

Volatility and persistence of capital flows

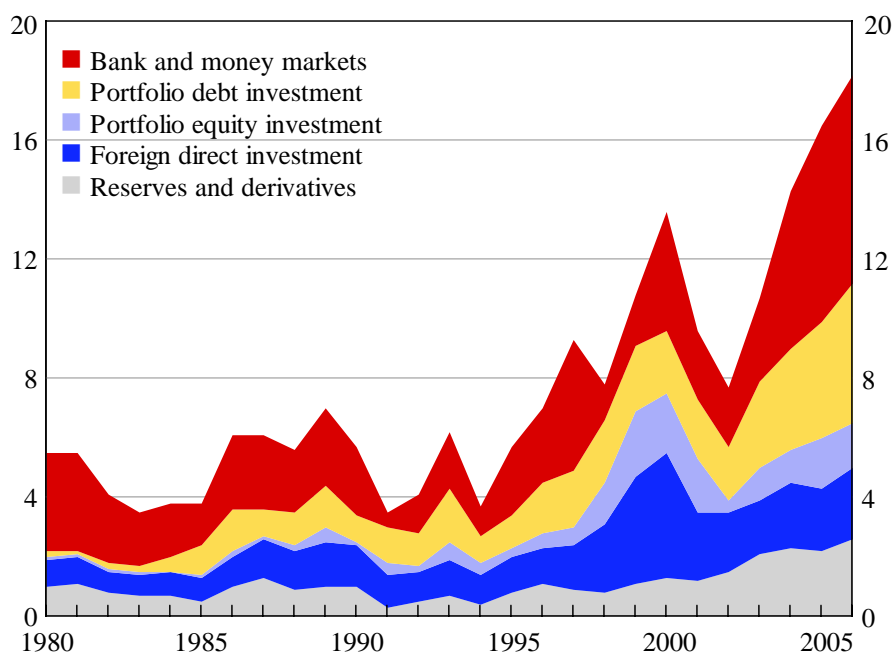
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Introduction

Over the past decade or so, financial globalisation has accelerated as domestic financial markets have grown rapidly and a greater proportion of financial capital has come to be traded across international borders. Following a period of relatively steady expansion in line with world output growth in the 1980s and early 1990s, gross international capital flows began to grow more rapidly in the mid-1990s (Graph 1). It is also evident that there have been major fluctuations around the uptrend in gross capital flows and occasions when the composition of capital flows changed noticeably, with shifts in the importance of various types of flows.²

Graph 1

Gross international capital flows¹



¹ Ratio to world GDP; in per cent.

Sources: IMF; RBA estimates.

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² For a more detailed exposition of these trends, refer to Battellino (2006).

While these trends have generally been viewed as a sign of economic development, the merits of financial globalisation and integration have attracted an increasing amount of critical scrutiny. The proliferation of financial crises in the 1990s has given rise to a body of literature that calls into question the unqualified benefits of international integration (Krugman (2000), Calvo and Reinhart (2000), Kose et al (2006)). In particular, the literature has focused on the possible disadvantages faced by emerging economies that open up to global capital markets prematurely. Key characteristics identified in the literature as determinants of successful financial integration include macroeconomic policies, development of domestic financial markets, quality of domestic institutions and corporate governance.³

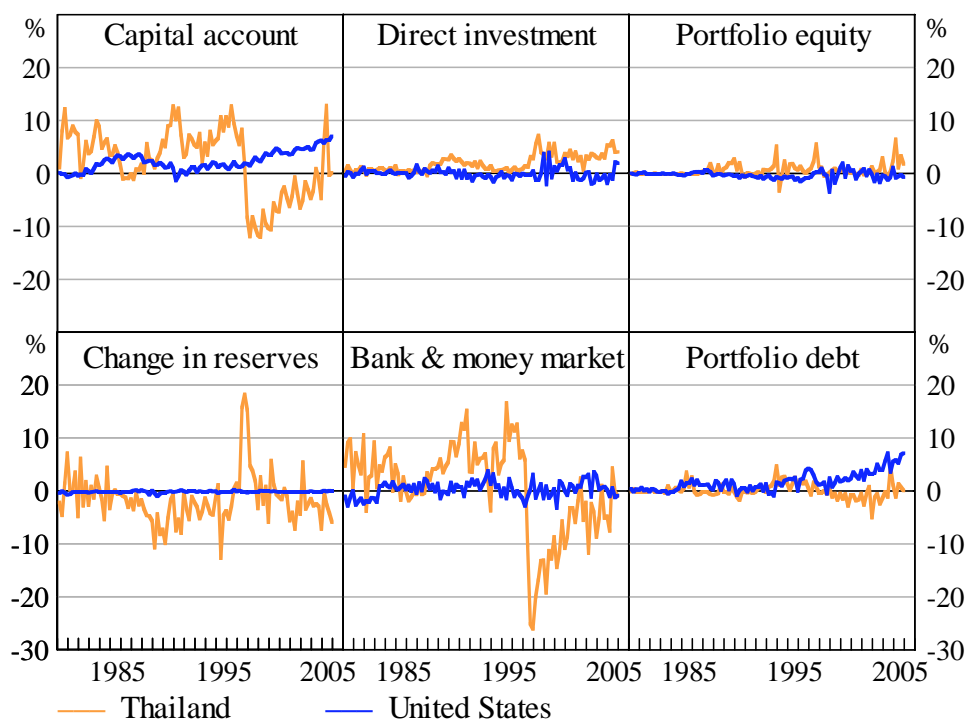
In emerging economies, crises have focused attention on the potentially destabilising aspects of capital flows over which the domestic authorities have little or no influence.⁴ With some types of flows typically seen to be inherently more susceptible to sudden reversals, one dimension of financial integration that has attracted interest is the composition of the overall capital account. The conventional wisdom is that certain types of capital flows are more volatile and destabilising than others (Claessens et al (1995)). As a result, flows such as foreign direct investment, which are seen to engender a longer-term commitment determined by a country's fundamentals, have come to be viewed as being relatively stable and unlikely to reverse without good reason. Because of this perceived lack of skittishness, such flows are said to be "cold". In contrast, flows such as portfolio or bank and money market flows are often seen as a form of speculation by investors seeking short-term gains and therefore volatile and subject to sharp reversals, exposing recipient countries to the whims of international financiers. These flows are correspondingly often described as "hot".

This view appeared to be reinforced by the Asian financial crisis, which first erupted in Thailand. The characteristics of the capital flows involved in the crisis in Thailand are compared in Graph 2 with the types of capital flows received by the United States. The United States provides a useful benchmark when considering the scale of the flows involved. Thailand and other East Asian economies had current account deficits, as might be expected for emerging economies (Lipsey (1999)). Capital was imported through a number of channels, with bank lending the predominant source of inflows prior to the crisis. During the crisis, it was this short-term foreign currency denominated borrowing that suddenly reversed, putting downward pressure on the exchange rate and prompting large-scale foreign exchange intervention; it eventually came to be seen as the cause of the deep recession that followed (see also Grenville (1998) and Radelet and Sachs (2000)). Direct investment flows remained stable during this time, and private sector portfolio flows also showed relatively few signs of volatility. This seemed to support the view that bank and money market flows are inherently speculative and destabilising, and that they should be discouraged in favour of sources of finance, such as direct investment, driven by fundamentals.

