Reserve Bank of Australia

RESEARCH
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Volatility in International Capital Movements

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RDP 2009-09

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Research Discussion Paper
2009-09

December 2009

International Department
Reserve Bank of Australia

We thank Cameron Deans for research assistance and are grateful to Guy Debelle, Keith Hall and participants in an internal seminar for their helpful comments on earlier drafts of this paper. Any remaining errors are our own. The views expressed in this paper are those of the authors and not necessarily those of the Reserve Bank of Australia.

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Abstract

Conventional wisdom is that some capital flows are inherently more volatile than others. However, our investigation of the statistical properties of these flows shows that no regular relationships exist to suggest that the particular composition of capital flows can help to explain the overall stability of the external accounts. Instead, capital seems to come and go in different forms with few reliable patterns.

We show that while industrialised economies have experienced a trend rise in the volatility of individual components in the capital account, this variability is largely offsetting. Such offsetting relationships appear less prevalent in emerging economies.

JEL Classification Numbers: F21, F32, F36, O16, O24
Keywords: capital flows, volatility, financial globalisation

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VOLATILITY IN INTERNATIONAL CAPITAL MOVEMENTS

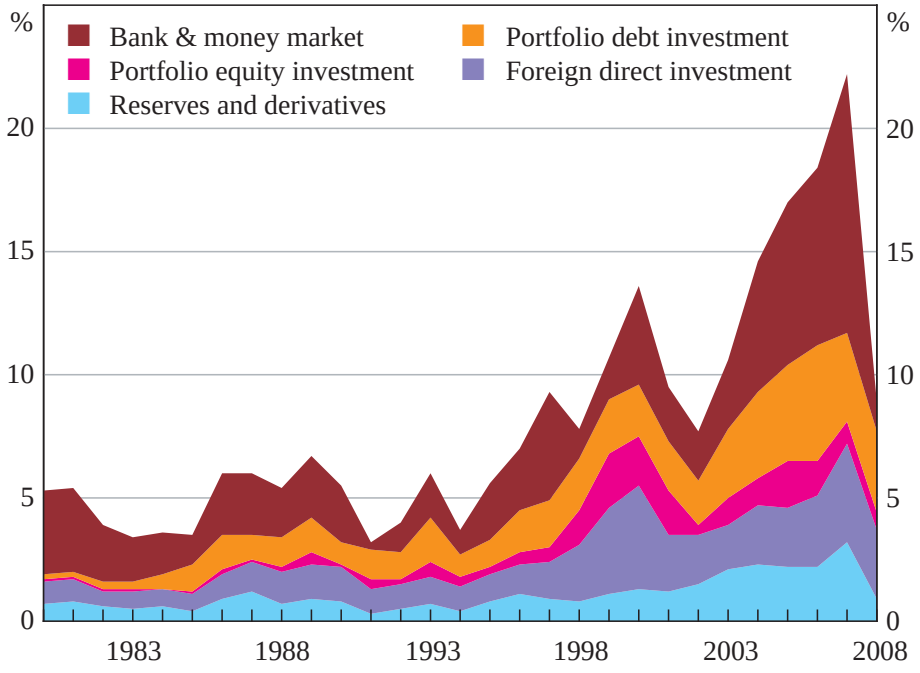
Chris Becker and Clare Noone

1. Introduction

Over the past decade or so, 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 (Figure 1). It is also evident that there have been major fluctuations around an upward trend in gross capital flows and that at times there were noticeable compositional shifts in the importance of various types of flows.[1]

Figure 1: Gross International Capital Flows

Ratio to World GDP



Sources: IMF; RBA

1 Battellino (2006) provides a more detailed exposition of these trends. Although not part of our detailed analysis, we also note the dramatic decline in gross flows in the recent financial crisis.

While these trends have generally been viewed as a sign of economic and financial development, the merits of financial globalisation and integration have attracted an increasing amount of scrutiny. Financial crises, particularly in the 1990s, have given rise to a body of literature which calls into question the unqualified benefits of international integration (Krugman 2000, Calvo and Reinhart 2000 and Kose *et al* 2006). One focus has been on the possible disadvantages faced by emerging economies that open up to global capital markets prematurely.[2]

With some types of flows typically seen to be inherently more susceptible to sudden reversals, the composition of the overall capital account has also received considerable attention. The conventional wisdom is that certain types of capital flows are more volatile than others and thus potentially destabilising (Classens, Dooley and Warner 1995; Becker and Noone 2008). In particular, portfolio or bank and money market flows are often seen as being speculative and subject to sharp reversals, thereby exposing recipient countries to the whims of international financiers. These flows are correspondingly often described as being 'hot'. In contrast, flows such as foreign direct investment, which are seen to engender a longer-term commitment determined by fundamental developments, have come to be viewed as being relatively stable and unlikely to reverse without good reason. This perceived lack of 'skittishness' has seen such flows labelled as being 'cold'.

This paper examines whether different types of capital flows have attributes that make them more or less likely to contribute to volatility in the overall capital account. We examine the statistical properties of the flows to judge whether they are regularly 'hot' or 'cold'. For the purpose of this paper we leave aside the question of whether some forms of capital confer other desirable economic effects on the recipient country, such as the technological and managerial transfer often

2 For a literature survey, see Obstfeld and Taylor (2003). For related discussions on the disadvantages faced by emerging economies, possible transitional arrangements, and prerequisites required to gain from trade in capital, see Nakagawa and Psalida (2007) and Kose *et al* (2006). If capital flows are completely determined by domestic variables such as economic growth and the expected return on assets, they would be of little direct policy interest. Instead, the underlying source of any weakness would attract the attention. On the other hand, if capital flows are not uniquely determined (that is, subject to bouts of excessive optimism and crises of confidence) and are influenced by variables in international capital markets that lie beyond the control of domestic policy-makers, they may warrant more direct scrutiny (Krugman 2000; Radelet and Sachs 2000).

associated with direct investment. And since we are interested in assessing the overall volatility of the capital account, we largely focus on net flows while acknowledging that gross flows play a crucial role in understanding the underlying sources of variability.[3] Throughout, we compare and contrast the experience of six industrialised economies with that of six emerging economies.

The remainder of the paper is structured as follows. Section 2 defines our concept of volatility and examines a number of measures to test the validity of commonly held priors. Section 3 provides several insights into how capital flows interact within the capital account of a country and with the flows of other countries. Section 4 provides empirical estimates of possible explanations for capital account volatility. The final Section provides some concluding remarks, while Appendix A applies a series of simple econometric techniques to the question at hand.

2. Variability of the Capital Account

There are several ways of measuring the variability of the capital account and its components. We take our lead from Classens *et al* (1995) who employ a number of simple statistical techniques to test whether some types of capital flows can be reliably identified as being inherently more volatile than others. Contrary to the commonly held view, their findings suggest that the composition of capital flows is endogenously determined by domestic factors and that little can be learned from looking at individual flows in isolation when the source of instability tends to be aggregate shocks to the determinants of the capital account. Our work is somewhat different in the way it measures volatility and offers some explanations for why industrialised and emerging economies have different experiences when it comes to capital flows.

Throughout the paper we use standard balance of payments data sourced from the International Monetary Fund's *International Financial Statistics* (IFS), on a

3 Debelle and Galati (2005) point out that knowledge of whether foreigners or domestic residents are driving the flows is useful. There is some evidence that in contrast to industrialised economies, emerging economies' net capital flows are usually driven in large part by non-residents (Lowe 2009). This may expose emerging economies to sudden turns in the sentiment of foreign investors (see also Calvo 2000).

quarterly basis. Except where explicitly stated, the data are then converted into local currency terms and scaled by nominal GDP (for details see Appendix B) for analysis. 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 (BMM)[4], and official reserve (RES) flows. We use this disaggregation of the data for the remainder of the paper. Our sample of six industrialised economies comprises the United States, Japan, Germany, the United Kingdom, Australia and Sweden. The six emerging economies for which data are readily available are South Korea, Thailand, the Philippines, Brazil, Mexico and Argentina. In the interest of brevity we present most results in terms of the simple unweighted average for industrialised and emerging economies. Where interesting results are apparent on a by-country basis these are discussed in their own right. The sample period spans the first quarter of 1980 to the fourth quarter of 2005, inclusively.

