What Makes Hot Money Hot? The Relative Volatility of International Flows of Debt and Equity Capital

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This paper is concerned with the relative volatility of international flows of debt and equity capital. It is shown that if foreign investors are less well informed about the domestic economy than domestic investors, then international flows of debt capital will be more volatile than flows of equity capital in the sense that the proportional change of foreign bondholdings in an economy in response to a change in that economy’s economic prospects will be greater than the proportional change in foreign stockholdings. This is shown to be consistent with the behavior of international flows of debt and equity capital during the Asian crisis.

1. Introduction

The recent crises in Asia, Russia, and Latin America have given rise to renewed concern about the effects of the free flow of capital between countries, particularly in the case of countries with inadequately developed capital markets. Some countries have even responded to capital outflows by re-imposing

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"While there is general agreement about the potential benefits that well-functioning global capital markets can generate, there has been much more controversy about the market's ability both to generate a sustainable flow of capital to emerging markets and to evaluate and price the credit risks associated with different borrowers." (IMF, 1998), p. 67.
In 1991 Chile introduced a one-year mandatory non-interest-bearing reserve requirement on all foreign borrowing exceeding 20 percent of the total. This measure was aimed at reducing the vulnerability of the country's financial system to external shocks. The table below provides a breakdown of the composition of foreign investment flows by sector and type for the period from 1990 to 1994, as reported by the IMF.

### Table 1: International Capital Flows 1990-94

<table>
<thead>
<tr>
<th>YEAR</th>
<th>Foreign Investment Flows</th>
<th>Domestic Loans</th>
<th>Payment of Interest and Markup Adjusted</th>
<th>Current Account Balance</th>
<th>Total Capital Inflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>6.3%</td>
<td>1.6%</td>
<td>0%</td>
<td>10%</td>
<td>9.5%</td>
</tr>
<tr>
<td>1991</td>
<td>8.3%</td>
<td>1.7%</td>
<td>0%</td>
<td>12%</td>
<td>10.4%</td>
</tr>
<tr>
<td>1992</td>
<td>9.3%</td>
<td>2.7%</td>
<td>0%</td>
<td>14%</td>
<td>12.4%</td>
</tr>
<tr>
<td>1993</td>
<td>10.4%</td>
<td>3.8%</td>
<td>0%</td>
<td>16%</td>
<td>14.2%</td>
</tr>
<tr>
<td>1994</td>
<td>11.4%</td>
<td>4.9%</td>
<td>0%</td>
<td>18%</td>
<td>16.1%</td>
</tr>
</tbody>
</table>


By 1995, the Philippines had implemented a number of financial sector reforms, including the establishment of a new banking law and the introduction of a reserve requirement on foreign borrowing. These measures helped to reduce the vulnerability of the financial system to external shocks and improve its resilience. The table below provides a breakdown of the composition of foreign investment flows by sector and type for the period from 1990 to 1994, as reported by the IMF.
Table 2. Volatility of Components of International Capital Flows 1990–97¹

<table>
<thead>
<tr>
<th></th>
<th>Coefficients of Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Asia</td>
</tr>
<tr>
<td>Portfolio investment</td>
<td>1.34</td>
</tr>
<tr>
<td>Bank loans</td>
<td>2.48</td>
</tr>
<tr>
<td>FDI</td>
<td>0.56</td>
</tr>
</tbody>
</table>

¹Indonesia, Korea, Malaysia, the Philippines, Thailand.

both portfolio investment and bank lending. Our analysis is based on an extension of the models of Brennan and Cao (1996, 1997) which focus on the consequences of information asymmetry between investors.⁵

It is commonly suggested that capital flows that are invested in short maturity assets are more volatile than flows that are invested in longer term assets such as bonds or equity.⁶ One reason that holdings of short maturity debt securities may be more volatile than holdings of longer maturity debt contracts or equity is the possibility of bank runs.⁷ To the extent that short maturity debt securities are liabilities of banks and there is no lender of last resort, occasional bank runs would give rise to big negative capital flows.⁸ This would imply negative skewness in capital flows but would not explain large positive inflows. A second possibility is that markets for short term debt securities are more liquid than markets for longer term debt and equity; since the costs of portfolio adjustment would be lower for these securities we might expect to see their holdings more responsive to changes in expected returns relative to other securities. In this paper we pursue a related but different explanation. We argue that equilibrium