³ For a literature survey, see Obstfeld and Taylor (2002). For related discussions on the disadvantages faced by emerging economies, possible transitional arrangements and conditions that must exist for countries to gain from trade in capital, see Nakagawa and Psalida (2007) and Kose et al (2006).

⁴ If capital flows were completely determined by domestic variables such as economic growth and expected returns on assets, they would be of little direct policy interest. Instead, the underlying reasons for variations in flows would attract the attention of policymakers. On the other hand, if capital flows are not uniquely determined (that is, subject to crises of confidence) and are influenced by variables in international capital markets that lie beyond the control of domestic policymakers, they may warrant more direct scrutiny (see also Krugman (2000), and Radelet and Sachs (2000)).

Graph 2

Net international capital flows¹

¹ Ratio to national GDP; in per cent.

Sources: IMF; Thomson Financial.

In this paper, we investigate whether different types of capital flows have inherent attributes that make them more likely to be associated with variability in the overall capital account. We undertake this investigation as it is not immediately obvious why this would be the case over time for a diverse group of countries. For example, debt instruments can be structured to take on the characteristics of an equity investment, while beyond a certain threshold portfolio equity is reclassified as direct investment. Short-term loans that are continually rolled over may have characteristics similar to those of longer-term investments, while lumpy cross-border mergers and acquisitions can cause considerable fluctuations in foreign direct investment. Additionally, when domestic markets are deep, liquid and well developed, there is no a priori reason to expect that capital entering the host country will necessarily leave it in the same form. With financial innovation and a greater degree of financial integration, the original source of capital is becoming increasingly remote from the capital's ultimate destination – for example, the financing of an investment project.

We investigate the statistical properties of the flows to judge whether they are regularly “hot” or “cold”. For the purpose of this paper, we put aside the question of whether different forms of capital confer desirable economic benefits on the recipient country, such as the transfer of technological and managerial know-how often associated with direct investment. Since we are interested in assessing the overall volatility of the capital account, we focus largely on net flows while acknowledging that gross flows play a crucial role in understanding the

underlying sources of variability.⁵ Throughout we compare the experiences of six advanced industrial economies with those of six emerging market economies.

The remainder of the paper is structured as follows. In the next section, we define our concept of variability and apply a number of measures to test the validity of commonly held priors. In the third section, we provide several insights into how capital flows interact within a country's capital account and how they interact with the flows of other countries. The fourth section provides empirical estimates of possible explanations for capital account volatility that may be the subject of future research. The final section provides some concluding remarks, while the appendix applies a series of simple econometric techniques to the question at hand.

Variability of the capital account

There are several methods for measuring the variability of the capital account and its components. We take our lead from Claessens et al (1995), but our approach differs from theirs in a number of ways.

Throughout the paper we use standard balance of payments data sourced from the International Monetary Fund's International Financial Statistics, on a quarterly basis, with the US dollar serving as the numeraire. The balance of payments identity imposes the constraint that the current account balance (*CAB*) is equal to the capital account balance (*KAB*), and the two concepts can be used more or less interchangeably. The capital account refers to what has become more conventionally termed the financial account and consists of foreign direct investment (*FDI*), portfolio equity (*PFE*), portfolio debt (*PFD*), bank and money market flows (*BMM*)⁶ and official reserves (*RES*). We use this disaggregation of the data for the remainder of the paper, and while the error term is at times large, we ignore the implications of this. Our sample of six advanced industrial economies comprises Australia, Germany, Japan, Sweden, the United Kingdom and the United States. The six emerging market economies are chosen based largely on data availability. The three East Asian economies are Korea, the Philippines and Thailand. The three Latin American countries are Argentina, Brazil and Mexico. In the interest of brevity we present most results in terms of the simple unweighted average for industrial and emerging economies. Interesting results apparent on a country-by-country basis are discussed in their own right. The sample period runs from the first quarter of 1980 through the fourth quarter of 2005.

Composition of cross-border finance

If a particular type of capital flow reliably exhibits certain characteristics, one could expect to find these reflected in the overall capital account. More specifically, as a flow assumes a more prominent position in the overall capital account, it may be possible to discern a systematic relationship between its volatility and that of the total capital account. This would

⁵ Debelle and Galati (2005) point out that it is useful to know whether foreigners or domestic residents are driving the flows. In preliminary work on gross flows (not shown), we found that net capital flows in emerging economies, unlike those in industrial economies, are usually driven entirely by non-residents. This may expose emerging economies to sudden changes in the sentiment of foreign investors (see also Calvo (2000)).

⁶ In the balance of payments, these flows fall in the category of "other". As bank loans and money market transactions are the main components of this category, we use the more meaningful label "bank and money market flows" in referring to them.

be self-evident in the extreme case where the capital account is restricted to just one type of flow.

To test whether such statistical regularities are observable, we disaggregate quarterly country data by type of flow, as defined above. We then calculate the average importance of each type of capital flow in the overall capital account of every country.⁷ This is done over five-year blocks in our 25-year sample period. The changing importance of each flow for every country is measured as the difference in the flow's share of total flows from one five-year block to the next. A positive number indicates that a flow has become more important in the overall capital account of the country in question.

To measure the variability of total net capital flows, we first scale the quarterly capital account balance for each country by GDP and then calculate the standard deviation of the data over the same five-year blocks. Our gauge of how the variability of the capital account has changed is then given by the difference in the standard deviations from one five-year block to the next. A positive number indicates that the standard deviation has risen and that the capital account of the country in question has become more volatile.

Graph 3 plots the relationship between the importance of different flows and capital account volatility for industrial and emerging economies. The changing importance of the flows is plotted on the vertical axis, the changing volatility in the capital account on the horizontal axis. Given that we have 12 countries, five types of capital flows and the change over five subsamples, the figure plots 240 observations.

A positive relationship in the scatter plots could signify a systematic relationship between more volatile flows becoming more important, thereby raising the average volatility of the capital account. Conversely, a negative relationship could be expected if less volatile flows were to become more important and capital account volatility could be expected to decline eventually. When we fitted regression lines through the data (not shown), no statistically significant evidence was found of such relationships.