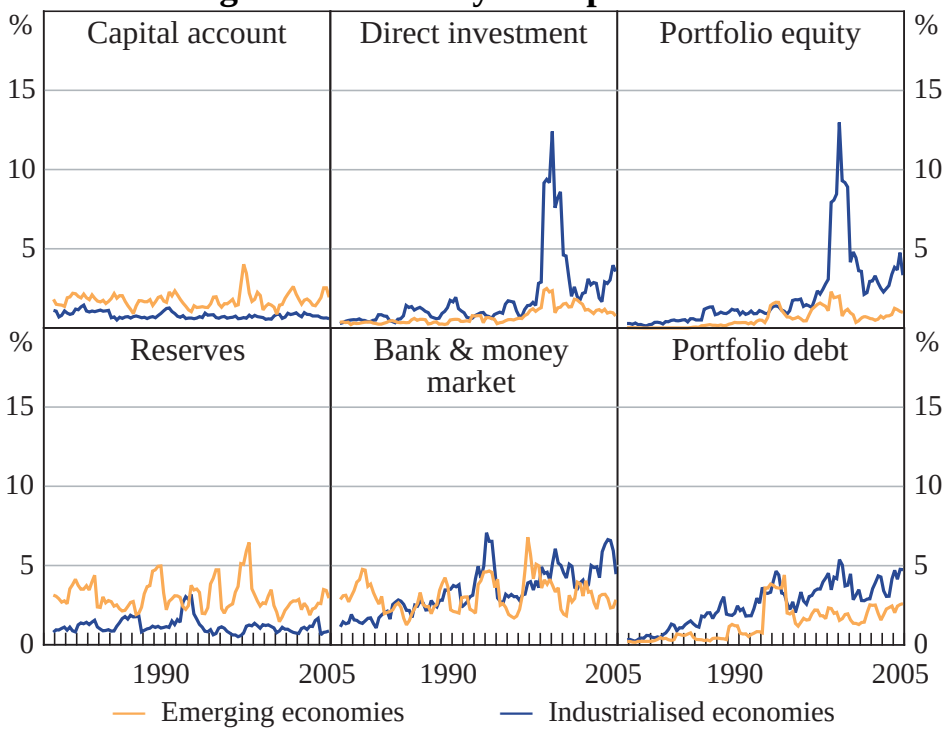
2.1 Volatility of Capital Flows

We measure the volatility of flows as the standard deviation of the ratio of the flows to GDP. Scaling by GDP is important because we are most interested in large swings in the flows from each country's perspective. To capture how volatility among the flows has evolved over time we calculate the standard deviations of quarterly data over a one-year rolling window for each country. For expositional purposes we average the results across emerging economies and across industrialised economies as depicted in Figure 2.

The overall volatility of the capital account in emerging economies has generally been around double that experienced by industrialised economies. Furthermore, emerging economies have more discrete episodes when volatility rises markedly, in part reflecting the fact that they have more frequent balance of payments crises.

4 In the balance of payments these flows appear under the category of 'other'. As bank loans and money market transactions are the main components of this category, we refer to these flows as 'bank and money market' flows to lend them a more meaningful label.

Figure 2: Volatility of Capital Flows



Notes: Volatility of capital flows is measured as the simple average of the standard deviation in the ratio of capital flows to GDP over a quarterly 1-year rolling window. Industrialised economies are United States, Japan, Germany, the United Kingdom, Australia and Sweden, and the emerging economies are South Korea, Thailand, the Philippines, Brazil, Mexico and Argentina.

Sources: ABS; Bloomberg; CEIC; IMF; Thomson Reuters; authors' calculations

These outcomes are in line with what we know about emerging economies. More insights are to be found in the developments in the volatility of the different types of flows, and the contrast between the experiences of emerging and industrialised economies.

One of the most noteworthy findings is that while there has been little change in the average degree of volatility observed in total flows, the pattern of volatility has evolved very differently among the various components of the capital account. In industrialised economies, the component flows are generally more volatile than the total and have virtually all exhibited a trend rise in volatility. Given no such trend in the volatility of the overall capital account, there must be a degree of negative correlation between various components. Indeed, there is a sizeable negative correlation between portfolio debt and bank and money market flows. This suggests a degree of substitutability between different forms of capital that allows

industrialised economies to accommodate variability in the mix of different types of capital flows without significant adverse consequences for overall flows.[5]

Another interesting feature of the data for industrialised economies is the sharp movement in the volatility of foreign direct investment and portfolio equity investment flows earlier this decade. This principally reflects the increase in mergers and acquisitions among European countries, which was financed through stock swaps. Under these deals, direct investment is financed by exchanging stocks between companies. This results in offsetting portfolio equity and foreign direct investment flows, with little if any effect on the overall capital account.[6]

Among emerging economies, the trend rise in the standard deviation of the constituent flows is less pronounced, and the constituent flows within the capital account are often less volatile than the total. Importantly, this suggests not only that the substitutability between the flows evident in industrialised economies may not be present in emerging economies but also that at least some flows tend to move in the same direction. The volatility of bank and money market flows is relatively high for emerging economies, in which there is typically also a greater reliance on bank-intermediated finance and local currency debt markets remain relatively underdeveloped.

The behaviour of reserve flows is quite different for emerging and industrialised economies. Not surprisingly, reserves are considerably more volatile among the emerging economies where monetary authorities are typically more active in foreign exchange markets. With the exceptions of the Plaza Accord and the European Exchange Rate Mechanism crisis, the less activist role of central banks among industrialised economies, with their typically floating exchange rates, results in reserve flows that are, on average, less than half as volatile as those of emerging economies. Japan is an obvious exception to this, with a jump in volatility in 2003–2004.

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

6 The merger of Vodafone Plc in the United Kingdom with Mannesmann AG in Germany is a prominent example of this phenomenon. For more details see Becker (2003).

2.2 Persistence of Capital Flows

A complementary measure of the stability of capital flows is their degree of persistence over time. 'Cold' flows that are perceived to be relatively stable should also display evidence of strong positive correlation with their own past values. To assess persistence we calculate autocorrelation coefficients for each flow in each country over the sample. The data are quarterly ratios of flows to GDP and the correlations are calculated for 16 lags (Figures 3 and 4).

Total capital flows are found to exhibit a high degree of persistence in most industrialised economies. The autocorrelation coefficients are typically large, positive, and gradually decay as the lags increase. This suggests that there is a high degree of persistence in the overall capital account for at least one to two years.[7] The capital account in emerging economies is typically less autocorrelated and only two of the emerging economies examined have autocorrelation coefficients of greater than two-thirds for four or more lags, compared to five out of the six industrialised economies.

The autocorrelation coefficients for the components of the capital account suggest that these flows generally display little if any persistence for industrialised economies. The coefficients are small and change sign frequently. There are, however, a number of notable exceptions. For the United States we find that portfolio debt flows are highly persistent. This is not surprising given that the United States is home to the largest debt markets and the US dollar is the world's main reserve currency. Japanese foreign direct investment flows are also shown to be highly persistent. This may reflect the structural 'hollowing out' of Japanese manufacturing as Japanese companies undertook direct investment to set up plants in other Asian countries where labour costs were lower.

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7 Further evidence of this persistence is presented when we investigate the forecastability of the flows in Appendix A. For more persistent flows, the expected future value will be closer to the current value of that flow. There is some evidence to suggest that for industrialised economies the current account is endogenous to domestic economic fundamentals such as growth, saving and investment, and that current account deficits do not by themselves precipitate sudden stops that cause adjustment in other variables (Debelle and Galati 2005).

Other than these exceptions, there is no evidence among industrialised economies to support the view that some types of capital flow are inherently more persistent than others. Foreign direct investment is typically not as persistent as might have been expected and can hardly be distinguished from the bank and money market or portfolio flows, which are often thought of as being relatively temporary.

The evidence is somewhat different for emerging economies. Foreign direct investment flows are relatively persistent for a number of these economies. This can probably be attributed to emerging economies being natural destinations for such investments, with inflows typically dominating this category.[8] There are also several other examples of persistence for some components of the capital account, but there are no consistent patterns across emerging economies.