⁵Chari and Kehoe (1996) construct a model of (debt) capital flows based on the herding model of Bikhchandani et al. (1992). Calvo and Mendoza (1998) present a model of (equity) capital flows in which volatility is also created by herding; they argue that opportunities for international diversification reduce incentives to become informed which makes herding more likely.

⁶For example, Michel Camdessus, Managing Director of the International Monetary Fund, “We need to push ahead with capital flow liberalisation but in an orderly fashion. The last thing you must liberalise is the very short term capital movements”. Financial Times, February 4, 1998.


⁸That there was an element of the bank run in the recent Asian crisis seems beyond dispute. “Banks' weak fundamentals combined with a lack of transparency and of decisive response from the authorities fueled the reluctance of foreign creditors to roll over short term loans to banks” (IMF, 1998).
The price of uncertainty: The price of uncertainty, recognize that banks which use that term also need to reflect on their exposure to changes in the value of the portfolio. However, the situation is more complex. The value of a portfolio of illiquid assets is affected by changes in the market value of these assets, and the exposure of these assets to changes in the value of the portfolio is reduced by the risk of default. As a result, the risk of default becomes more pronounced the riskier the default becomes. As a result, foreign investors are more likely to reduce their holdings of default securities by a larger amount. The result is that the default becomes more risky. As a result, to achieve a given reduction in the sensitivity of the value of the portfolio to changes in the domestic market portfolio, the exposure to the market portfolio is reduced. This causes a decrease in the value of the portfolio. This, in turn, reduces their holdings of illiquid assets, and their holdings of illiquid assets are reduced. The result is that the risk of default becomes more pronounced the riskier the default becomes. As a result, foreign investors are more likely to reduce their holdings of default securities by a larger amount.
economy rises, giving rise to a balance of payments crisis. Section 2 discusses the data on capital flows to emerging markets and Asia in recent years and summarizes recent studies relating capital flows to informational considerations. Section 3 presents the basic model, Sec. 4 presents some numerical examples, and Sec. 5 considers the determinants of flows of debt, equity and bank loan capital to Indonesia, Korea and Thailand during the 1990's in light of the theory.

2. Information and Capital Flows

The recent history of foreign capital flows to Asia and the emerging markets is well summarized in IMF (1998, p. 12):

“portfolio flows to the emerging markets have been volatile. From a peak of 104 billion in 1993, for example, they fell to less than one-fourth of this level in 1995 in the aftermath of the Mexico peso crisis in 1995, then more than doubled to 50 billion in 1996. During 1997 portfolio flows shrank by 14 percent to 43 billion. “Other flows”, which largely consisted of bank lending, were negative — that is, there were net outflows of 7.3 billion during 1997. This reflected a massive turnaround — from net bank lending inflows of over 70 billion in 1995 and in 1996.

The precipitous decline of almost 100 billion in net private capital flows to Asia in 1997 reflected a 75 billion turnaround in bank lending flows and 22 billion in portfolio flows, while FDI flows to the region remained stable. Most of the declines in total flows to the Asian region reflected declines in flows to the affected Asian countries — Thailand, Malaysia, the Philippines, Indonesia and Korea — where net inflows of 73 billion in 1996 were replaced by net outflows of 11 billion in 1997. Most of the turnaround to these countries in turn arose from a 73 billion turnaround in net bank lending flows, with the sharpest outflows recorded from Thailand and Korea of some 18 billion each. Portfolio flows to the affected countries fell but remained positive while FDI flows remained resilient.”

