Reserve Bank of Kansas City, 2006, pp. 119–158.
- Tille, C., "Financial Integration and the Wealth Effect of Exchange Rate Fluctuations," Federal Reserve Bank of New York Staff Report No. 226, Federal Reserve Bank of New York, 2005.

## Comment

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I would like to thank the Bank of Japan for organizing this conference and inviting me, and in particular for asking me to discuss today's paper. I really enjoyed it.

One way to place the contribution of this paper is to ask, "What are the unique characteristics of emerging Asian economies relative to the rest of the world?" We might have a shopping list along these lines: Asian economies tend to have high savings rates. They tend to currently be running large current account surpluses. Many of them have huge holdings of foreign reserves, which in reference to this paper one could characterize as fixed-income assets. They are also a popular destination for portfolio equity and for foreign direct investment (FDI), which in the context of this paper we would characterize as variable-income assets.

As this paper also notes, Asian nations have become much more financially integrated with the rest of the world. There has been a big increase in gross positions of Asian external assets and liabilities, much bigger than the net rate of increase in these assets. This pattern is not unique to Asia. It is exhibited by other economies and developed countries as well, as noted in recent research by Lane and Milesi-Ferretti (2006). Today's paper asks, "Can we use the recent phenomenon of increased gross positions in assets and liabilities to explain the other unique characteristics of Asian economies listed above?"

There is a burgeoning literature examining the phenomenon of large gross asset positions. Caballero, Fahri, and Gourinchas (2006) address this question in terms of

4. Opinions are my own and not necessarily those of the Federal Reserve Board or the Federal Reserve Bank of San Francisco.

segmented financial markets. In their paper, savings instruments are only available in the North, but FDI can move from North to South, resulting in a pattern of investment similar to the one derived in today's paper. Another related paper is Evans and Hnatkovska (2006), which looks at different intensities of market segmentation. They ask the question, "What happens when there is a move to full integration in international financial markets?" They find that when you go to full integration, where the agents can invest in both their own and foreign equities, there is a large decrease in trade in bonds. This would suggest that part of the big increase in gross positions in bonds is attributable to the market segmentation discussed in today's paper. Finally, Devereux and Sutherland (2006) also solve for optimal gross asset positions under segmented markets.

The model in today's paper has two countries: there is an advanced economy, which has a single technology, and an emerging economy that has two sectors, a traditional sector, and a modern sector. The modern sector is only operable by FDI from the advanced country.

The assumption of complete market segmentation in this manner is strong. Agents in the South cannot invest in equities in the advanced technology. They cannot buy shares in, say, Goodyear, which will then invest in a plant in the emerging market economy. In addition, the advanced economy is also segmented in the sense that it can only invest in the modern sector of the emerging economy. It cannot invest in the traditional sector. To defend this strong assumption, which buys a lot of analytic simplification, today's paper uses the example of China, which is a net creditor in securities, but also an important destination for FDI.

The advanced economy assets include internationally tradable bonds, which are denominated in the home-country currency, and equity shares in the home-country multinational, which are not internationally tradable. In the emerging economy, there are also bonds denominated in the home-country currency, but they are completely non-tradable. Instead, the emerging economy agents can hold advanced-country bonds that are associated in the model in the paper with international reserves, and in the calibration exercise are associated with the level of reserves held by China. There is also a risk-free asset in the background in this model that bears some analysis, but mainly it is there to simplify the analytics.

So what are the results of the model? First, the model demonstrates that the FDI share of the advanced-country investment portfolio is increasing in the return on FDI, decreasing in the volatility of return on FDI, and if the expected returns in the home sector are close to those of the FDI (meaning the modern technology investment in the emerging market countries), the FDI share is also increasing in the volatility of home-sector returns. These are all very intuitive results. The second set of results concerns the "reserve holdings" of the emerging market country agents. Reserve holdings are decreasing in the excess return on FDI, decreasing in advanced-country inflation volatility, and if expected returns in the home sector are sufficiently close to those of FDI, also increasing in the volatility of FDI. All of these relationships are pretty intuitive, as well.