8 In contrast, for industrialised economies foreign direct investment typically flows in both directions.

Figure 3: Autocorrelation Coefficients – Industrialised Economies
1980 to 2005 (*continued next page*)

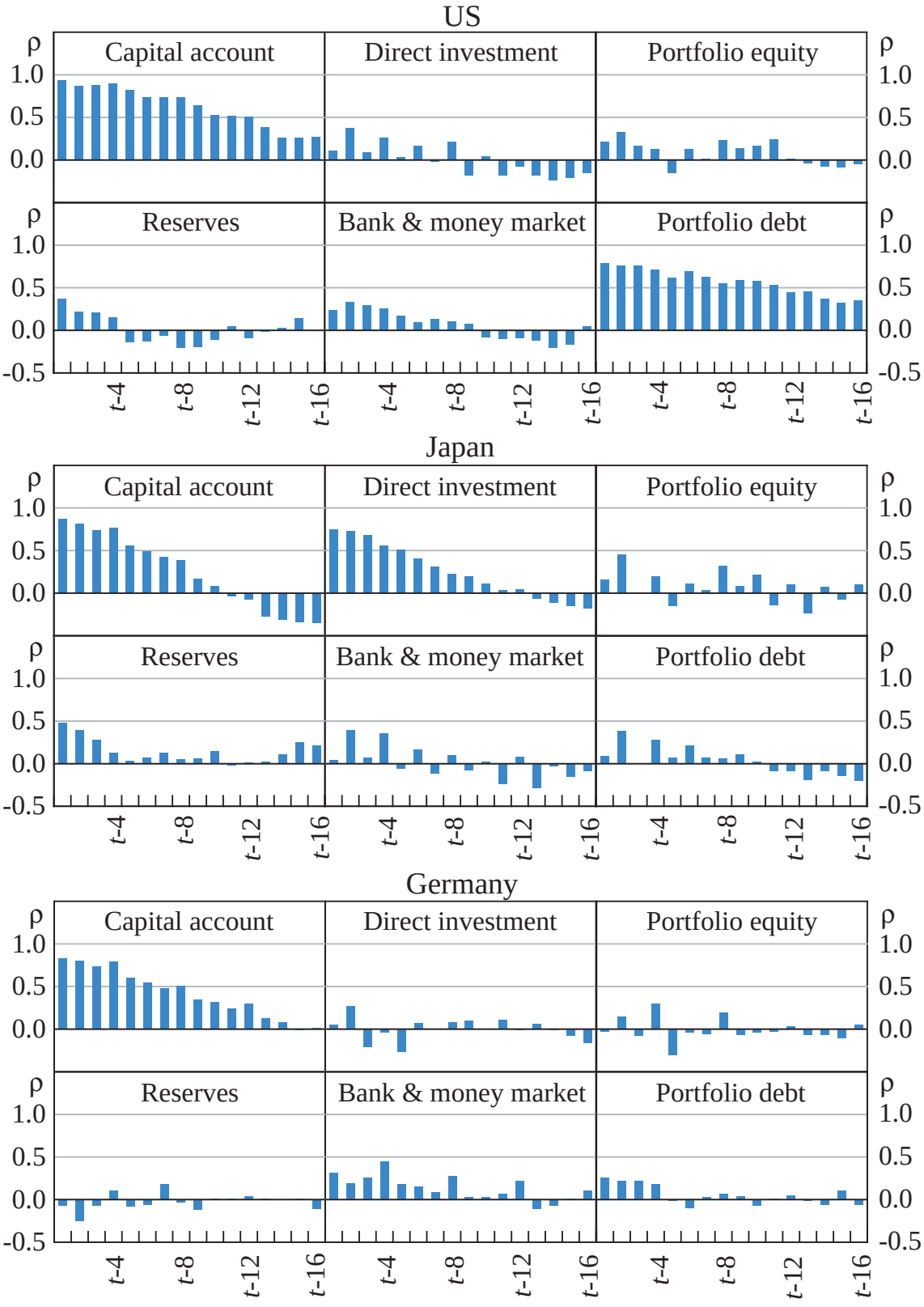
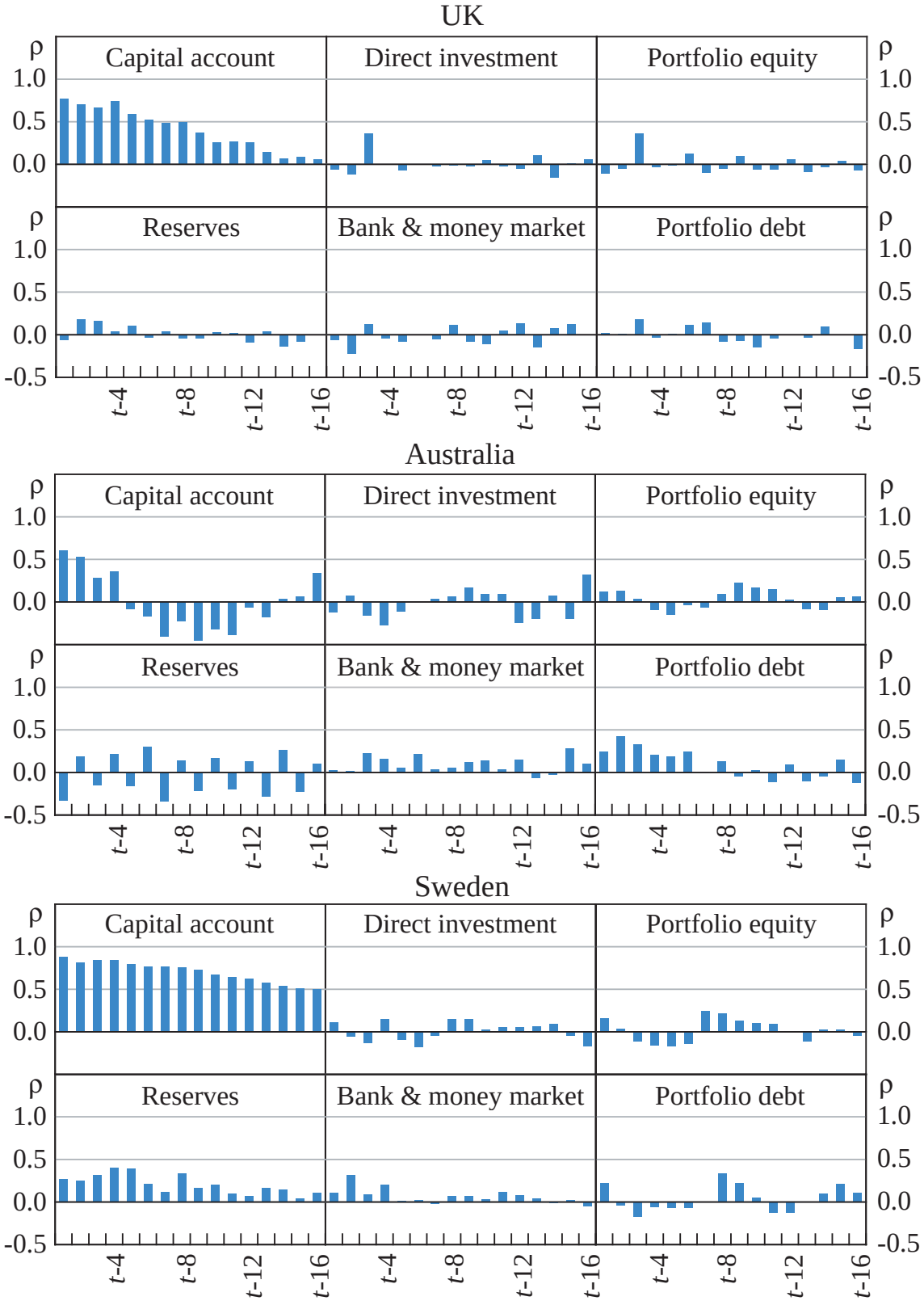


Figure 3: Autocorrelation Coefficients – Industrialised Economies
1980 to 2005 (*continued*)



Source: authors' calculations

Figure 4: Autocorrelation Coefficients – Emerging Economies
1980 to 2005 (*continued next page*)