The model that we shall develop in the following section predicts that as economic conditions in a country improve there will be a rapid increase in holdings of foreign bond investors. This is consistent with the above and with the fact that “a new set of institutional investors (for example, mutual

secret underperformance of international funds relative to the U$S in the last four or five years, and especially over domestic stocks, a trend that has been exacerbated by the decline in foreign stock prices and the strong performance of the US equity markets.

Following the decline of the Thai baht at the beginning of the third quarter (of 1997),

1. In consequence, they reflect the Pentagon-CIA hypothesis that there is due to informational asymmetries,

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indirect evidence. For example, Frankel and Schmukler (1996) find that changes in the Net Asset Values of Mexican closed end funds Granger cause changes in the fund prices on the NYSE at times of crisis — the implication is that prices of the underlying shares are set by better-informed locals. Stulz (1997) reports that capital outflows from the residents of Mexico took place following the Colosio assassination in March 1994 while foreign investors were net purchasers of Mexican equities even in December, immediately before the crisis. Klibanoff et al. (1998) report that price changes of closed end country funds in the US are strongly influenced by news stories in the New York Times even after adjusting for the concurrent change in the Net Asset Value. Kang and Stulz (1997) report that foreign equity investors in Korea concentrate their investments in the larger firms and conclude that their findings are consistent with a model in which foreign investors know more about large firms than about small firms in the markets in which they invest. Portes and Rey (1999) find that cross-border equity flows are well-explained by such informational variables as telephone call traffic and multinational bank branches. Some authorities have suggested that foreign investors are inclined to rely too much on credit ratings and too little on their own research.15 And concerns have been expressed that the rating agencies were slow in adjusting their ratings to the new realities in Asia;16 this is consistent with the ratings agencies themselves suffering from an informational disadvantage.

In the following section we shall develop a model which relates debt and equity capital flows to market returns in a setting in which foreign investors are less well informed than domestic investors.

3. A Model of Debt and Equity Capital Flows

3.1. The basic model

To simplify, we shall consider a setting in which there is a single risky asset which corresponds to the domestic market portfolio.17 The market portfolio

14Stulz (1997) cites a somewhat different argument of Shleifer and Vishny (1997) which predicts that clients of managers committed to foreign markets will withdraw funds when the returns are poor.

15"Several times during 1997 the IIF (International Institute of Finance) urged lenders and investors to undertake thorough research and not to rely on credit ratings", said William R. Rhodes, vice-chairman of the IIF. "Subsequent events showed that those concerns were correct". International Institute of Finance press release, January 29, 1998.

16"The (credit) ratings agencies were clearly late in downgrading the affected Asian countries" (IMF, 1998, p. 52)
For simplicity, we assume that the market portfolio pays no dividends between time 0 and time 1.


where \( \xi \) denotes the subjective held realized by \( \{\xi_t\} \), and measure of the market portfolio is demand by investor \( i \). \( \theta_i \) is measure of the price and investor information are self-financing. The optimal number of investors' demand and their control of the market portfolio, \( \{\pi_t\} \), are truncated the investor's expected equilibriums in the market. Let \( \Pi_i \) denote the market value of the market portfolio at time \( t \). In a riskless environment, for trading and at time 1, the return on the risky asset is realized and composition is distributed with mean 0 and precision \( \psi \). Where each global market opens distributed with mean \( \frac{\xi}{\psi} \) and precision \( \omega \). Where \( \xi \) is normal and independently distributed with mean 0 and precision \( \omega \).

\[
\frac{1}{\omega} = \frac{1}{\psi} + \frac{1}{n}
\]

where \( n \) is normal and independently distributed with mean 0 and precision \( \frac{1}{\omega} \).
subsigma field generated by \( \{ \tilde{y}_j, \tilde{p}_j, j = 0, 1, \ldots, t \} \) is denoted by \( \tilde{\mathcal{F}} \). The optimal asset demands and equilibrium market value process are then given in the following theorem:

**Theorem 1** (Brennan and Cao (1996)): In an economy with \( T \) trading sessions, there exists a partially revealing rational expectations equilibrium in which prices and asset demands are given by:

\[
\begin{align*}
\tilde{P}_t &= K_t^{-1} \left[ (K_t - s) \tilde{\mu}_t + s \tilde{u} - \tilde{x} / r \right] \\
\tilde{D}_n &= \tau \left[ s \tilde{z}_i - s \tilde{u} + \tilde{x} / r - (s_t - s) \tilde{P}_t \right]
\end{align*}
\]

where

\[
\tilde{\mu}_t \equiv E(\tilde{u} | \mathcal{F}_t) = \frac{h \tilde{u} + \sum_{j=0}^t n_j \tilde{y}_j + r^2 s^2 \tilde{p} \tilde{q}}{h + \sum_{j=0}^t n_j + r^2 s^2} \\
\tilde{q} = \tilde{u} - (\tilde{x} - \tilde{x}) / rs \\
K_t = h + s + \sum_{j=0}^t n_j + r^2 s^2 \\
r = \int_0^1 \tau_i d\tau_i, \quad s = \frac{1}{r} \int_0^1 \tau_i s_i d\tau_i.
\]

Theorem 1 shows how \( \tilde{P}_t \), the value of the market portfolio, and \( \tilde{D}_n \), the number of units in the market portfolio held by investors with different information, are established. Now consider the implications of increasing the frequency of trading: Brennan and Cao (1996) establish that so long as the information flow is sufficiently smooth, the variance of price changes between trading sessions tends to zero as the number of trading sessions is increased without limit. In the limit, as trading becomes continuous, it is possible to price claims whose payoff is contingent on the value of the market portfolio by Black-Scholes (1973) principles, and the wealth allocation converges in probability to a set of quadratic functions of \( \tilde{u} \) which is Pareto efficient. Then, as shown in the following Lemma, the prices of all securities are as if there existed a single representative investor with average beliefs and risk tolerance:

**Lemma 1** (Brennan-Kraus (1978), Rubinstein (1974)): As the limiting economy is Pareto efficient, it follows from the results of Brennan and Kraus (1978) and Rubinstein (1974) that, in the limiting economy, prices are as if there existed a single
In order to capture the notion of country risk in a tractable fashion we shall
assess the notion of country risk which gives rise to the notion of country risk.

Level of domestic economic activity! It is this common dependence of the quality
and the ability of the debtor to make good on his debts and the effect of

the market value of the claim in the case of corporate debt, and on the value of
the claims in the case of government claims. Claims made on the market
will depend on the level of tax receipts in the case of government claims,
on the value of

The ability of debtors to make good on these claims is reflected in the level of tax receipts, the ability of debtors to make good on these claims

\[ \frac{1}{2} \int_0^\infty K^0, \omega^0 \lambda^\omega \] 

where \( \omega_0, \lambda^0 \) are given by probability distributions, respectively, and \( \omega, \lambda \) are the standard normal density and standard normal

\[ \left( \frac{\omega}{\sqrt{d - \omega}} \right) u_{\omega} \left( \frac{\omega}{\sqrt{d - \omega}} \right) + \left( \frac{\omega}{\sqrt{d - \omega}} \right) N(d - \omega) = \omega, \lambda \] 

where \( n(\omega, \lambda) \) are the standard normal density and standard normal

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where \( n(\omega, \lambda) \) are the standard normal density and standard normal
by the domestic market portfolio. Then the payoff on a risky bond which matures at time $T$ with face value, $F$, and is secured by a fraction $k$ of the domestic market portfolio is given by:

$$\min\{kP_T,F\} = k \min\{P_T,F/k\} = k(P_T - \max[P_T - F/k,0]).$$  \hspace{1cm} (6)

Ignoring any intermediate coupon payments, the bond is equivalent to a portfolio consisting of a fraction $k$ of the domestic market portfolio and a short position in $k$ call options on the portfolio with exercise price $F/k$. Therefore the value of the bond at time $\tau < T$, which we denote by $B(F,k,T;P,\tau)$, can be written as:

$$B(F,k,T;P,\tau) = kP - kC(F/k,T;P,\tau).$$  \hspace{1cm} (7)