We get stronger results if we look at a special symmetric case, where the expected returns in the South's modern sector are sufficiently close to the expected return in

the advanced-country modern sector. If those expected returns and their variances are roughly the same, FDI is decreasing in the absolute value of the covariance between inflation and the home technology shock, a parameter labeled  $\lambda$  in the paper.

The intuition behind this result is that when  $\lambda$  increases in absolute value (for normal parameter values, we would expect that  $\lambda$  would tend to be a negative term), this raises the degree to which you can hedge by having a short position in domestic bonds. When you are able to hedge more, in terms of having a short position in domestic bonds, your overall portfolio becomes less risky. In the case of the United States–China example, this would correspond to having China hold more of your country's bonds. Part of the reason that agents in the North engage in FDI is that FDI is a vehicle for hedging. When the absolute value of  $\lambda$  increases, the reduction in risk from holding short positions in domestic bonds is greater. As a result, the Northern agents have less incentive to engage in FDI, which is an alternative source of hedging. In the special symmetric case where the returns are expected to be the same, the only incentive for being in one asset or another is due to risk considerations.

The other result in the symmetric case is that the total reserves held by the emerging market economy are going to be increasing in the absolute value of  $\lambda$  as well. The intuition here is that for the emerging economy, an increase in the absolute value of  $\lambda$  improves the hedging performance of the advanced-country bonds, raising the demand for these assets by agents in the emerging economy.

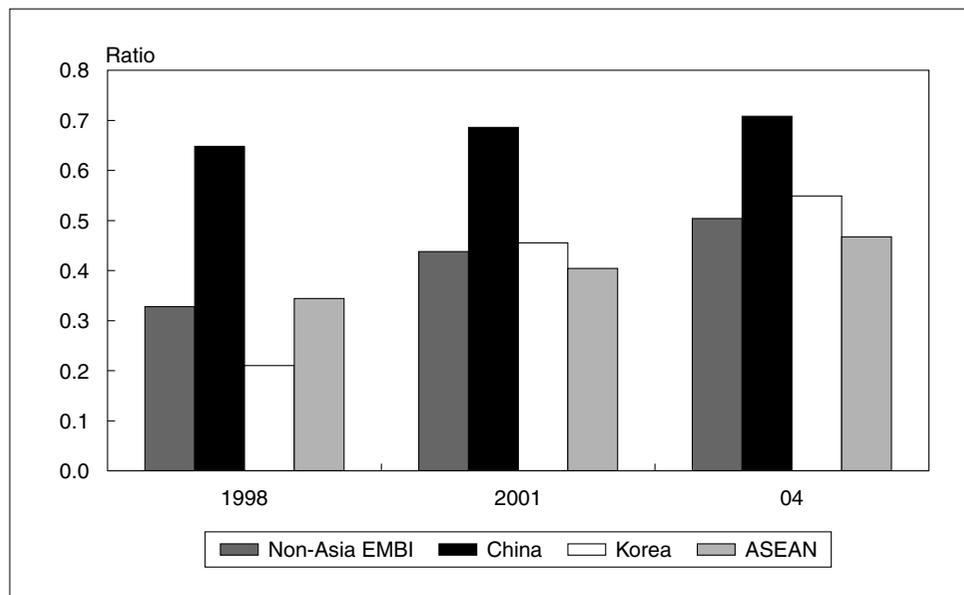
The calibration exercises in the paper provide some further results. Southern reserve positions are increasing in emerging market volatility, which is intuitive as the Southern demand for hedging opportunities provided by these assets is increased. Reserve positions are also found to be decreasing in advanced-country inflation and GDP volatility. Again, these results are intuitive, as the quality of advanced-country bonds as hedging vehicles is decreasing in both of these arguments.