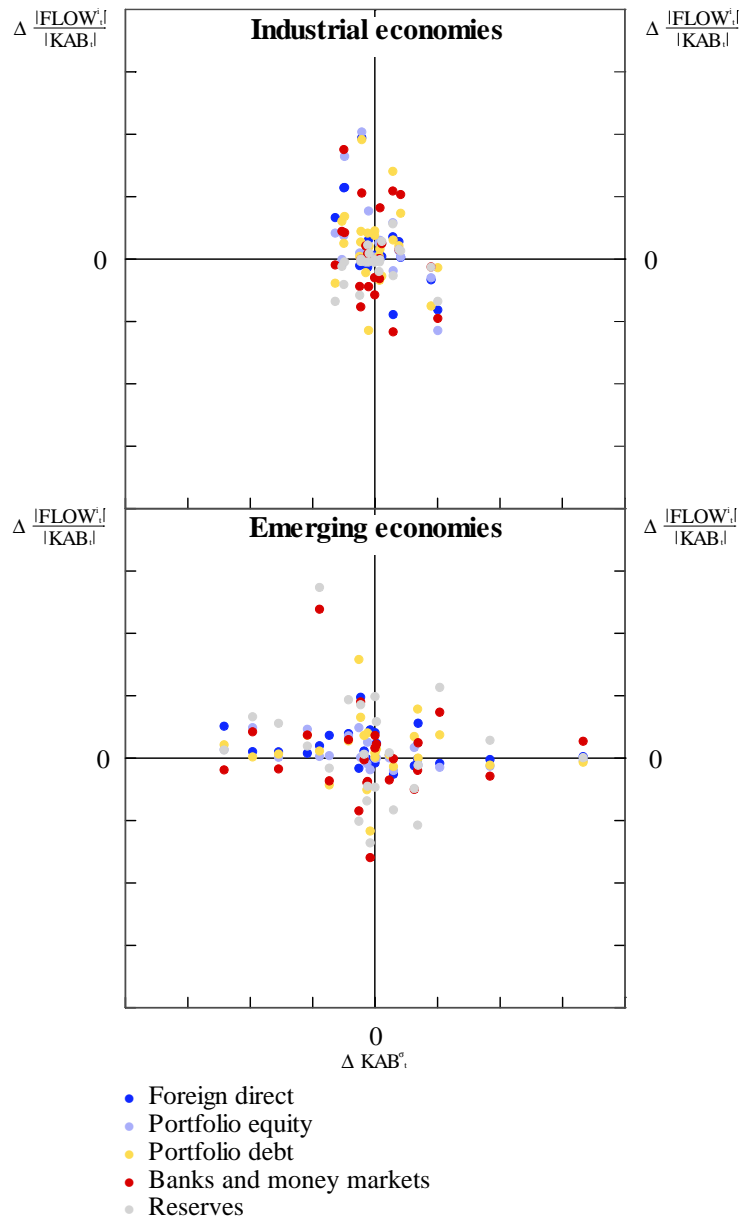
For example, Australia saw a rise in the importance of direct investment and a decline in the importance of bank and money market flows in the 1990s, relative to the 1980s. While preconceived ideas about the rising importance of cold flows and the decline in hot flows could lead us to expect lower variability in overall capital inflows, at the margin the opposite occurred. Similarly, during the same time the United States experienced a decline in direct investment relative to bank and money market flows, but the volatility of overall flows declined.

What is evident, however, is that for industrial economies the observations lie clustered in an ellipse around the vertical axis. This means that the composition of finance changes noticeably over time between the flows but that this has little consequence for the evolving variability in the capital account, which remains relatively stable. The observations for emerging economies are more randomly dispersed but show some tendency to lie around the horizontal axis. We interpret this as showing that while changes in the composition of capital flows are less significant, overall capital account volatility changes noticeably over time. These results suggest that evolution in the volatility of the capital account may not be systematically related to the capital account's composition.

⁷ We take the absolute value of the quarterly flows and the capital account to avoid the problems of interpretation associated with a change in sign for either the numerator or the denominator.

Graph 3

Composition of finance and volatility¹



¹ Standard deviation of capital account as ratio to GDP.

Source: RBA estimates.

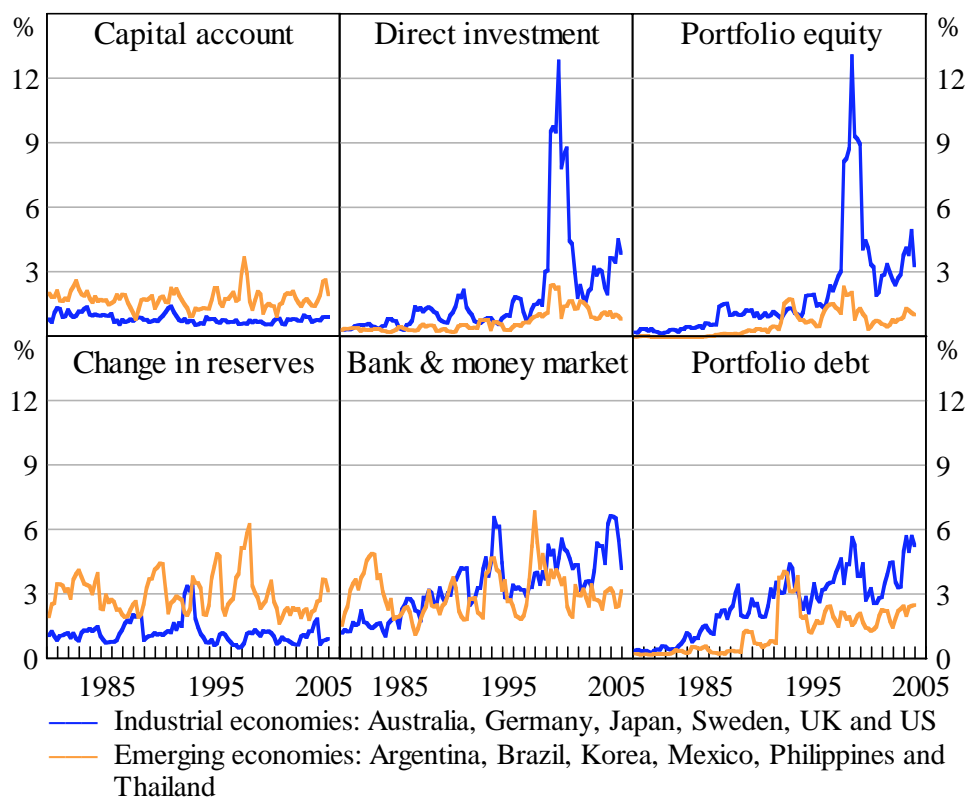
Volatility of capital flows

A more direct measure of flow variability is the standard deviation in the ratio of the flows to GDP. Scaling by GDP is important because we are most interested in large swings in total flows from each country's perspective and their possible implications for variables such as the exchange rate.⁸ To capture how flow volatility has evolved over time we calculate the

⁸ As all flows are expressed in US dollars. GDP is also in nominal US dollars, at current exchange rates. However, this measure of output is subject to three different sources of potential variability – prices, real

standard deviations in the quarterly data over a one-year rolling window for each country. For expositional reasons, we average the results for industrial economies and emerging economies as depicted in Graph 4.

Graph 4
Volatility of capital flows¹



¹ Simple average of standard deviation in the ratio of capital flows to GDP. Quarterly one-year rolling window.

Source: RBA estimates.

Emerging economies have always experienced around twice as much overall volatility in their capital accounts as industrial economies. Furthermore, emerging economies have more discrete episodes when volatility rises markedly, indicating that they have more frequent crises. These outcomes are in line with what we know about emerging economies. Developments in the volatility of different flows, comparison with the overall capital account and the contrast between the experiences of emerging market and industrial economies yield additional insights.