Define the bond’s sensitivity to the value of the market portfolio, or its “delta”, by $\delta(F,k,T;P,\tau) \equiv \partial B(F,k,T;P,\tau)/\partial P$. Then

$$\delta(F,k,T;P,\tau) = k \left[ 1 - N\left( \frac{P - F/k}{\sigma(\tau,T)} \right) \right].$$  \hspace{1cm} (8)

Note that $k > \delta(F,k,T;P,\tau) > 0$: bond values are increasing in the value of the market portfolio since their payoffs are (weakly) increasing in the value of the portfolio at maturity. Similarly, define the bond’s “gamma” or rate of change of the bond’s delta with respect to changes in the value of the market portfolio, as $\Gamma(F,k,T;P,\tau) \equiv \partial^2 B(F,k,T;P,\tau)/\partial P^2$. Then, differentiating expression (8) with respect to $P$:

$$\Gamma(F,k,T;P,\tau) = -\frac{k}{\sigma(\tau,T)} n\left( \frac{P - F/k}{\sigma(\tau,T)} \right).$$  \hspace{1cm} (9)

Note that $\Gamma < 0$, so that a bond’s delta is a monotonic decreasing function of the value of the market portfolio: as the value of the market portfolio increases, the risk of the bond decreases, and therefore its value becomes less sensitive to changes in the value of the market portfolio.

Since $\delta \neq 0$, it is possible in the limiting economy to replicate the returns on an equity portfolio by continuous trading in a single bond or portfolio of bonds and the riskless asset. Formally:

**Lemma 2** The wealth outcome of individual $i$ in the limiting economy that is generated by following the strategy of holding $D_n$ units of the market portfolio at time $t$ and $W_i - D_n P_i$ dollars in the riskless asset, may be replicated by holding $b_{ij}$ units of bond $j (j = 1, \ldots, J)$ at time $t$ and $W_i - \sum_{j=1}^{J} b_{ij} B_{j}$ dollars in the riskless asset, where $B_{j}$ denotes the price of bond $j$ at time $t$ and $b_{ij}$ is chosen so that $\sum_{j=1}^{J} b_{ij} \delta_{ij} = D_n$. 

The value of the bondholding is \( b^g \).

\[ b^g / n_D = b^g / \left( \frac{1}{x} - \frac{1}{s} + \frac{1}{n_D - x} \right) = b^g q \]

In other words, in a single-dealer contract, \( Q \) is the number of units of the market portfolio, and \( b^g q \) is the number of units of bonds.

\[ \sum_{j=1}^{n_D} 1 = \sum_{j=1}^{n_D} \frac{1}{1} = n_D \]

\[ \left( \frac{1}{x} - \frac{1}{s} + \frac{1}{n_D - x} \right) = b^g q \]

is given by Eq. (1) and portfolio holdings satisfy:

**Theorem 2** In the limiting economy in which risky deals contracts are traded, the value of the domestic market portfolio is given by Eq. (2), the price of dealer contracts may be extended in the limiting economy to allow trading in risky bonds.
Now consider the proportional rate of change in the number of bonds of type \( j \) held by the investor with respect to a change in the level of the domestic market portfolio, \( \varepsilon_{\text{bin}} \), which we refer to as the investor's "personal bond elasticity":

\[
\varepsilon_{\text{jt}} \equiv \frac{1}{b_{\text{aj}}} \frac{\partial b_{\text{aj}}}{\partial P} = \frac{1}{D_\text{a}} \frac{\partial D_\text{a}}{\partial P} \frac{1}{\delta_\text{a}} \frac{\partial \delta_\text{a}}{\partial P}.
\] (13)