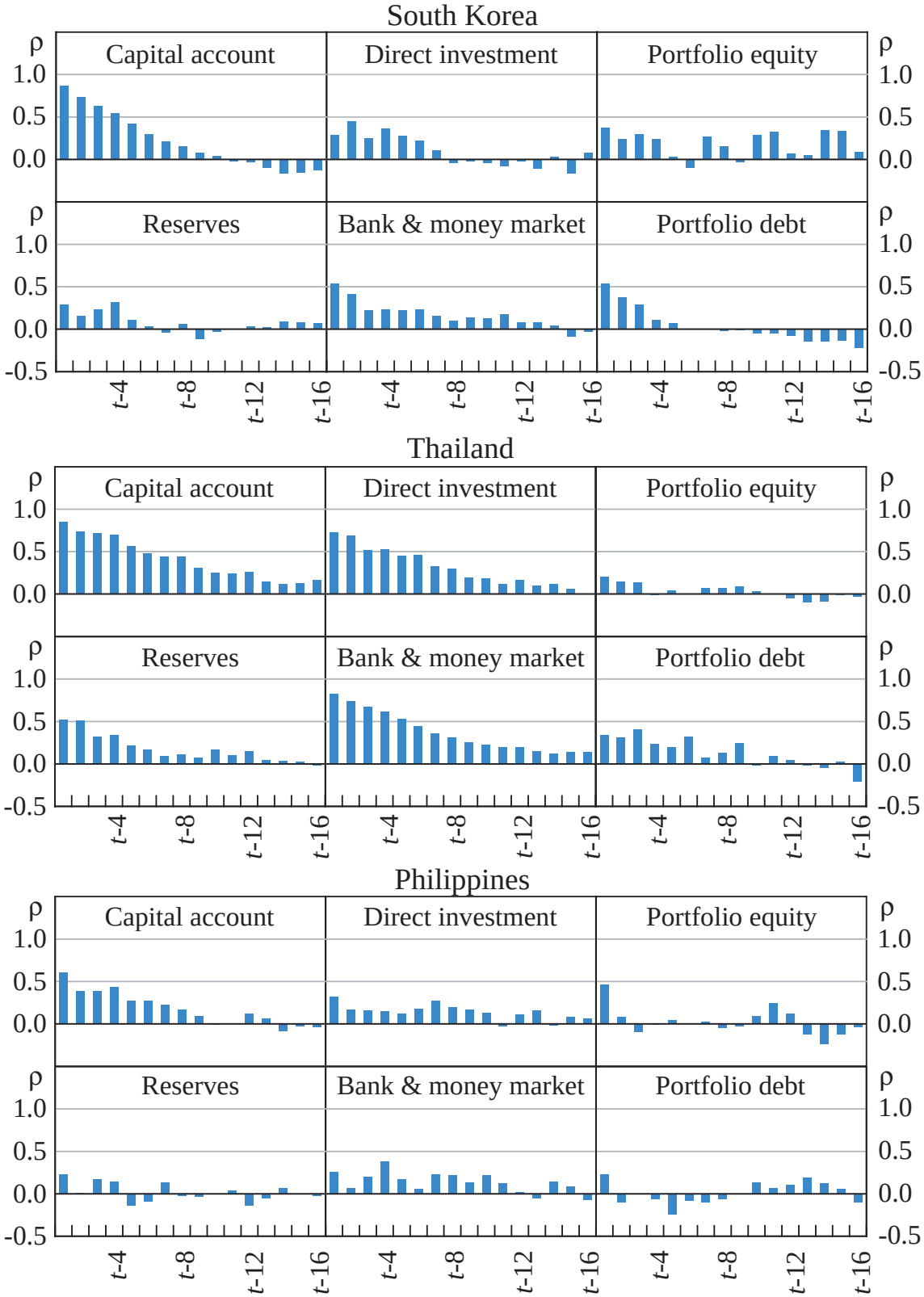
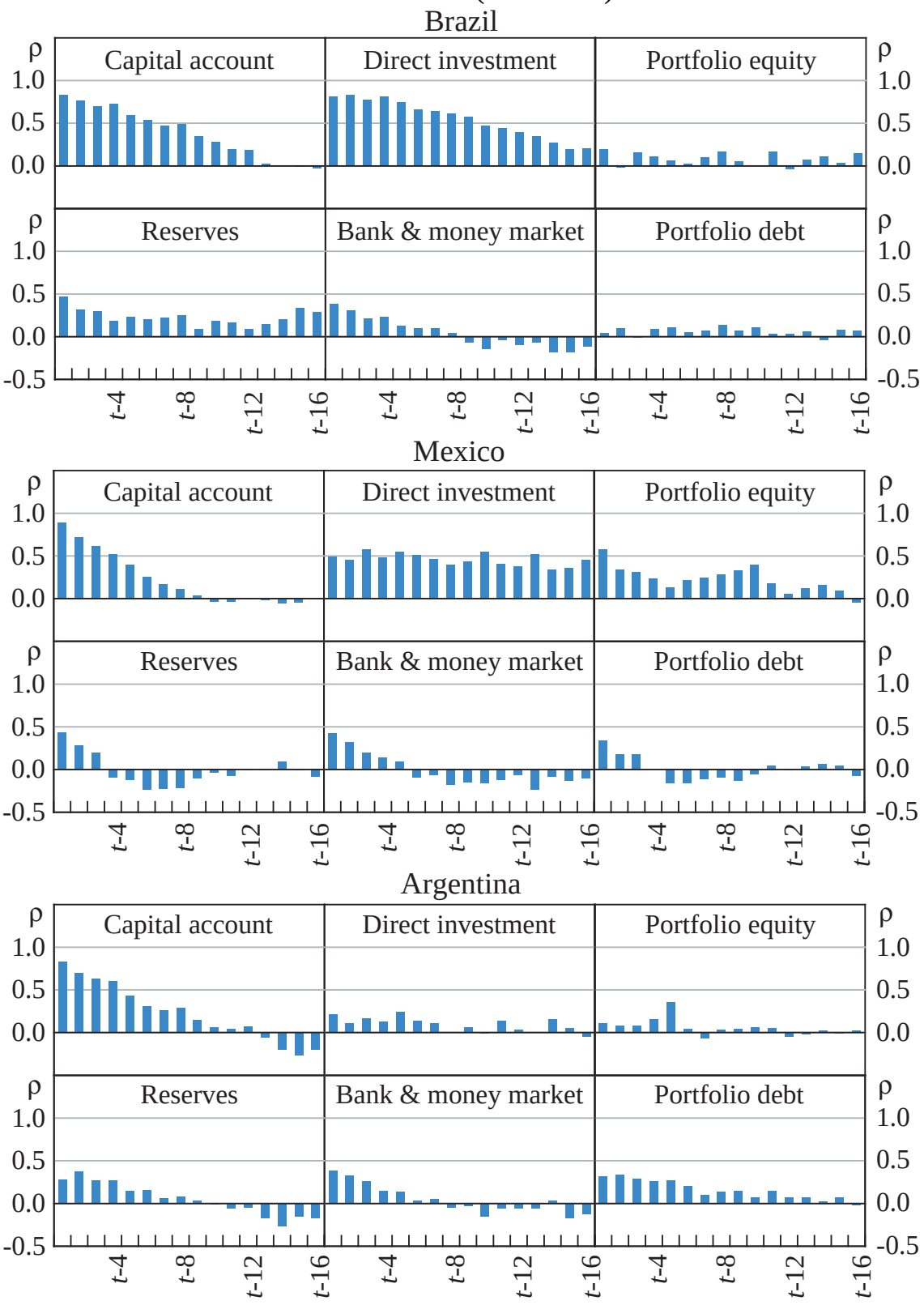


Figure 4: Autocorrelation Coefficients – Emerging Economies
1980 to 2005 (*continued*)



Source: authors' calculations

2.3 Composition of Cross-border Finance

Policy-makers may be interested in understanding how capital account volatility is related to the composition of cross-border flows. More specifically, as a flow assumes a more prominent share in the capital account, a systematic relationship between its volatility and that of the total may be discernible. If some flows are inherently more or less stable, then as these flows become more important as a source of cross-border financing we should be able to observe whether or not this exerts an influence on the overall capital account.

To test whether such statistical regularities are observable we disaggregate the quarterly country data by type of flow, as defined earlier. We then calculate the importance of each type of capital flow in the overall capital account. The importance of each type of flow in a particular economy's capital account is calculated as the ratio of the absolute value of the net flow to the sum of the absolute value of all flows in the capital account.[9] This is done over five-year blocks from 1981 to 2005. The changing importance of each flow for every country is measured as the difference in this ratio 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 (Table 1). 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.

9 We take the absolute value of the quarterly flows and the capital account to avoid the problems of interpretation associated with either the numerator or denominator switching sign.