One of the most noteworthy findings is that while there has been little change in the average volatility of total flows, the pattern of volatility has evolved very differently for the various flows that make up the capital account. In industrial economies, individual flows are always

output and the exchange rate. Since we wish to avoid attributing the volatility inherent in these variables to our measure of capital flow variability, we use the trend of nominal US dollar GDP in the denominator. This normally makes very little difference to the measurement of volatility, except in periods when financial crises lead to a subsequent collapse in output, which would unnecessarily inflate the measure of capital flow volatility for the purpose at hand.

more volatile than total flows, and all flows except for reserves have exhibited a trend rise. Given that there is no such time trend in the evolution of the capital account's volatility, it implies a degree of negative correlation between flows, which ensures that aggregate net flows are less volatile than their parts. This is an important attribute in that it suggests a degree of substitutability between different forms of capital, which allows industrial economies to accommodate variability without significant adverse consequences, such as frequent crises.⁹

For example, the trend increase in the standard deviation of portfolio debt flows for industrial economies is closely aligned with that observed for bank and money market flows. This raises the question of whether these flows are complements or substitutes. We found a strong negative correlation over time between portfolio debt and bank and money market flows, suggesting that the industrial economies are able to substitute different forms of debt finance for each other. As a result, the rise in volatility of both types of flows has few implications for the overall capital account's variability.

Among emerging economies there is no similar generalised trend rise in the standard deviation of the flows, and the constituent flows of the capital account are typically less volatile than the total. The volatility of bank and money market flows is high but bears little resemblance to that of portfolio debt over time. The reliance of some emerging economies on bank-intermediated finance while local currency debt markets remain relatively underdeveloped may provide a partial explanation for this finding.

Another interesting feature of the data for industrial economies is the sharp movement in foreign direct investment and portfolio equity investment earlier this decade. This was due primarily to the increase in mergers and acquisitions in European countries, which was financed through stock swaps. In these kinds of deals, direct investment is financed by an exchange of stock between companies, resulting in a portfolio equity flow that is opposite to, and that often fully offsets, the foreign direct investment flow.¹⁰ Once again, because the flows move in opposite directions, the effect of rising volatility on the overall capital account is fully offset.

The behaviour of reserve flows is also quite different for the two groups of countries. Not surprisingly, reserves are considerably more volatile in emerging economies, where monetary authorities are typically more active in foreign exchange markets. It would appear that attempts to offset the effects of private flows have been mostly unsuccessful in emerging economies, given that the overall capital account remains highly variable at all times.¹¹ With the exceptions of the Plaza Accord in 1985 and the European Exchange Rate Mechanism crisis of 1992–93, central banks in the advanced industrial economies, which typically have floating exchange rates, play a less activist role in foreign exchange markets; their reserves

⁹ Levchenko and Mauro (2007) also find that while the overall capital account of emerging economies is more volatile than that of industrial economies, portfolio flows in industrial economies are two to five times more volatile than those in emerging economies.

¹⁰ The merger of Vodafone Plc in the United Kingdom with Mannesmann AG in Germany is one of the most prominent examples of this phenomenon. For more details, see Becker (2003).

¹¹ The results could be criticised as unfair to emerging economies because the latter experienced a higher incidence of crises during the sample period. We argue that the reason we are interested in this topic in the first place is because of these crises and that they should be included. However, we recalibrate our results for the post-crisis sample period 2000–05. While the smaller sample results are less robust, they lead to the same conclusions we present in the main part of the paper. So even under relatively favourable macroeconomic conditions without major shocks, emerging economies experience a relatively variable capital account with individual flows that are less volatile than the total. Broner and Rigobon (2006) also find that removing outliers (ie crises) does not account for the higher volatility of capital flows to emerging economies.

are therefore only around half as volatile as reserves in emerging market economies. Japan is an obvious exception and is responsible for the blip in volatility in 2003–04.

Persistence of capital flows

A complementary measure of variability is the degree to which capital flows persist over time. Capital flows that are perceived to be relatively stable should also display evidence of a strong positive correlation with their own past values. The absence of such a correlation would suggest that a flow switches sign and is relatively unpredictable. To assess persistence we calculate autocorrelation coefficients for each flow in each country over the sample period. The data are quarterly ratios of capital flows to GDP, and the correlations are calculated for 16 lags (Graphs 5 and 6).

Consistent with the volatility results discussed earlier, total capital flows are found to exhibit a high degree of persistence in industrial economies. The autocorrelation coefficients are typically large and positive, and they gradually decay as the lags increase. This suggests that there is a high degree of persistence in the overall balance of payments for at least one to two years. Again we attribute this lack of deviation from a slow-moving trend to the smaller number of shocks that affect the current and capital accounts of industrial economies.¹² In contrast, there is typically less autocorrelation in the capital accounts of emerging economies. Most striking is the result for the Philippines, where there is the least evidence of a systematic relationship between the capital account and its own lags.

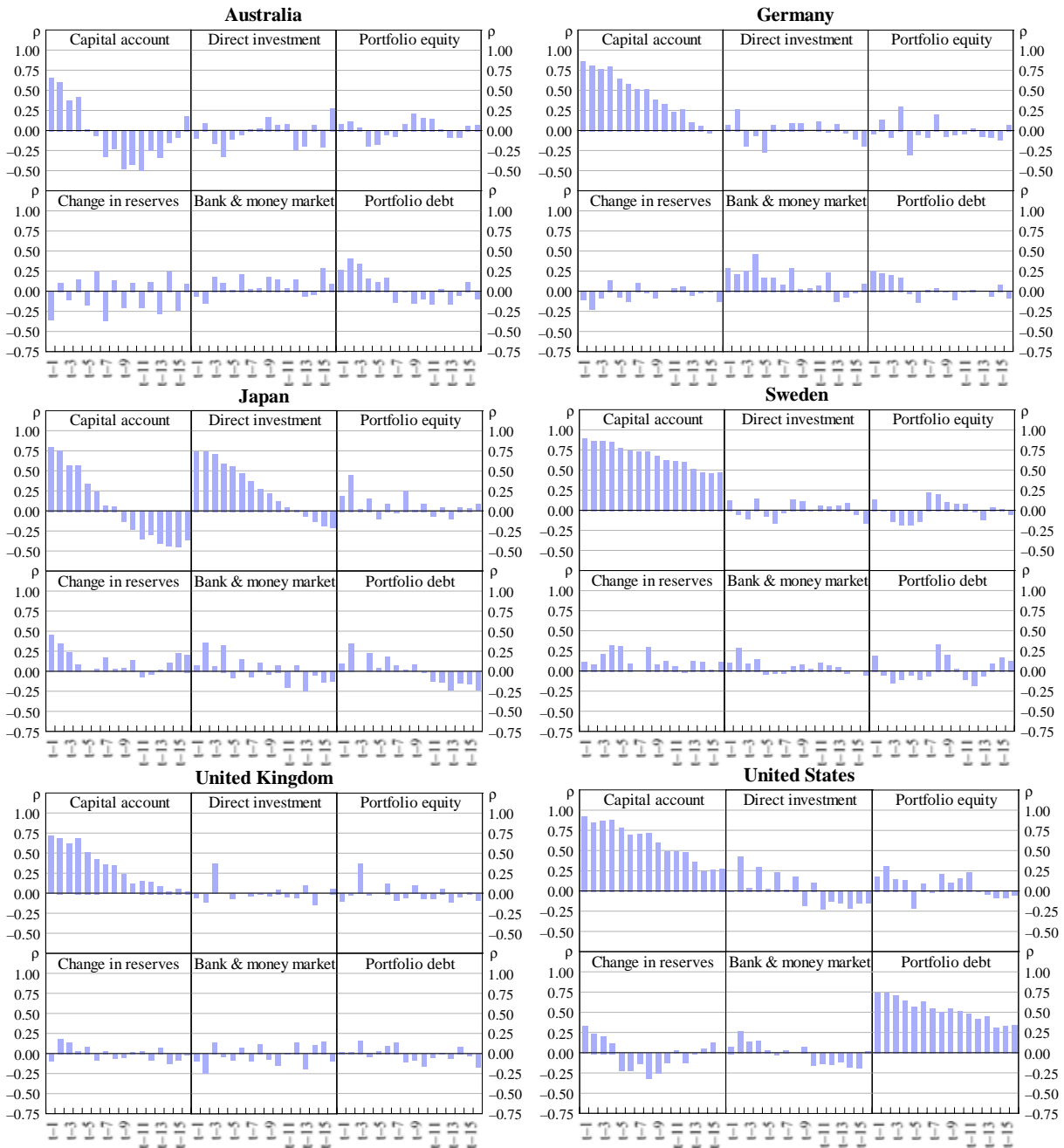
Looking at the individual components of the capital account, there is virtually no evidence in the autocorrelation coefficients to suggest that the flows systematically exhibit any signs of persistence for industrial economies. The coefficients are small and change sign frequently. There are, however, a number of notable exceptions. We find that in the United States portfolio debt flows are highly persistent. Given that the United States is home to the largest debt markets and the US dollar is the world's reserve currency, this should not come as too much of a surprise. Japanese foreign direct investment is also shown to be highly persistent. This may reflect the structural "hollowing out" of Japanese manufacturing, as companies set up plants in other Asian countries where labour costs are more advantageous. There is also persistence in the reserves component of the Japanese capital account, which is probably related to the monetary authorities' presence in the foreign exchange market.