Define \( \eta_t \equiv \frac{1}{D_\text{a}} \frac{\partial D_\text{a}}{\partial P} \), as the semi-elasticity of the holdings of a pure equity investor with respect to the level of the market index; we shall call this the investor's "personal equity elasticity". Define \( \gamma_t \equiv \frac{1}{\delta_\text{a}} \frac{\partial \delta_\text{a}}{\partial P} = \frac{\Gamma_t}{\delta_\text{a}} \) as the semi-elasticity of the delta of the bond with respect to the level of the market index; we shall call this the bond's "delta elasticity". A positive personal equity elasticity means that an investor increases the number of shares that he holds in the market portfolio as the value of the portfolio rises. Since a bond's delta is always positive and its gamma is always negative, it follows that a bond's delta elasticity is always negative. Notice that the personal equity elasticity depends on the identity of the investor, while the bond's delta elasticity depends only on the characteristics of the bond. Then the investor's personal bond elasticity may be written as the difference between the investor's personal equity elasticity and the bond's delta elasticity:

\[
\varepsilon_{\text{jt}} \equiv \eta_t - \gamma_t
\] (14)

and we have the following result:

**Proposition 1**

(i) An investor's personal bond elasticity is equal to the difference between the investor's personal equity elasticity and the bond's delta elasticity.

(ii) Since a bond's delta elasticity is always negative, an investor's bond elasticity is always greater than his personal equity elasticity.

Note that it is possible that the absolute value of an investor's personal bond elasticity may be less than the absolute value of his personal equity elasticity. In this case the volatility of an investor's holdings in foreign equities will be greater than the volatility of his holdings in the bond if he is forced to replicate his desired equity payoff with a dynamic strategy in bonds. This can only happen if the investor's personal equity elasticity is negative. Therefore, in order to use the results of Proposition 2 to make claims about the volatility of international flows of debt and equity capital, it is necessary for us to make an assumption about the relative information of domestic and foreign
The standard normal density function

\[ \phi(x) = \frac{1}{\sqrt{2\pi}} e^{-x^2/2} \]

is the hazard function of

\[ h(t) = \mu \phi(x) \]

(1)

Lemma 2

The following lemma describes the determinants of a bond's delta elasticity:

\[ \Delta \text{bond} = \text{delta elasticity of bond} \times \text{delta elasticity of spot} \]

Thus, if the delta of a bond is large, the elasticity of the bond will be high.

Proposition 2

The following results:

\[ \text{Assumption A: For any foreign investor, } \lambda \]

Assumption A: Formally:

\[ \alpha \text{ or } \beta \]

then the foreign investor will receive more signals about the payoffs on the domestic portfolio, and therefore receive more information than the domestic investor. Therefore, less well-informed foreign investors are more likely to invest.

The assumption implies that foreign investors start the period with less precise
Since the hazard function of the normal distribution is increasing,
(i) a bond's delta elasticity, $\gamma$, is decreasing in $P$, the value of the market portfolio, and in $k$, the fraction of the portfolio that collateralizes the bond.
(iii) for $P \geq F/k$, a bond's delta elasticity, $\gamma$, is increasing in $\sigma(t, T) \equiv (T-t)^{1/2}\sigma$, and is therefore increasing in both the risk of the economy, $\sigma$, and in the time to maturity of the bond, $(T-t)$; for $P \ll F/k$, a bond's delta elasticity, $\gamma$, is decreasing in $\sigma(t, T) \equiv (T-t)^{1/2}\sigma$, and is therefore decreasing in both the risk of the economy, $\sigma$, and in the time to maturity of the bond, $(T-t)$.

Lemma 3 implies that the bond's delta elasticity is increasing in $\gamma(t, T)$ if the bond's face value exceeds the value of the collateral. This implies the following for the personal bond elasticity of a foreign investor:

Lemma 4

(i) A foreign investor's personal bond elasticity is decreasing in the term to maturity of the bond for $P \geq F/k$.
(ii) A foreign investor's personal bond elasticity is increasing in the term to maturity of the bond for $P \ll F/k$.

Lemmas 3 and 4 imply that the most volatile bond holdings will be those of bonds which are well collateralized, and that for well collateralized bonds those with the shortest maturities will be the most volatile. Thus, consistent with the popular view, the hottest money is that which is invested in relatively riskless short term bank deposits.