Table 1: The Volatility of Capital Account Flows

Standard deviation in the quarterly ratio of the capital account to GDP

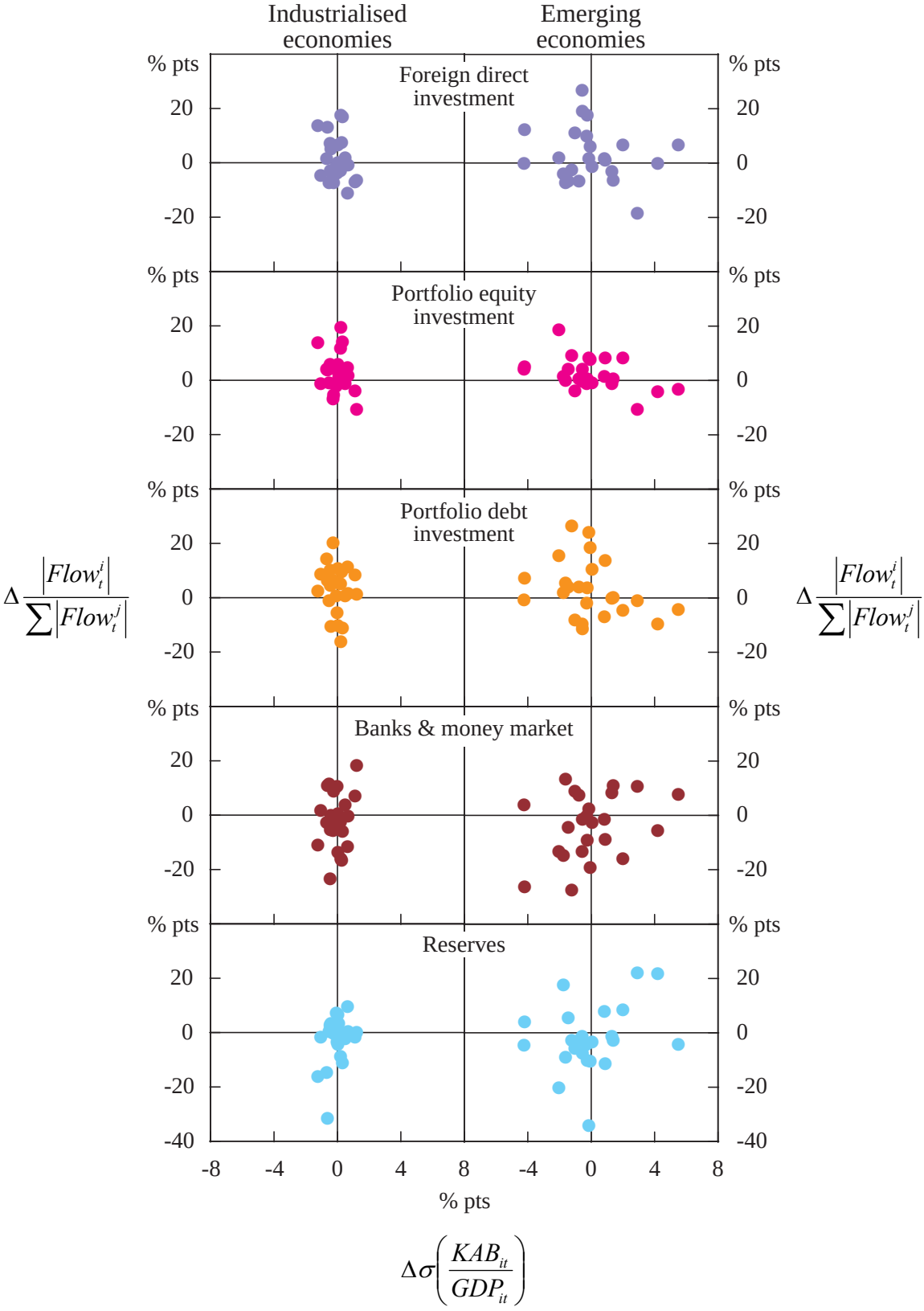
	1981–1985	1986–1990	1991–1995	1996–2000	2001–2005
US	1.3	0.9	0.9	1.1	0.8
Japan	1.5	1.1	0.5	0.6	0.7
Germany	1.7	1.0	0.6	0.9	2.1
UK	1.4	2.0	1.0	1.2	1.0
Australia	1.0	1.1	1.3	1.2	1.7
Sweden	2.0	1.4	2.1	0.8	2.0
Korea	2.7	3.6	1.5	5.7	1.5
Thailand	2.8	4.8	3.2	8.6	4.4
Philippines	3.7	3.5	2.7	3.6	3.7
Brazil	3.6	1.9	1.7	1.2	2.5
Mexico	3.8	2.4	2.3	1.3	1.0
Argentina	1.7	3.0	1.8	1.3	4.2

Source: authors' calculations

Figure 5 plots the relationship between changes in the importance of each of the flows and capital account volatility for industrialised and emerging economies. The changing importance of the flows lies along the vertical axis and the changing volatility in the capital account on the horizontal axis.

A positive relationship in the scatter plots would be consistent with more volatile flows becoming more important, thereby raising the average volatility of the capital account. Conversely, a negative relationship would be consistent with less volatile flows becoming more important.

Figure 5: Composition and Volatility of Capital Flows



Source: authors' calculations

Few statistically significant relationships emerge when regression lines are fitted to the data (not shown). For industrialised economies there is a statistically significant positive relationship between the increasing importance of reserve flows and increasing capital account volatility. For emerging economies the increasing importance of portfolio equity flows tend to be associated with decreasing capital account volatility, contrary to the conventional wisdom.[10]

In addition, a number of specific cases can be cited that are clearly at odds with the conventional wisdom. For example, in Australia from the 1980s to the 1990s there was a rise in the importance of foreign direct investment and a decline in the importance of bank and money market flows. While preconceived ideas about the former being cold and the latter being hot flows would imply lower variability in overall capital inflows, the opposite occurred (refer also to Table 1). Similarly, at the same time, the United States experienced a decline in the importance of foreign direct investment at the expense of bank and money market flows, but, on average, volatility of overall flows declined.

What is evident from Figure 5 is that for industrialised economies the observations are clustered in an ellipse around the vertical axis. This implies that the composition of finance changed noticeably over time, but the capital account remained relatively stable. The observations for emerging economies are more widely dispersed and spread out along the horizontal axis, indicating that overall capital account volatility changed more noticeably over time. Overall, these results suggest that volatility of the capital account is not systematically related to its composition.

10 Comparing the composition of the capital account to its overall volatility in levels, rather than changes, also fails to reveal any compelling patterns. Although we find that a high share of portfolio debt flows tends to be associated with relatively low capital account volatility for industrialised economies, the reverse is true for emerging economies. We also find that high capital account volatility is associated with a high share of bank and money market flows for emerging economies, but not for industrialised countries. Note that this analysis does not account for possible unobserved country fixed effects.

3. Interactions Between Flows

The results in the preceding Sections suggest that the co-movement of different types of capital flows seems to be central to understanding the overall variability of the capital account.

To provide a more comprehensive view of the data and how the flows interact we estimate cross-correlation coefficients for all capital flows. Importantly, we distinguish between how different types of flows are correlated 'within' each country's capital account and with the flows of 'other' countries. The quarterly data are summed to annual totals (and expressed as a ratio to GDP) for this purpose, thereby shifting focus away from high-frequency changes in the flows.

3.1 Within Capital Account Correlations

Table 2 summarises within country cross-correlation results by showing the average of the correlation coefficients across industrialised economies and across emerging economies. It also shows, in brackets, the number of countries with negative correlation coefficients for a given pairing of capital account flows.

Correlations between various types of flows within each country's capital account are generally negative. For industrialised economies, around 75 per cent of the flows are negatively correlated within their own capital account. For emerging economies the degree of negative correlation is smaller at 47 per cent.

For industrialised economies, on average there is a sizeable negative correlation between foreign direct investment and portfolio equity flows. Bank and money market and portfolio debt flows also show a negative correlation on average for industrialised economies.

There is a strong positive correlation between portfolio debt flows and the capital account for both industrialised and emerging economies. This positive relationship is particularly strong for Australia, Japan and the United States. For emerging economies, the capital account is also always positively correlated with bank and money market flows, and typically more so than for industrialised economies. This

strong link is consistent with a greater degree of bank dependence among emerging economies.