¹² We find further evidence of this persistence when we investigate the forecastability of the flows, as shown in the appendix. There is some evidence to suggest that the current account of industrial countries is endogenous to domestic economic fundamentals such as growth, saving and investment and does not in itself precipitate sudden stops that cause adjustment in other variables (DeBelle and Galati (2005)).

Graph 5

Industrial economies' autocorrelation coefficients

Sample, 1980–2005

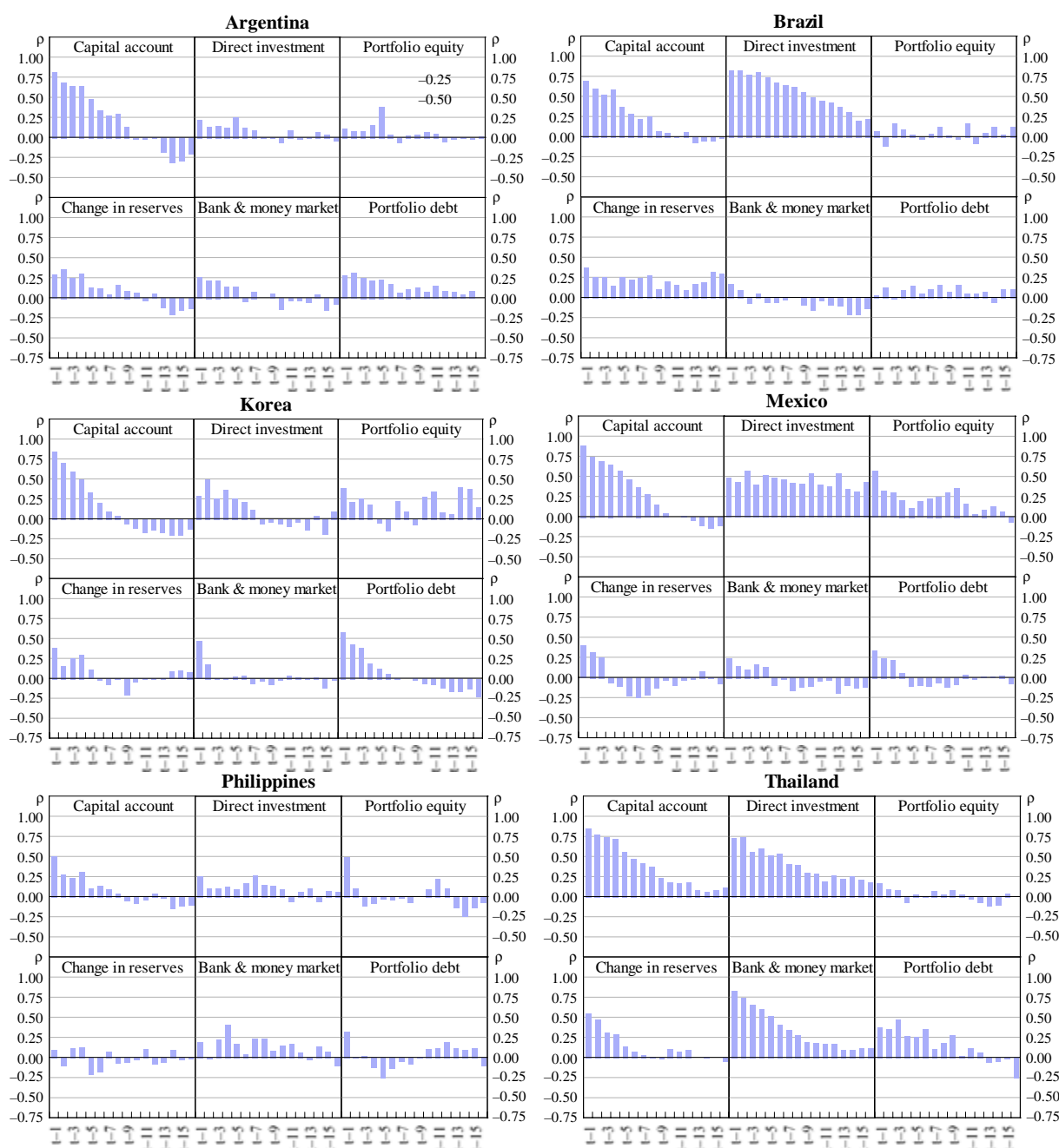


Source: RBA calculations.

Graph 6

Emerging economies' autocorrelation coefficients

Sample, 1980–2005



Source: RBA calculations.

There is little evidence from the advanced industrial economies to support the claim that some types of capital flows are inherently more stable than others. Foreign direct investment is typically not as stable as what some priors may suggest and can hardly be distinguished from the bank and money market and portfolio flows that are often blamed for causing instability.

In emerging economies the evidence is somewhat different. Foreign direct investment is often persistent. This can probably be attributed to the fact that these countries are natural destinations for foreign direct investment, with inflows typically exceeding outflows. In

contrast, for industrial economies gross direct investment typically flows in both directions as companies merge and are taken over. There are also several other examples of persistence in emerging economies, but we suggest that this is unlikely to be an inherent property of the flows themselves.

Interactions between flows

The results in the preceding sections demonstrate the importance of studying the interactions between capital flows, as the co-movement of the flows seems to be central to understanding the overall variability of the capital account. What this section further highlights is that the analysis of a given type of capital flow in isolation could yield misleading results. Instead, the whole of the capital account should be drawn into the analysis, even when we are investigating the behaviour of individual components.