Let me turn now to some comments. Before criticizing the paper, I would like to praise it, because I think that it is a very nice treatment and that the basic idea and the results in the paper are quite intuitive. Recall that the basic assumptions are that production in the emerging economy under the advanced technology is only available through FDI, and that Southern owners of capital in an emerging economy cannot directly buy equity in advanced multinationals. Because Southern owners of capital want to produce under the modern technology, they effectively lend money to the multinationals by purchasing advanced-economy bonds. These then get repatriated to the emerging market economy through FDI. These very simple, albeit strong, assumptions deliver the expansion of the gross positions that are observed in the data.

My first comment is, is this really an Asian story? The assumptions in the model might be considered a little heavy-handed for leading Asian economies. As we discussed, there is a lot of market segmentation in the paper. Emerging economies are completely prohibited from buying equity shares in the multinationals of the advanced country. These assumptions are motivated in the paper by the restrictions that exist on Chinese capital outflows.

However, if we look at the data, it does not appear to be the case that the growth of equity in total liabilities has been exceptional in Asia. Figure 1 depicts the value of this ratio for China, Korea, and the ASEAN economies as a group, as well as the

**Figure 1 Share of Portfolio Equity and FDI in Total Liabilities, 1998–2004**

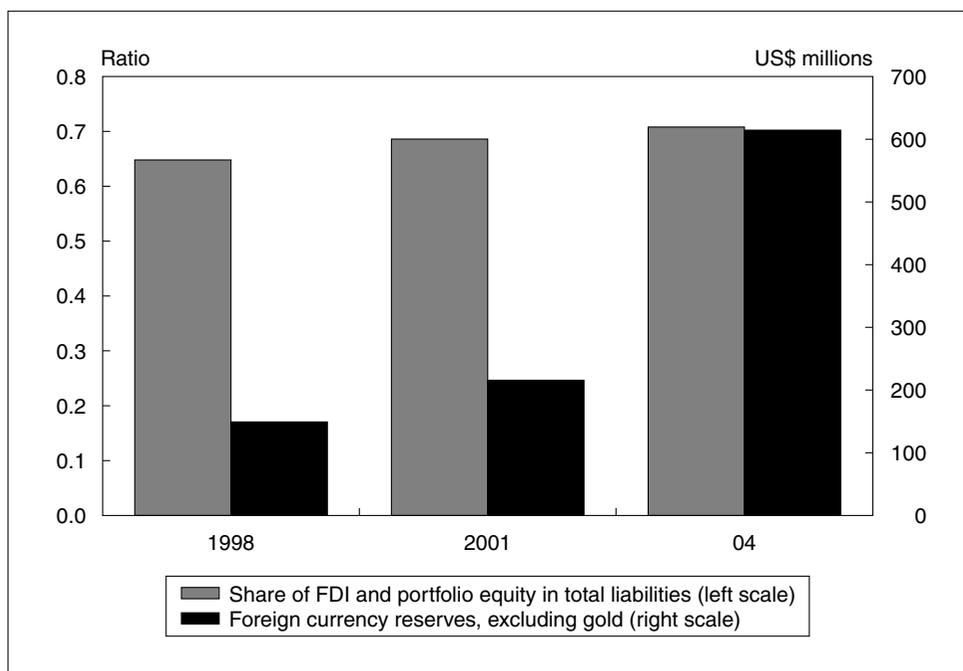


non-Asia Emerging Market Bond Index (EMBI) countries as a control.<sup>5</sup> It can be seen that with the exception of Korea, the rate of growth in the share of equity in total liabilities has not been exceptional. The growth in this share in either the ASEAN economies or China from 1998 to 2004 has been modest relative to the non-Asian emerging bond market countries.

Second, what of the contention that purchases of foreign reserves by agents in the South are financing FDI from North to South? Let us concentrate on China, whose restrictions on capital outflows have been stressed to motivate the segmented markets assumptions maintained in the model. Figure 2 shows the ratio of equity in the total liability portfolio as well as the level of reserve holdings. As we all know, there has been a large buildup in Chinese foreign exchange reserves in recent years. However, the share of FDI and portfolio equity and overall Chinese liabilities was almost as high in 1998 as it was in 2004. So, whatever is driving this big increase in reserves, it does not look like it is gross movement of positions trying to finance additional FDI holdings.