Table 2: Within Country Capital Account Correlations

Average of coefficients for each country calculated on annual values as a ratio to GDP (number of countries with negative coefficients), 1980 to 2005

	Foreign direct investment	Portfolio equity investment	Portfolio debt investment	Bank and money markets	Reserves	Capital account
Industrialised economies						
Foreign direct investment	1.0					
Portfolio equity investment	–0.3 (4)	1.0				
Portfolio debt investment	0.0 (4)	–0.3 (5)	1.0			
Bank and money markets	–0.2 (5)	–0.2 (4)	–0.3 (5)	1.0		
Reserves	0.0 (2)	–0.1 (5)	0.0 (3)	–0.2 (4)	1.0	
Capital account	0.1 (1)	0.0 (2)	0.5 (0)	0.2 (1)	0.1 (2)	1.0
Emerging economies						
Foreign direct investment	1.0					
Portfolio equity investment	0.0 (3)	1.0				
Portfolio debt investment	–0.2 (3)	0.3 (1)	1.0			
Bank and money markets	–0.2 (4)	–0.1 (5)	0.1 (1)	1.0		
Reserves	–0.2 (6)	–0.3 (5)	–0.2 (4)	–0.3 (5)	1.0	
Capital account	–0.1 (3)	–0.1 (5)	0.4 (1)	0.7 (0)	0.1 (2)	1.0

For emerging economies there is also a consistent 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 aim 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. Second, it is also feasible that since the capital account, current account and the exchange rate are jointly determined, actions to maintain a given exchange rate through variations in reserves may cause disturbances in the other types of flows within the capital account. Such disturbances may manifest themselves in such a way that it is

typically the bank and money markets component of the capital account which is most accommodating. The scope of this paper is too limited to adequately address this interesting aside in the research.

3.2 Cross-country Correlations

The correlation in capital flows between countries may also be useful in understanding volatility. Several interesting links across countries are evident and worth highlighting, although there is no overwhelmingly regular pattern among the flows (results not shown).

There is a negative correlation between total net flows for Japan and those of other industrialised economies that are net capital importers, such as Australia and the United States. There is less evidence of correlation between the capital accounts of industrialised and emerging economies. This is indicative of a relatively high degree of financial integration among industrialised economies, while emerging economies are less integrated into global financial markets.

The capital accounts tend to be positively correlated among the emerging economies. Given that these balances are also relatively volatile, this result is consistent with evidence that these countries are subject to the same balance of payments shocks. That is, they tend to experience crises at the same time, which also reflects a degree of contagion (Broner and Rigobon 2006).

Another interesting aspect of the correlations is that they reflect foreign exchange intervention that, to varying degrees, attempts to limit currency variations. *A priori,* if reserves are accumulated (a capital outflow) to stem an incipient appreciation of the exchange rate (from a capital inflow) and are invested in fixed-income assets, this would lead to a negative correlation between reserves in the intervening country and portfolio debt inflows for the recipient country, or countries. For both Japan and Korea, reserves are significantly negatively correlated with portfolio debt flows for the United States, the United Kingdom and Australia. Holding reserves in US dollars and investing the proceeds in Treasury securities is common to most central banks around the world.

4. Sources of Capital Account Volatility

This section attempts to explore some of the underlying sources of capital account variability using panel data regressions. Broadly speaking there are two types of shocks that could affect the capital account flows of a particular country. First, investors (for whatever reason) may change their views about the prospects for that country as a whole, leading capital to either flow into or out of that country in a way that implies a positive correlation of the components of the capital account. Second, a shock may be more specific to a particular asset class within a country (or across countries), but the extent to which this affects the overall volatility of the capital account and the correlations between its various components will depend on the degree of substitutability between different asset classes within that country.

We examine the extent to which factors that may affect the degree of substitutability within each country play a role in explaining volatility of the overall capital account. Of course, the results will only be suggestive of any substitutability effect, since changes in the nature of the country-specific shocks may also affect overall capital account volatility. We leave a more detailed investigation of this issue to future research.

4.1 Selection of Explanatory Variables and the Model

The dependent variable to be explained is the volatility of the overall capital account balance (as a share of GDP). Data are annual, and so we measure volatility as the standard deviation of quarterly capital account observations within a given year.

The first two explanatory variables we consider correspond to those discussed in Section 2, which 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 (net) flow as the ratio of its absolute value to the sum of the absolute value of all flows (within each year).

We also control for the exchange rate regime. If the exchange rate is fixed or pegged, the burden of any external adjustment following a shock must fall more on quantities rather than prices, which may imply a more volatile capital account. To

test for this we include a dummy variable that is 'zero' when the exchange rate is freely floating or under a managed float, and 'one' if the exchange rate regime is less flexible (*FXregime*); see Appendix B for further details.

We include two variables to capture the potential for a substitutability effect. Both are intended to capture the extent of the development or depth of financial markets; of course, this in turn is likely to reflect some deeper structural features of the various economies. The first variable is a measure of the volume of gross flows. Large two-way flows may limit volatility by enhancing the scope of residents to meet financing requirements at times when foreigners reverse their investments and become sellers.[11] The extent of gross flows may also 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.[12] Furthermore, the extent of gross capital flows reflects the degree of capital account openness. The less open the capital account, the less scope there is for shocks to one type of flow to be offset by changes in other flows.

To gauge the importance of these factors, we construct a summary measure based on gross flows (*FlowOpenness*). We create an index that depends on the ratio of the absolute value of the gross flows to the absolute value of the sum of gross and net flows as follows:

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

When capital flows freely in both directions, we expect the sum of absolute gross flows to be large relative to net flows. In this case, the index tends towards 100.

11 There is some evidence to suggest that industrialised economies are well placed to benefit from large overall gross flows, with both residents and non-residents playing sizeable roles in the external accounts. In contrast, emerging economies are characterised by being somewhat bank dependent and typically have gross flows dominated by the actions of foreigners (Lowe 2009). A history of large two-way flows may indicate an increased ability for residents to offset volatility caused by foreign investors, in part because it may be associated with residents accumulating a larger stock of foreign assets.

12 Refer also to Debelle and Galati (2005).

When capital flows are very one-sided, we expect gross flows to be smaller 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 value of the index would be zero. To illustrate, the United Kingdom has an average openness index score of 90 over the period 1980 to 2005, the highest for any economy in our sample reflecting London's role as a global financial centre, while Thailand has an average score of only 8, the lowest average score of the countries sampled (see also Appendix C). In the panel analysis, the *FlowOpenness* variable is included contemporaneously and with a lag.

The second variable intended to capture any substitutability effect is a measure of the degree of domestic financial market development. This is likely to be an important determinant of the ability of investors to substitute between different forms of finance. We use the ratio of equity-market turnover to market capitalisation as a proxy for financial market development (*MarketDevelopment*).

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

In summary, the regression we estimate is of the form:

$$\begin{aligned}\sigma\left(\frac{KAB_{it}}{GDP_{it}}\right) = \; & \eta_i + \beta_1 FDIshare_{it} + \beta_2 BMMshare_{it} + \beta_3 FlowOpenness_{it} \\ & + \beta_4 FlowOpenness_{it-1} + \beta_5 MarketDevelopment_{it} \\ & + \beta_6 FXregime_{it} + \varepsilon_{it}\end{aligned} \tag{2}$$

where: $\sigma\left(\frac{KAB_{it}}{GDP_{it}}\right)$ represents the volatility of the capital account as a ratio to GDP for country i in year t; η_i is the fixed effect for country i; and ε_{it} is the error term.

We use a balanced panel of annual data for our 12 countries over the period 1991 to 2005.[13]

4.2 Regression Results

The results in Table 3 suggest that the composition of the capital account is not a significant determinant of its volatility – there is no statistically significant relationship between the share of foreign direct investment or bank and money market flows and the volatility of the total capital account. The coefficients on market development and financial openness (lagged) are negative and statistically significant (at the 5 and 10 per cent levels, respectively). This is tentative evidence in support of the idea that more developed financial markets might encourage greater substitutability between different types of flows, thereby helping to reduce the volatility of the overall capital account.

Table 3: Panel Data Estimation Results
Dependent variable is the volatility of the capital account to GDP

	Coefficient value	P-value
Constant	1.97	0.00
$FDIshare_{it}$	–1.07	0.24
$BMMshare_{it}$	–0.20	0.75
$FlowOpenness_{it}$	-1.4×10^{-3}	0.33
$FlowOpenness_{it-1}$	-3.5×10^{-3}	0.06
$MarketDevelopment_{it}$	–0.46	0.04
FXregime	0.15	0.44
R^2	0.64	
Number of observations	180	
Wooldridge test for autocorrelation	0.00	

13 There may be an issue of endogeneity, whereby some of the right-hand-side variables are influenced by the same shocks that affect the overall volatility of the capital account. We leave this issue for future research and note for now that the results here need to be interpreted with this caveat in mind.