To provide a comprehensive view of the data and how the flows interact, we estimate correlation coefficients for each of the flows over the entire period of the sample. The quarterly data are summed to annual totals for this purpose. The correlations are estimated for each individual flow with every other type of flow within a country's capital account, as well as with each type of flow for all other countries. We are thus able to assess the degree of correlation within the capital account as well as across countries. Since we are now comparing the flows of capital between countries, we use US dollar amounts and no longer scale the flows by the source country's size. The results refer to the average degree of correlation over the sample period, and we acknowledge that there are subperiods within the sample period when the correlations rise and fall sharply, which is not fully reflected in this section.

Correlations within a capital account

We find that correlations between various types of flows within each country's capital account are mainly negative, providing further support for the argument that there may be a degree of substitutability between flows. We note that around 70% of industrial economies' flows are negatively correlated within the capital account but that the degree of negative correlation is smaller for emerging economies, at 60%. The implication would seem to be that emerging economies are less able to substitute between different types of international capital flows.

Table 1 summarises our general findings on correlation between flows within a given capital account. In the interest of brevity we show only the average correlation coefficients for industrial economies and emerging economies.

It is generally difficult to detect any regular correlation patterns for industrial economies. The negative correlation between foreign direct investment and portfolio equity flows for countries such as the United Kingdom, discussed earlier in this paper, are an exception. Bank and money market and portfolio debt flows among industrial economies are also negatively correlated. Overall, however, capital appears to come and go irregularly and in different forms with no strong link to a particular form of finance and without causing undue disturbances in the overall capital account of industrial economies.

An interesting finding is that the capital account and bank and money market flows are always positively correlated for emerging economies and, typically, significantly more so than for industrial economies. This strong link may indicate the greater dependence of emerging economies on banks, which may also explain why these economies are more vulnerable to sudden stops and reversals of flows and why such changes in flows can become full-blown crises (see also Calvo (2000) and Radelet and Sachs (2000)).

Table 1
Correlation within a capital account, by country
 Sample, 1980–2005

	Foreign direct investment	Portfolio equity investment	Portfolio debt investment	Bank and money market flows	Reserves	Capital account
Industrial economies						
Foreign direct investment	1.0					
Portfolio equity investment	-0.4	1.0				
Portfolio debt investment	0.1	-0.3	1.0			
Bank and money market flows	-0.2	-0.1	-0.3	1.0		
Reserves	0.1	-0.2	0.0	-0.2	1.0	
Capital account	0.2	-0.2	0.6	0.2	0.1	1.0
Emerging economies						
Foreign direct investment	1.0					
Portfolio equity investment	0.1	1.0				
Portfolio debt investment	0.0	0.4	1.0			
Bank and money market flows	-0.2	-0.1	0.0	1.0		
Reserves	-0.3	-0.3	-0.3	-0.3	1.0	
Capital account	0.1	0.0	0.5	0.5	0.1	1.0

Coefficients are calculated on annual values in US dollars and are the simple average of coefficients calculated for individual countries.

Source: RBA calculations.

For emerging economies, there also appears to be a pattern of negative correlation between reserves and private flows. In particular, bank and money market flows stand out in the country data as always being negatively correlated with official reserve flows. There are two possible explanations for this outcome. First, domestic monetary authorities may be aiming to offset the effects of bank and money market flows on the overall capital account and the ensuing consequences for the exchange rate. Indeed, intervention during the Asian financial crisis was squarely aimed at mitigating the sudden reversal of bank and money market flows. Nonetheless, it is also feasible that since the capital account must balance with the current account, actions to maintain a given exchange rate through variations in reserves will cause disturbances in the capital account and expectations, thereby inducing a change in private flows. Such disturbances may manifest themselves in such a way that it is typically the bank and money market component of the capital account that is most accommodating.¹³

¹³ See also further evidence of this in the appendix, where we investigate the marginal source of finance for the current account.

Cross-country correlations

The correlation in capital flows between countries may also be useful in understanding volatility. Identification of regular relationships may be informative as to why such correlation is observable and thus shed some light on the underlying sources of variability. Several interesting capital flow linkages across countries are evident and worth highlighting, but once again there is no overwhelmingly clear or regular pattern (results not shown).

While the capital account balance of the United States is significantly correlated with that of other industrial economies, there is less evidence of its correlation with the capital accounts of emerging economies. Also of note, Japan's net creditor status is borne out in the negative correlation between its total flows and those of other industrial economies that are net capital importers, such as the United States and Australia. We take these results to be indicative of a relatively high degree of financial integration among industrial economies, while emerging economies are less integrated into global financial markets. It is possible that the degree of financial market development and integration allows industrial economies to accommodate the volatility of individual flows by substituting different types of financing for each other, thereby leaving the overall capital account balance relatively stable.

The capital accounts of emerging markets tend to be positively correlated. Given that these balances are also relatively volatile, we suggest that this result may be interpreted as evidence that these countries are subject to similar balance of payments shocks – that is, they experience crises at the same time, which also reflects a degree of contagion (see also Broner and Rigobon (2006)).

Another interesting aspect of the flows is that they reflect correlations with foreign exchange interventions by economies with exchange rate regimes that, to varying degrees, attempt to limit currency variations. One would expect that the accumulation of reserves and their investment in fixed income assets in an attempt to stem the appreciation of the exchange rate (ie a capital outflow) would lead to a negative correlation between reserves in the intervening country and portfolio debt flows to the recipient country. We find evidence that the reserves of both Japan and Korea are significantly negatively correlated with portfolio debt flows to the United States, the United Kingdom and Australia. Most central banks hold reserves in US dollars and invest the proceeds in US Treasuries. The demand for holding reserve assets in pound sterling is probably somewhat smaller, but the correlations probably reflect that London is a major financial centre through which intervening countries churn their investments with an indeterminate eventual destination. The relationship with Australian debt may be due to the yield advantages and the liquidity of the Australian dollar, as well as a number of other benefits not directly relevant in the context of this paper. While we learn little that is new from these findings, we note that the emerging economies' actions on reserves have not subdued the relatively high volatility of their capital accounts.

Sources of capital account volatility

In this section we make a first pass at explaining the underlying sources of capital account variability. In our study, we discovered certain characteristics that we attempt to condense into explanatory variables. The panel data regression that we run is not meant to be an exhaustive attempt at modelling capital flows. Rather, it is aimed at testing whether some of our broad insights have explanatory power and should be the subject of further research. Central to our approach is the generalised finding that industrial economies appear to have a greater ability than emerging market economies to substitute different forms of capital for each other. As argued earlier, substitutability seems to allow the industrial economies to accommodate volatile flows in a manner that leaves the overall capital account relatively stable.

Selection of explanatory variables and the model

The first two variables we consider correspond to those calculated in the section on the composition of cross-border finance, above. They reflect the importance of foreign direct investment (*FDIshare*) and bank and money market flows (*BMMshare*) in the capital account. We measure the importance of a flow as the ratio of its absolute value to the sum of the absolute value of all flows. Given the work presented in earlier sections, we expect to confirm that these variables are not significant in explaining overall capital account variability.

Another factor potentially relevant to explaining the ability of a country's capital account to absorb the volatility of individual net capital flows appears to be the volume of gross flows. Gross capital movements probably reflect three important differences between industrial and emerging market economies. The first is that sizeable two-way flows signal not only that capital flows are diversified among different types of capital but also that investors are diversified and include both resident and foreign entities. Such diversification may limit volatility when foreigners sell off their investment because resident investors may fill the void. Emerging economies are somewhat dependent on bank financing, and foreign investors typically dominate gross flows to these economies. In contrast, industrial economies appear to be better placed to reap the benefits from universally large gross flows. Second, limited gross flows may reflect the degree of market development. For example, it would be unrealistic to expect portfolio debt flows to play a major part in smoothing capital flows in economies that do not have well-developed bond markets. Finally, the scope of gross capital flows reflects the degree of capital account openness. The less open the capital account, the less scope there is for volatility to be absorbed by offsetting flows.