The major empirical implication of our theory that we shall examine in Sec. 5 below is that foreign debt and equity flows are positively related to the return on the market portfolio. While the theory implies that foreign debt holdings are proportionately more sensitive to market returns that are foreign equity holdings, lacking reliable data on the market values of asset holdings, we shall restrict our attention to the foreign portfolio investment flows to three countries affected by the Asian crisis. However, before turning our attention to the data, we consider an illustrative example of the model.

4. Illustrative Example

To illustrate the model we consider a simple example in which the (risk-tolerance-weighted) average precision of foreign investors, $s_F$, is less than that of the average investor. Define $F$ as the set of foreign investors, and define the aggregate share-equivalent holdings of foreign investors, $\tilde{d}_t^F$, by $\tilde{d}_t^F \equiv \int_{t \in F} d_t^F dt$. Then, using Eq. (3) and noting that $\int_{t \in F} \tilde{d}_t = \tilde{u}$ a.s., it follows that the aggregate share-equivalent holdings of foreign investors may be written as:
Investor performance is evaluated based on the number of bonds they hold, which is a function of the foreign index. The figure shows the foreign index's performance, where the dotted line represents the number of shares held by a foreign investor.

Figure 1. Dotted line shows the number of shares held by a foreign investor.

To find the number of shares, we use the equation:

\[ d_D = \left( \frac{\text{foreign index}}{100} \right) \]

To be:

In our numerical example, we take the share-equivalent demand of foreign investors again as the foreign index holding and information dissemination. For the foreign index holding, the coefficient of \( d_D \) depends on how the foreign index is scaled. Similarly, the coefficient of \( d_D \) depends on how the foreign index is scaled. The first term in expression (16) is given by the product of the foreign index holding risk tolerance, \( T^f \), and the foreign index. The coefficient in the foreign index risk tolerance function is the foreign index, which is assumed to be a constant value, \( F \), divided by the foreign index. The foreign index holding risk tolerance function is the foreign index, which is assumed to be a constant value, \( F \), divided by the foreign index. The foreign index holding risk tolerance function is the foreign index, which is assumed to be a constant value, \( F \), divided by the foreign index.

\[ \frac{d_D}{s} \left( 1 - \frac{d_D}{s} \right) - \frac{d_D}{s} = \frac{d_D}{s} \]
Figure 1. The figures show the number of shares held by a hypothetical foreign investor as a function of the domestic market index. Also shown are the holdings of one and five year bonds that have the same risk as the given stock position. The face value of the bonds is 200 and they are collateralized by twice the level of the index. The standard deviation of the market return is 30 per year and the interest rate is assumed to be zero.

of maturity instead of stock. The risk-equivalent number of bonds is a convex increasing function of the level of the market index. When the market index is 100 so that both bonds have an asset coverage ratio of one, the desired bondholding for either maturity is 200 units; when the market index is 50 percent higher at 150, so that the coverage ratio is 1.5, the desired bondholding is 548.2 bonds for five-year maturity and 2615.6 bonds for the one-year maturity. Conversely, if the market index drops from 150 to 100, under these assumptions foreign bondholders will liquidate 93 percent of their one-year bondholding, but only 64 percent of their five-year bondholding, and 20 percent of their stockholdings. Even if the market drops only by 10 percent from 150, the stockholding drops by 6.0 percent, the five-year bondholding by 28.9 percent, and the one-year bondholding by 85.1 percent.

This example illustrates in a dramatic fashion that foreign debt holdings of risk averse expected utility maximising investors are likely to be much more volatile than foreign equity holdings, and that the most volatile holdings are likely to be represented by short-term debt contracts. Foreign investors will
The capital flows into Indonesia, Thailand, and Korea were strongly affected by the Asian financial crisis. Capital flows into these countries were associated with the domestic shock. In the next section, we shall see the evidence of capital controls, which was held in short-term positions with high uncertainty. The foreign money identified as the domestic shock. The portfolio model uses the foreign currency holdings as the default risk. In this model, the risk of the foreign currency positions is held and foreign currency is held very large quantities of these contracts when the risk of default is low, but will scale back their holdings as default risks rise. In this section, we shall see the evidence of capital controls, which was held in short-term positions with high uncertainty. The foreign money identified as the domestic shock.
Figure 2. Cumulative Capital Flows and the Level of the Stock Market
The figures show the cumulative flows in USD million from 1995.1 of debt and equity securities and bank loans into Korea, Indonesia and Thailand, taken from International Financial Statistics. The dotted line represents the rescaled level of the domestic market index in USD calculated by compounding the returns from the International Finance Corporation (IFC) total dollar return series.
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would be positively and correlated to the current flows would be positively related to past as well as