The coefficient on the exchange rate regime dummy was found to be statistically insignificant. However, care should also be taken when interpreting this result. In particular, we caution against interpreting this as evidence that fixing the exchange rate will not affect capital account volatility. Given that the capital account, current account and the exchange rate are jointly determined, it seems probable that fixing one of these variables would have some effect on the others. Indeed, when we run the above regression using a sub-sample of just the industrialised countries, the coefficient on the exchange rate variable is positive and statistically significant.

5. Conclusion

Capital has become increasingly mobile as global financial integration has accelerated. Interestingly, while industrialised economies have experienced increased volatility in different types of capital flows as financial globalisation progressed, there is no evidence to suggest that the capital account has become more volatile overall.

It appears that capital flows exhibit few regular and systematic relationships and there is little evidence across our sample of countries to suggest that some flows are inherently more conducive to overall stability than others. Hence, the overall stability of the capital account among industrialised economies does not appear to be due to the inherent properties of different types of capital flows and the mix of capital flows underpinning the capital account of these countries. There is tentative evidence that these countries meet certain preconditions that allow them to integrate into global markets more smoothly.[14]

14 Refer also to Broner and Rigobon (2006), Daude and Fratzscher (2008), Grenville (1998) and Nakagawa and Psalida (2007).

Appendix A: Predictability of Capital Flows

In this Appendix we employ some simple econometric techniques to check the robustness of the findings discussed in the main part of the paper.

A.1 Forecasting

One way of ascertaining whether knowledge of a particular flow conveys information useful in making inferences about the overall capital account is to test how well it can explain contemporaneous capital account developments. In particular, we test whether the fit of a naïve first-order autoregressive (AR(1)) model of the capital account can be improved upon by including information about specific components of the capital account by estimating the equation

$$kabr_t = \alpha_0 + \alpha_1 kabr_{t-1} + \alpha_2 flowr_t^i + \varepsilon_t \qquad \text{(A1)}$$

where $kabr_t$ is the capital account in ratio to GDP in the current period, $flowr_t^i$ is the contemporaneous value of the *i*th capital flow as a ratio to GDP, and ε_t is the error term. We run this regression for the baseline AR(1) model, and for each of the five key components of the capital account.

Table A1 reports the main results of these regressions for industrialised and emerging economies. The Root Mean Squared Error (RMSE) serves as a measure of the fit for each model. Results are reported in terms of the ratio of the RMSE of the *i*th model as a ratio to the RMSE of the naïve baseline AR(1) model. A value of 1 signifies no improvement over the naïve model. A value greater than 1 signals deterioration in the ability to predict the capital account, while a value less than 1 implies an improvement (adjusted for degrees of freedom). In the interest of brevity we do not report the ratio for every flow and every country. Instead we distinguish between industrialised and emerging economies and average the ratios across the six countries in each sample. The second column lists the countries for which we find a statistically significant coefficient on the variable of interest.

Table A1: Ability to Predict the Capital Account
Sample 1980–2005, quarterly

Model	$RMSE_i/RMSE_{Naïve}$	Countries for which p-value indicates significance at 5 per cent level
Industrialised economies		
Foreign direct	0.999	–
Portfolio equity	0.991	Japan, UK
Portfolio debt	0.991	Japan
Banks & money markets	0.992	Germany, Sweden
Reserves	0.994	Australia
Emerging economies		
Foreign direct	1.001	–
Portfolio equity	1.004	–
Portfolio debt	0.990	Mexico
Banks & money markets	0.922	Korea, Thailand, Mexico, Argentina
Reserves	0.990	Brazil, Mexico

Notes: Simple average of results for industrialised and emerging economies. Due to data availability, regressions for Korea, Mexico, Argentina and the Philippines are calculated on samples starting in 1988:Q1, 1989:Q1, 1992:Q1 and 1996:Q1. All samples end in 2005:Q4.

As expected, all industrialised and emerging economies have highly significant coefficients on the lag of the capital account in the naïve model. However, for emerging economies the average RMSE for the naïve model is more than twice as large as that for industrialised countries (not shown). Introducing information on a particular type of flow generally adds less than 2 percentage points of explanatory power to the model (adjusted for degrees of freedom) for industrialised economies, and less than 2½ percentage points for emerging economies (excluding the bank and money market flows), and in many cases there is an outright deterioration in explanatory power.

For industrialised economies, individual flows do not consistently add significant explanatory power over and above the naïve AR(1) benchmark. Portfolio equity flows are statistically significant for Japan and the United Kingdom, but not for other industrialised economies. Portfolio debt flows are only significant for Japan, and bank and money market flows only for Germany and Sweden, and in all of these cases the fit is only marginally improved. Information on reserve flows

markedly improves the fit for Australia, but not for any other industrialised economies.

Emerging economies on the other hand appear to exhibit a more robust relationship between bank and money market flows and the capital account, perhaps reflecting a degree of bank dependence, as discussed earlier. Bank and money market flows improve the fit over the naïve model for Korea, Thailand, Mexico and Argentina. However, for the Philippines and Brazil the coefficient on bank and money market flows is not statistically significant. Other types of capital also fail to consistently improve the fit of the model. In summary, these results suggest that adding information about any particular flow is not particularly useful when trying to understand and predict capital account developments.

A.2 Offsetting versus Compounding Relationships

An additional way to gauge the substitutability of particular flows within the capital account is to examine whether a flow tends to move in the same direction as the rest of the capital account – compounding the movement of the other flows – or if it exhibits an offsetting relationship. To capture these relationships, we regress each flow on the sum of the remaining flows within the capital account as follows

$$flowr_t^i = a_1 + a_2 \sum_{j \neq i} flowr_t^j + \varepsilon_t \qquad \text{(A2)}$$

where: $flowr_t^i$ is the local currency value of the *i*th capital flow as a ratio to GDP in the current period; $flowr_t^j$ is the *j*th capital flow as a ratio to GDP in the current period; and ε_t is the error term.

A negative coefficient implies an offsetting relationship, while a positive coefficient indicates that the flow has a compounding effect on the rest of the capital account. For each of the industrialised economies, almost all flows are offsetting to some degree, with virtually all coefficients negative and statistically significant (Table A2). Bank and money market flows tend to have the strongest negative relationship with the rest of the capital account in industrialised economies. For the United States, reserve flows do have a positive and statistically significant relationship with the rest of the capital account. However, this

relationship is economically insignificant compared to all other relationships reported in this section.

Table A2: Offsetting versus Compounding Flows – Industrialised Economies
Slope coefficients, sample 1980–2005

Dependent variables	US	Japan	Germany	UK	Australia	Sweden
Foreign direct investment	–0.15**	–0.17**	–0.45**	–0.84**	–0.74**	–0.66**
Portfolio equity investment	–0.07*	–0.73**	–0.51**	–0.83**	–0.71**	–0.63**
Portfolio debt investment	–0.31**	–0.86**	–0.43**	–0.94**	–0.84**	–0.49**
Bank and money markets	–0.19**	–0.92**	–0.86**	–0.87**	–0.83**	–0.80**
Reserves	0.01*	–0.67**	–0.15**	–0.14**	–0.80**	–0.28**

Notes: ** and * denote significance at the 5 and 10 per cent levels respectively; quarterly observations. All samples end in 2005:Q4.

For emerging economies, almost all coefficients are also negative and statically significant. However, the offsetting relationship between particular flows and the rest of the capital account is generally less pronounced, particularly for direct investment and portfolio equity flows (Table A3). The exception is reserve flows which, on average, have a stronger offsetting relationship in the emerging economies examined than in the industries economies. Similar to the results for industrialised countries, bank and money market flows tend to have a strong negative relationship with the rest of the capital account.