To gauge the importance of these factors we construct a summary measure based on gross flows (*FlowOpenness*). We create an index that captures the relationship of the absolute value of the gross flows to the absolute value of the sum of gross and net flows (see equation (1)). When capital flows freely in both directions, we expect the sum of absolute gross flows to be large relative to net flows. When this is the case, the index tends towards 100. When capital flows are not large or are very one-sided, we expect gross flows to be small relative to net flows. The most extreme case would be where gross flows are the same size as net flows. This would occur if resident or non-resident flows were completely restricted. In this case, the index would register zero.¹⁴

$$FlowOpenness_{it} = \left[\frac{|resident\ flows_{it}| + |nonresident\ flows_{it}|}{|resident\ flows_{it}| + |nonresident\ flows_{it}| + |net\ flows_{it}|} - \frac{1}{2} \right] \cdot 200 \quad (1)$$

A further difference between advanced industrial and emerging market economies is the degree of development of their domestic financial markets. We suggest that highly developed financial markets are probably an important prerequisite for the substitutability of different forms of finance. We therefore test whether market development can be linked to capital account volatility using the ratio of equity market turnover to market capitalisation as a proxy for financial market development (*MarketDevelopment*).

We also control for the exchange rate regime under the presumption that if the exchange rate is fixed or pegged, more of the burden of external adjustment is borne by quantities than

¹⁴ The United Kingdom provides a useful illustration of the index. Despite having an average annual capital account surplus of just 2% of GDP over 2000 to 2005, the United Kingdom records an average openness index of 96, the highest for any economy in our sample. The high score reflects London's role as a global financial centre.

by prices.¹⁵ Limiting the nominal variability of the exchange rate may result in more adjustment taking place in capital flows, which introduces greater volatility into the capital account. To test for the significance of the exchange rate regime we include a dummy variable that is zero when the exchange rate regime is a free or managed float, and one if the exchange rate regime is less flexible (*FXregime*). The classification of each country's exchange rate is taken from the International Monetary Fund's *Annual Report on Exchange Arrangements and Exchange Rate Restrictions*.

In addition to these explicit variables, by using a fixed-effects estimator we allow for unobserved time-invariant factors to influence the volatility of each economy's capital account.

In summary, the regressions we estimate are of the form:

$$\left(\frac{KAB_{it}}{GDP_{it}}\right)^{\sigma} = \eta_i + \beta_1 FDIshare_{it} + \beta_2 BMMshare_{it} + \beta_3 FlowOpenness_{it} + \beta_4 MarketDevelopment_{it} + \beta_5 FXregime_{it} + \varepsilon_{it}$$

where $\left(\frac{KAB_{it}}{GDP_{it}}\right)^{\sigma}$ represents the volatility of the capital account as a ratio to GDP for country i , η_i is the fixed effect for country i , ε_{it} is the error term and β_j denotes the parameters.¹⁶

We use a balanced panel of annual data over 1991–2005 for the 12 countries examined in this paper.

Regression results

The preliminary results shown in Table 2 broadly support the view that while the composition of the capital account is not a significant determinant of its volatility, market development and a general openness to capital foster substitutability between different forms of capital, which helps smooth total capital movements. We also find a statistically significant relationship between the exchange rate regime and capital account variability.

As suggested in previous sections, we find no statistically significant relationship between the importance of foreign direct investment or bank and money market flows and the volatility of the total capital account. Both variables have p values beyond any reasonable threshold for significance.

The two factors we put forward as potential drivers of substitutability – the development of domestic financial markets and the freedom of capital flows – do have a statistically significant relationship with the volatility of the capital account. Moreover, the signs of their coefficients are consistent with our priors. We find that as the ratio of equity market turnover to market capitalisation increases, the volatility of the capital account decreases. Economies that experience large two-way gross capital flows also tend to have less volatile capital accounts.

¹⁵ When the price of one currency vis-a-vis another changes, it imparts valuation changes on the existing stock of foreign currency denominated assets and liabilities. These international wealth transfers can be an important adjustment mechanism but do not involve the transaction in any quantity of financial assets.

¹⁶ In this model, the assumption that the slope parameters are the same across all countries is implicit.

Table 2
Panel data estimation results

	Coefficient value	<i>p</i> value
<i>Constant</i>	2.0403	0.0000
<i>FDIshare</i>	−0.2267	0.8139
<i>BMMshare</i>	−0.7936	0.1934
<i>FlowOpenness</i>	−0.0070	0.0834
<i>MarketDevelopment</i>	−0.4223	0.0335
<i>FXregime</i>	0.3530	0.0496
R ²	0.6452	
Number of observations	180	

Wooldridge test for autocorrelation: 0.0000. Dependent variable is the volatility of the capital account.

Source: RBA calculations.

The exchange rate regime dummy was also found to be significant. When a country maintains a fixed rate or a crawling peg, its capital account typically also exhibits higher volatility than the capital accounts of countries that allow more flexibility. We caution against interpreting this as evidence that fixing the exchange rate causes capital account volatility. Rather, the results indicate that the two appear to be related, but further work is necessary to address whether they reflect common factors not explicitly considered here or whether the relationship is indeed causal.

Conclusion

Capital has become increasingly mobile as global financial integration has accelerated. Interestingly, while industrial economies have experienced more volatility in individual capital flows as financial globalisation has progressed, there is no evidence to suggest that the overall capital account has exhibited a trend rise in variability. Indeed, greater financial integration may have fostered the substitutability between different forms of international finance that helps economies cope with variability. A direct link between financial integration and the increased incidence of financial crises in the 1990s appears tenuous.

We suggest that there are few regular and systematic relationships to be found in the statistical properties of capital flows and reject the view that some flows are inherently more conducive to stability than others. We also reject the view that the combination of different types of capital flows is relevant to the overall stability of the external accounts.

Given that the substitutability between different forms of capital is stronger for industrial economies than for emerging market economies, we suggest that openness to capital flows and financial market development may be positively related to overall stability in the capital and current accounts. However, we think it unlikely that the stability of the overall capital account in advanced industrial economies is attributable to inherent properties of the capital flows. Rather, these countries probably meet certain preconditions that allow them to integrate into global markets more smoothly, which in turn is reflected in their external accounts.¹⁷

¹⁷ See Broner and Rigobon (2006), Daude and Fratzscher (2008), Grenville (1998) and Nakagawa and Psalida (2007).

Appendix: predictability of capital flows

In this appendix we maintain as simple and transparent an approach as feasible but employ basic econometric techniques to investigate whether the findings discussed in the main part of the paper are consistent with results obtained under more intense statistical scrutiny.

Forecasting ability

One way of ascertaining whether knowledge of a particular flow conveys information useful in making inferences about the total capital account is to test how well it can explain contemporaneous capital account developments. In other words, we ask if knowledge of the composition of the capital account conveys useful information about the total. For this purpose we conduct a simple modelling exercise.