The pattern of Korean equity shares in Figure 1 appears to match the predictions of the model more closely, but I am afraid that it may be a little harder to accept the restrictions which the theory placed on the capital account for the Korean case. In particular, Koreans do not face restrictions on capital outflows, such as purchases of foreign equities. An alternative plausible story is that Korea, along with a number of other East Asian emerging market economies, was “overbanked” in the 1990s, and the growth in the equity share in liabilities in these countries represented a recovery from very low portfolio investment shares after the 1997 Asia crisis.

5. The non-Asian EMBI countries in our sample include Argentina, Bolivia, Brazil, Bulgaria, Ecuador, Mexico, Morocco, Nigeria, Panama, Peru, Poland, Russia, South Africa, and Venezuela.

**Figure 2 China, 1998–2004**

One alternative to the risk-hedging motivation posited in today's paper to explain the buildup in gross asset positions is the so-called "mercantilist motive," which would explain reserve buildups by Asian nations as efforts to resist exchange rate appreciation (e.g., Dooley, Folkerts-Landau, and Garber [2003]). The mercantile story could also, unlike this story, partially explain imbalances in the current account, as Southern countries build up stocks of foreign reserves as "collateral" against future opportunistic behavior against multinationals operating in their country.

Lastly, one issue that is unresolved in the paper is that the net Asian positions, that is, the large current account surpluses currently run by these nations, remain unexplained. Savings rates are taken as given in this model, so the net position is not going to be explained, except to the extent that savings can be influenced by changes in hedging opportunities. One might take this as a weakness of the paper, in that the buildup in large gross positions in many Asian nations may be related to their buildups in large net positions, but this model is relatively silent on this issue.

One interesting issue that could be confronted with this model concerns the welfare effects of incomplete markets. Even given the strict segmentation in this model, the ability to build up gross positions to circumvent this restriction may indicate that the welfare costs might not be that high if alternative forms of finance could serve as substitutes. Still, the simple model presented above is missing a lot of real-world frictions associated with FDI to run this kind of a horse race, such as issues of sovereign risk and technology transfer.

To conclude, I would say that I learned a lot from this paper, and I think it is a good way to start to address the question of large buildups of gross asset positions.

This model could be used to yield measures of the gains from increased financial integration that previous works cannot, because they do not concentrate on the optimal agent portfolios.

However, while this paper suggests that market segmentation can contribute to understanding portfolio positions in emerging Asia and its main trading partners, I am not sure if this channel is the whole story. In particular, I think there is still a lot of room for proponents of the argument that mercantilist motivations have driven the runup in holdings of foreign reserves in these nations, in particular due to exchange rate policies. It may also be the case that this model is better fitting to other emerging market economies, say, in Latin America, than those in Asia. I think that the assumptions of the model, such as the restrictions on international capital movements, appear to best fit China over this period, but when we look at the data, other Asian nations such as Korea match the empirical predictions of the model better. It seems difficult to come up with an Asian case that matches both.

#### References

- Caballero, R. J., E. Fahri, and P.-O. Gourinchas, "An Equilibrium Model of 'Global Imbalances' and Low Interest Rates," NBER Working Paper No. 11996, National Bureau of Economic Research, 2006.
- Devereux, M. B., and A. Sutherland, "Solving for Country Portfolios in Open-Economy Macro Models," CEPR Discussion Paper No. 5966, Center for Economic Policy Research, 2006.
- Dooley, M., D. Folkerts-Landau, and P. Garber, "An Essay on the Revived Bretton Woods System," NBER Working Paper No. 9971, National Bureau of Economic Research, 2003.
- Evans, M., and V. Hnatkovska, "Solving General Equilibrium Models with Incomplete Markets and Many Assets," mimeo, Georgetown University, 2006.
- Lane, P. R., and G. M. Milesi-Ferretti, "The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970–2004," IMF Working Paper No. 06/69, International Monetary Fund, 2006.