Table A3: Offsetting and Compounding Flows – Emerging Economies

Slope coefficients, sample 1980–2005

Dependent variables	South Korea	Thailand	Philippines	Brazil	Mexico	Argentina
Foreign direct investment	–0.10**	–0.15**	–0.15**	–0.16**	–0.17**	–0.24**
Portfolio equity investment	–0.40**	–0.04**	–0.10**	–0.14**	0.01	–0.19**
Portfolio debt investment	–0.16**	0.07**	–0.37**	–0.59**	–0.54**	–0.38**
Bank and money markets	–0.55**	–1.07**	–0.56**	–0.71**	–0.42**	–0.69**
Reserves	–0.61**	–0.38**	–0.39**	–0.80**	–0.65**	–0.61**

Notes: ** and * denote significance at the 5 and 10 per cent levels respectively; quarterly observations. Due to data availability, regressions for Korea, Mexico, Argentina and the Philippines are calculated on samples starting in 1988:Q1, 1989:Q1, 1992:Q1 and 1996:Q1. All samples end in 2005:Q4.

As emerging economies typically have more volatile capital accounts than industrialised economies (see Section 2.1), the results of this section may indicate that the degree to which individual flows have offsetting relationships with the rest of the capital account is an important factor in determining overall volatility. In addition, our results suggest that bank and money market flows may play an important role in reducing capital account volatility as they tend to offset the combined developments in the remaining flows to a greater degree than any other type of flow.

The relatively strong offsetting relationship between bank and money market flows and the rest of the capital account may reflect the fact that banks perform an important intermediation function in both industrialised and emerging economies. They are typically also active in international debt and foreign exchange markets, not only as intermediaries, but also as an important source of arbitrage. Perhaps it is this function which allows bank and money market flows to readily adjust and offset developments in other flows.

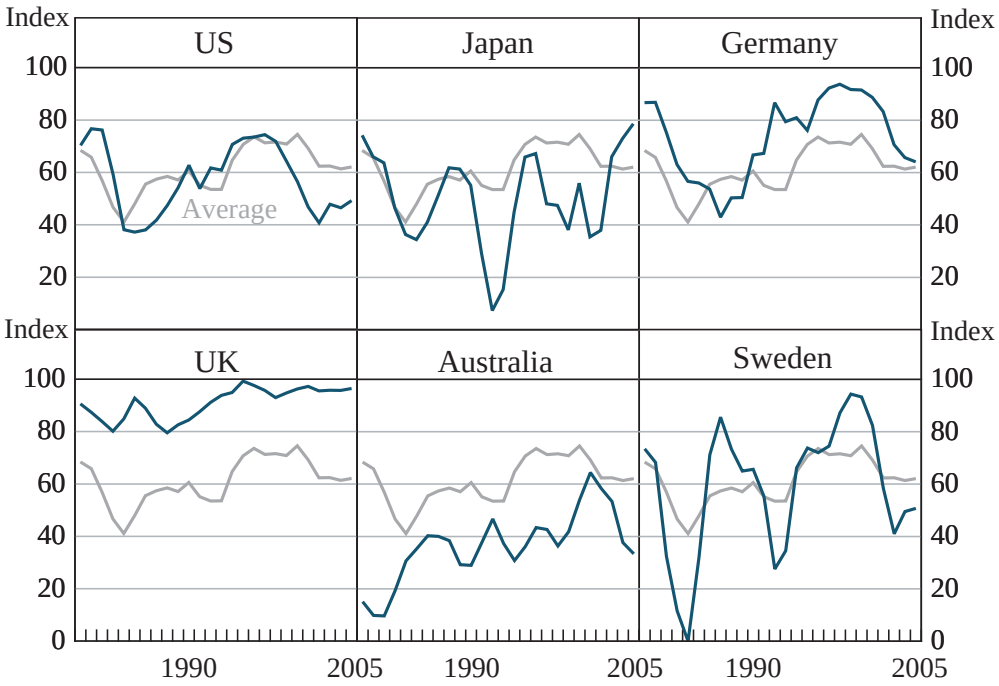
Appendix B: Data

Table B1: Data Definitions and Sources

Variable	Definition, notes and sources
Capital account (US dollars)	Set equal to the current account, consistent with the balance of payments identity. Source: International Monetary Fund's (IMF) *International Financial Statistics*
Capital flows (US dollars)	Gross and net flows. Source: IMF's *International Financial Statistics*
Capital account and capital flows (local currency)	Quarterly US-dollar-denominated capital account and capital flows data are converted into local currency terms using quarter-average exchange rates
Exchange rates	Quarter-average local currency to US dollar exchange rates. Sources: Euro/USD – Bloomberg; authors' calculations; All other exchange rates – IMF's *International Financial Statistics* (the December quarter 1985 Brazilian Real/USD exchange rate is estimated by the authors based on IMF data).
Exchange rate regime ($FXregime_{it}$)	The classification of each country's exchange rate is taken from the IMF's *Annual Report on Exchange Arrangements and Exchange Restrictions, 2006*. *De facto* exchange rate regime classifications are used.
Importance of a particular flows within the capital account (*FDIshare* and *BMMshare*)	Annual from quarterly data; sum of the absolute value of the particular flows in a given year, divided by the sum of the absolute value of all flows in that same year.
$MarketDevelopment_{it}$	Share market turnover; total value of shares traded to average real market capitalisation. Source: Beck, Demirgüç-Kunt and Levine (2000)
Nominal GDP (local currency)	Quarterly; seasonally adjusted; data for Korea, the Philippines, and Thailand are seasonally adjusted by the authors. Sources: Australia (1980–2005) – Australian Bureau of Statistics; South Korea (1980–2005), Philippines (1980–2005) and Thailand (1993–2005) – CEIC; Argentina (1993–2005), Brazil (1991–2005), Japan (1980–2005), Mexico (1980–2005), Sweden (1980–2005), United Kingdom (1980–2005) and United States (1980–2005) – Thomson Reuters; Germany (1980–2005) – Thomson Reuters and authors' calculations (data pre-1991 are spliced using West German nominal GDP growth rates); Argentina (1980–1992), Brazil (1980–1990) and Thailand (1980–1992) – IMF's *International Financial Statistics,* World Economic Outlook (WEO) database, and authors' estimates (annual US dollar current prices GDP from the WEO database is linearly interpolated to create a quarterly profile that is then converted into local currency terms using quarter-average exchange rates).

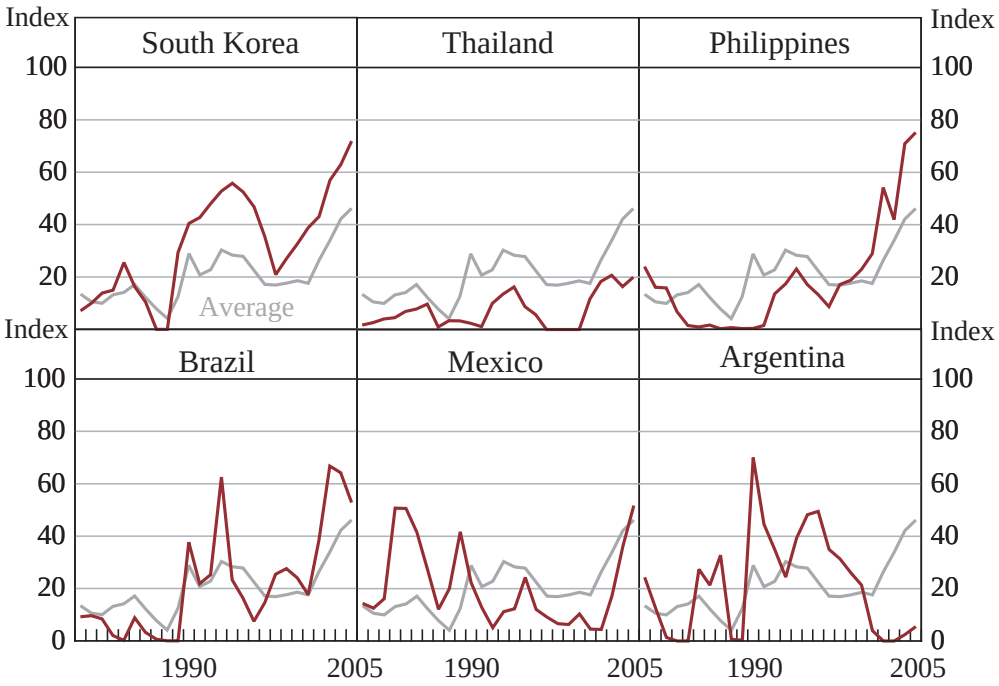
Appendix C: Gross Capital Flow Openness

Figure C1: Flow Openness
Industrialised economies



Source: authors' calculations

Figure C2: Flow Openness
Emerging economies



Source: authors' calculations

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