A naïve model is set up where the capital account (KAB) is modelled by its own first lag and a constant. That is, the first two terms on the right-hand side of equation (A1) below. Given the degree of autocorrelation discussed earlier, we expect to find that the coefficients are highly significant. Next we add the contemporaneous value of the i th capital flow ($Flow$) to the equation to test whether the fit of the model increases with its inclusion. One would expect that if this additional variable were an important determinant of the total its inclusion would significantly improve the predictive ability over and above the naïve model.

$$KAB_t = \alpha_0 + \alpha_1 KAB_{t-1} + \alpha_2 Flow_t^i \quad (A1)$$

Table A1 reports the main results of these regressions for industrial and emerging economies. The rows refer to each of the models run – first the naïve model, then the naïve model augmented for foreign direct investment and so on. The root mean squared error (RMSE) for each model serves as a measure of the model's predictive accuracy. For expositional purposes, we express the RMSE of the i th model as a ratio to the RMSE of the naïve model. As forecasting ability improves and the RMSE declines, this ratio tends towards zero. A value of one signifies no improvement over the naïve model; a value greater than one, a deterioration in the ability to predict the capital account. In the interest of brevity we do not report the ratio for every flow and every country. Instead we distinguish between industrial and emerging economies and average the ratios for the six countries in each sample to report a summary ratio for each type of flow. The second column lists the countries for which we find that the coefficient on the variable of interest is statistically significant.

The ratio of the errors in the first column indicates that the addition of information about individual flows to the forecast of overall capital movements improves the fit by around 5%, at best. However, in most cases the additional information adds less than 2% to explanatory power, and in some cases there is an outright deterioration.

As expected, all industrial and emerging economies have highly significant coefficients on the lag of the capital account in the naïve model. However, because there is typically less persistence in the emerging economies due to the higher incidence of crises, their RMSE for the naïve model is around twice as large (not shown).

None of the individual flows can be shown to systematically add statistically significant explanatory power over and above the naïve benchmark for a majority of the industrial countries. Portfolio debt flows are statistically significant only for the United States and Japan, but not enough to noticeably outperform the naïve model.

Table A1
Ability to predict the capital account
 Sample, 1980–2005, quarterly

Model	RMSE/ RMSE _{Naïve}	Countries for which <i>p</i> value indicates significance at 5% level
Industrial economies		
Naïve with lag	1.000	Australia, Germany, Japan, Sweden, United Kingdom, United States
Foreign direct investment	1.003	
Portfolio equity investment	1.000	
Portfolio debt investment	0.989	Japan, United States
Bank and money market flows	0.998	
Reserves	0.994	Australia , Japan
Emerging economies		
Naïve with lag	1.000	Argentina, Brazil, Korea, Mexico, Philippines, Thailand
Foreign direct investment	1.000	
Portfolio equity investment	1.001	
Portfolio debt investment	0.989	
Bank and money market flows	0.949	Argentina, Korea, Mexico, Thailand
Reserves	0.988	Brazil, Korea, Philippines, Thailand

Source: RBA calculations.

In contrast, the relationship between bank and money market flows and the capital account appears to be more robust in the emerging economies. For Argentina, Korea, Mexico and Thailand, the significance of these flows may reflect a degree of bank dependence, as discussed in the paper. Reserve flows are also more typically related to the overall capital account in emerging economies than they are in industrial economies. Once again, however, the improvement from adding this information to the regression is at best marginal, suggesting that there is little to be gained by adding information about individual flows when trying to understand capital account developments.

Marginal source of finance

In this section we run a set of simple regressions, with the total capital account on the right-hand side and, separately in turn, each of its components on the left. All variables are in US dollars, and we take account of the semiannual change in each over the full sample period. The coefficients are constrained to sum to one and may be interpreted in a number of ways. If the change in the current account on the right side is interpreted as the financing requirement, then the coefficients can be viewed as the responsiveness of each flow to a US\$1 increase in that funding requirement. The value of the slope coefficients and their statistical significance are shown in Table A2.

One of the first things to note is that many of the estimated coefficients are not statistically significant. This may well be because, as we suggest earlier in this paper, there is no

statistically reliable relationship over time between the current account and the different types of capital used to finance it. This is particularly evident for portfolio equity flows, given that almost no country has a highly significant coefficient.

Table A2
Marginal source for financing the current account

Slope coefficients^{1, 2}, sample 1980–2005³

	Foreign direct investment	Portfolio equity investment	Portfolio debt investment	Bank and money market flows	Change in reserves
Industrial economies					
Australia	0.52	-0.82	1.01**	0.07	0.22
Japan	-0.05	-0.12	-0.44	1.29**	0.32
Germany	0.63**	-0.35*	-0.27*	0.92**	0.07
Sweden	-0.17	0.00	0.70**	0.49**	-0.02
United Kingdom	0.93**	0.04	0.51	-0.52	0.03
United States	0.43**	0.07	0.07	0.42**	0.01
Emerging economies					
Argentina	0.15	0.30*	-0.30	0.94**	-0.08
Brazil	0.06	-0.37**	-0.47	0.54	1.23**
Korea	-0.07**	-0.11	0.04	0.25	0.89**
Mexico	0.11**	0.05	0.02	0.55**	0.27**
Philippines	-0.09*	0.06	0.27**	0.90**	-0.15
Thailand	0.01	0.03	-0.05	0.90**	0.11

¹ ** Significance at the 5% level or better. ² * Significance between the 5% and 10% levels. ³ Semiannual observations. Due to data availability, the portfolio debt slope coefficients for Korea, the Philippines, Mexico and Argentina are calculated on samples starting in the first quarters of 1988, 1996, 1989 and 1992, respectively. All samples end in 2005Q4.

Source: RBA calculations.

Portfolio debt flows are also found to have a relatively low significance for most countries. In the medium-sized economies of Australia and Sweden, international transactions in debt are found to be highly significant and have a large positive coefficient. With the exception of the Philippines, none of the emerging economies are found to have significant debt market relationships with the overall flow of capital. We suggest that this is not coincidental. The Philippines has had a relatively well-developed government bond market for some time due to a history of fiscal deficits, whereas the domestic bond markets of many other emerging economies remained underdeveloped for a longer time. As a result, we would not expect portfolio debt flows to play a major role in the determination of the overall capital account for these economies.

Foreign direct investment appears to be an important source of finance for a number of countries. For emerging economies this is to be expected, in part because these types of flows are generally encouraged and the host countries are a natural destination for such flows.

However, bank and money market flows are found to be the most responsive to financing requirements. The flows are most often found to be statistically significant and have large coefficients. Our interpretation of this finding is relatively simple. Banks perform an important intermediation function in both industrial and emerging economies. They are typically also active in international debt and foreign exchange markets. Furthermore, since banks are routinely found on both sides of most of these markets, they act not only as intermediaries but also as an important source of arbitrage. Perhaps this function is what makes these flows the most flexible and readily adjustable. Banks are most likely to be involved in such equilibrating transactions in industrial economies that have large two-way gross banking flows. In emerging economies, the importance of bank-related flows, with highly significant and large positive coefficients, may reflect a degree of dependence on banks in the absence of ready access to non-intermediated debt markets. The claim appears to be supported by net banking-related flows being dominated by gross foreign flows in emerging economies.

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