## General Discussion

Responding to the comments by the discussants, Michael Devereux first stressed that the assumption of market segmentation was not only important but also realistic. He stated that it was possible to have market segmentation in the model across another dimension, for example, by assuming that some U.S. assets are non-tradable and some are tradable. With such an assumption, however, he claimed that the model would have similar results. As for the issue of the savings-investment position and the current account, he replied that his general equilibrium model actually determined the long-run distribution of net foreign assets endogenously, although the model did not provide a good explanation for the massive buildup of current account surpluses in East Asian countries over the last eight or nine years. With regard to the issue of China's modest increase in the share of foreign direct investment (FDI) in its external liabilities relative to its large increase in foreign exchange reserves, he remarked that the model did not necessarily predict a concurrent increase in both FDI and foreign exchange reserves.

In the general discussion, several participants pointed to the implicit role of precautionary saving motives in Devereux's model. Maurice Obstfeld (University of California at Berkeley) proposed an alternative view: that in face of the increased uncertainties in the environment following the financial crises of the late 1990s, agents in East Asian countries decreased their illiquid investments and accumulated liquid investments. This could result in increased foreign exchange reserves. Devereux accepted the view and replied that the shift of savings into liquid assets may be responsible for the decline in investment. Anton Braun (University of Tokyo) pointed out that the precautionary saving motive was, in fact, operating in Devereux's model.

Several participants commented on the issue of the equity premium from the perspective of financial globalization. Obstfeld argued that one of the puzzling things about China's reserves portfolio was that it earned so little in comparison with the returns paid to its FDI liabilities and that this was not fully explained by risk aversion. He acknowledged that the issue was beyond the scope of Devereux's model and remarked that understanding the equity premium at the global level could be very important. Devereux replied that it was still an open question whether the equity premium existed or not and depends on how the data are treated. Kenichiro Watanabe (Bank of Japan) argued that the same investment opportunities in emerging markets could yield different returns depending on who invested in them: for example, U.S. multinational firms or local investors. Watanabe claimed that the difference in returns seemed to be one reason why FDI has replaced emerging market domestic investments. Devereux agreed with Watanabe on this viewpoint.

In relation to the issue of the goodness of fit of the model to the data, several participants made comments by referring to country experiences. Shaghil Ahmed (Board of Governors of the Federal Reserve System) claimed that Devereux's explanation on the level of foreign exchange reserves could not be applied to changes in recent years in Chinese reserves. Referring to Chinese data, Ahmed emphasized that the surge in foreign exchange reserves in tandem with the surge in the current account surplus over the past few years remained unexplained by the model. Devereux replied that the level of foreign exchange reserves could be changing in the model alongside net wealth, but he did not try to capture this relationship. Braun suggested that it would be interesting to separate government and private-sector savings to see what was going on behind the patterns in the savings rates. He also claimed that the view about output stability in Korea before 1998 was very different from that after 1998 and that the model could be used to explore which configuration of model parameters could reproduce the change in output stability. Sanghoon Ahn (Korea Development Institute) suggested three observations to be explained by the model in East Asian countries, especially in Korea: (1) countries (including Korea) that experienced the financial crises in the late 1990s dramatically improved their current account position and this seemed to be related to the significant depreciation of their currencies; (2) Korea's current account surplus appeared to be narrowing, mainly because of the large increase in the services balance deficit; and (3) Korea's high savings rate could be explained by savings in the corporate sector, while household savings were declining very rapidly.

Several participants posed questions about the modeling and its implications. Ippei Fujiwara (Bank of Japan) asked about the implications of the model for optimal

monetary policy in the global economy. He pointed out that the model seemed to be suggesting that, and contrary to conventional wisdom, monetary policy should not completely stabilize price developments. Devereux replied that this unconventional implication was simply due to a feature of the assumptions in the model that the price level was determined exogenously. Hans Genberg (Hong Kong Monetary Authority) asked why the model needed to include traditional technology and the risk-free bond. Devereux replied that a traditional sector was necessary for setting up incomplete markets and a risk-free bond was merely for ensuring the algebra made it easier to obtain clear-cut solutions.