The current return will be positively and correlated to the current flows would be positively related to past as well as

a lagged relation. While some authors have been concerned to describe this

the contemporaneous relation between flows and returns, we find evidence of

is for equity flows. While the simple theory we have developed emphasizes

and the relation is at least as strong or even stronger for debt flows than it

are strongly influenced by current and lagged domestic market returns

Overall, the results are consistent with the model we have developed. Capital

Domestic market returns for Thailand

there appears to be no significant relation between foreign equity and

they explained 25 percent and 30 percent of the variance respectively. However

the equity flow regressions are highly significant for Indonesia and Korea where

restrictions on foreign purchases of Korean bonds until December 1997. Finally,

for Indonesia, but not significant for Korea. This may be because Korea maintained

for Thailand, where it explains 62 percent of the variance; it is also significant

at a higher than the one percent level in every case and the regression explains

the combined market return regressions, the bank loan regressions is significant

market return over the currency and pass through. We note first that for each

the sole exception of equity flows to Thailand, the coefficients on the market

we also report the regression with a single independent variable, the compounded

we also reported the regression with a single independent variable, the compounded

market return; since this reduces the already small number of degrees of freedom,

were reported including both the currency and lagged value of the domestic

information in reality, it may take some time for foreign investors to react

Our theoretical model assumes that all gains and losses immediately to new

loans and debt flows than it is for equity flows.

In Indonesia, the estimated sensitivity to market returns is much greater for bank

is significant at the five percent level for equity, debt, and bank loan flows

and, despite the small sample size, the simple regression relation

exception of equity flows to Thailand, where the correlation is negatice, but

domestic market returns is positive for all three countries (with the single

residents, the correlation between each component of the capital and

researchers are less well informed about the domestic market than are domestic

Table 3 reports the results of regression on the three components of quarterly

448 Michael J. Brennan & Carmen A陓ande
simply as "trend following behavior", we note that this labelling of the phenomenon offers no explanation why it is foreigners rather than domestic agents who exhibit this behavior. We suggest that in equity markets it is due to foreigners being at an informational disadvantage and reacting slowly to new information about the country. The effects of information asymmetry on portfolio flows are compounded in the case of debt flows by the fact that, whereas a foreign investor will typically wish to reduce his exposure to a given country as its market falls, his exposure will actually increase if he holds an unchanged position in debt contracts.

6. Conclusion

In this paper we have shown that if foreigners are less well informed about the domestic market than domestic investors, and there are foreign investors who are constrained to invest in debt securities, then international flows of debt as well as equity capital will depend positively on the returns on the domestic market index, and the elasticity of debt flows with respect to the market index will exceed those of equity flows and will be highest for short term debt flows. Hence we have provided a model in which capital flows that are invested in short term debt securities are likely to constitute "hot money".

We have found that the predictions of the model are supported by the behavior of flows of equity, debt and bank loan capital to three countries affected by the Asian crisis. There is evidence that all three categories of flow are positively related to the domestic market return. We have also found evidence of a lagged relation of flows to returns; its magnitude seems to be too large to be explained by the current model. The challenge is to develop a model with asymmetric information and lagged decision making which will explain such a trend following behavior by foreign investors. Such work is currently in progress.

References


\(^{27}\) See Froot et al. (1998).

\(^{28}\) Slow reaction seems consistent with the notion of investors following a country asset allocation strategy, since the connotation of strategy is that it is changed infrequently or only after careful deliberation.