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Are Capital Flows Fickle? Increasingly? And Does the Answer Still Depend on Type?

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Abstract

According to conventional wisdom, capital flows are fickle. Focusing on emerging markets, this paper asks whether this conventional wisdom still holds in the contemporary world. The results show that, despite recent structural and regulatory changes, much of it survives. FDI inflows are more stable than non-FDI inflows. Within non-FDI inflows, portfolio debt and bank-intermediated flows remain the most volatile. While FDI inflows are driven mainly by pull factors, portfolio debt and equity are driven mainly by push factors; and bank-intermediated flows are driven by a combination of push and pull factors. But capital outflows from emerging markets behave differently. FDI outflows from emerging markets have grown and become significantly more volatile. There is similarly an increase in the volatility of bank-intermediated capital outflows from emerging markets. The findings underscore that outflows from emerging markets, both FDI and bank-related flows, have come to play a growing role and warrant greater attention from analysts and policy makers.

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Are Capital Flows Fickle? Increasingly? And Does the Answer Still Depend on Type?

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1. Introduction

According to conventional wisdom, capital flows are fickle (see e.g. Bluedorn, Duttagupta, Guajardo and Popalova 2013). They are fickle more or less independent of time and place. Having reached this conclusion, analysts then go on and rank different capital flows according to their volatility. Here the consensus is that FDI-related flows are least volatile, while bank-intermediated flows are most volatile. Other portfolio capital flows rank somewhere in between; within this intermediate category debt flows are generally considered to be more volatile than equity-based flows.

This conventional wisdom is a distillation of the experience of earlier decades (see Becker and Noone, 2008 for a survey of the literature in which this experience is reviewed). Yet the structure and regulation of international financial markets continue to change, especially recently. Chinese outward FDI has risen dramatically relative to other sources of FDI, for example, raising the question of whether FDI is equally stable regardless of source. South-South FDI flows have risen more generally, again raising the question of whether they behave in the same relatively stable manner as other FDI flows. Bank-intermediated flows have fallen, as large global banks have deleveraged and curtailed their cross-border operations in response to tighter regulatory oversight, although there is also the question of whether banks in emerging markets have stepped into this market space. Asian bond markets have grown relative to bond markets in other regions, pointing to the question of whether flows into and out of the bond markets of different regions are equally stable. Corporate bond markets have grown relative to sovereign bond markets. International investors have become active in equity markets worldwide.

All this raises the question of whether the conventional wisdom still holds in our contemporary world. Some authors suggest that it may not. Blanchard and Acalin (2016), for example, argue that FDI is now as volatile as portfolio capital flows.

In this paper we revisit these questions, focusing on emerging markets. We ask: how do the magnitude and volatility of various capital flows compare? How have they evolved over time? What are the observable empirical correlates of different flows?

We analyze trends in capital flows since the 1990s, including in the post-global-financial-crisis era. While a majority of previous studies have utilized annual data largely for reasons of availability and convenience, we work here with quarterly data. This allows us to analyze capital flows at business cycle frequencies and around country-specific sudden stops and global stops, events that are hard to pinpoint using annual data.

In terms of inflows into emerging markets, our results suggest that the patterns identified in earlier work persist despite recent structural and regulatory changes, and that much of the conventional wisdom survives. FDI inflows remain more stable than non-FDI inflows: FDI inflows have lower volatility; are more persistent; and decline by smaller amounts in both country-specific sudden stop and global stop episodes. Within non-FDI inflows, portfolio debt and bank-

intermediated flows remain the most volatile. Bank-intermediated flows, which rose in the mid-2000s, are especially volatile. They decline most sharply during country-specific sudden stops and global stop episodes. These results may not be surprising, but their constancy is surprising. Empirical regularities in international finance that stand the test of time are the exception, not the rule.

But outflows from emerging markets behave differently. In contrast to the findings for inflows, we document important changes since the turn of the century and in the most recent decade, in particular, in the behavior of outflows. FDI outflows from emerging markets have grown and become significantly more volatile. Similarly, there is a significant increase in the volatility of "other" (mainly bank-intermediated) capital outflows from emerging markets since the turn of the century. Those other outflows are twice as volatile again as FDI outflows, as measured by the coefficient of variation of gross flows scaled by GDP, in the most recent period, 2011-2015. In terms of shocks to the capital account of the balance of payments, our findings underscore that outflows from emerging markets, both FDI and bank-related flows, have come to play a growing role and deserve greater attention from analysts and policy makers.

2. Literature Review

The majority of previous papers in this area use annual data, as noted above, typically from 1980 through the early- to mid-2000s. Recent contributions tend to focus on gross flows rather than netting inflows and outflows. An example is Bluedorn et al (2013). Working with annual data on gross flows since 1980 for a sample of 150 advanced, emerging and developing countries, they argue that capital flows are volatile for all countries (advanced and emerging) and across all points in time. Flows exhibit low persistence regardless of country and type. Flows into emerging markets in particular rise when global financing conditions are relatively easy.

Levchenko and Mauro (2007) are another good example of the genre. Using annual data on gross flows for a panel of 142 advanced, emerging, and developing economies over the period 1970–2003, they find that FDI is the least volatile form of capital flows. Defining sudden stops as the episodes when the reversal in total financial flows is more than 5 percentage points of GDP compared with the previous year, they show that FDI remains relatively stable during sudden stops. Although portfolio equity flows seem to play a limited role in sudden stops as well, portfolio debt flows experience a reversal, although they recover relatively quickly after the sudden stop. Bank-related flows experience sharpest drops and typically remain depressed for several years.

Broner et al (2013) similarly use annual data on gross flows for 103 countries (mostly high income and middle income countries) over the period 1970–2009. They find a high correlation between inflows and outflows; both inflows and outflows decline during crises, and both are procyclical. They also note that the magnitude of both outflows and inflows has increased. They conclude that inflows and outflows have both become more volatile over the years, even as net flows and their volatility have remained broadly unchanged.

Fratscher (2012) focuses on the correlates of various types of capital flows in 50 emerging markets, and specifically on the collapse in capital flows during the 2008 global financial crisis. He finds that common shocks had a large effect on capital flows both during the crisis and in the subsequent recovery phase. However, these effects varied across countries, a pattern that he attributes to differences in the quality of domestic institutions, country risk, and the strength of domestic macroeconomic fundamentals.

Forbes and Warnock (2014) observe that investment outflows from emerging markets have become larger over time and have different dynamics than inflows (insights that we build on here). They distinguish several episodes of large increases and declines in the inflows and outflows of capital: surges, stops, retrenchments and flight, analyzing them separately. Using quarterly data from 1980-2009 for 50 developing and advanced economies, they further separate out events primarily driven by the decline in debt flows (portfolio debt and banking flows) and those driven by the decline in equity flows (FDI and portfolio equity).

The authors find that episodes dominated by equity-related flows are not associated with the standard explanatory variables (global risk and liquidity; contagion; domestic growth, etc.). In contrast, the standard measures of market risk are important for the incidence of debt-led episodes: for example, when risk aversion is high, debt-led surges are less likely and debt-led stops are more likely. Contagion at the regional level is also important in debt-led episodes. Country-specific variables are largely insignificant, with the exception of domestic growth shocks: debt-led stops are more likely in countries experiencing negative growth shocks, and debt-led surges are more likely in countries with positive growth shocks.

A few studies focus on particular types of capital flows, FDI flows for example. Lipsey (2001) points to the fact that in some prominent financial and exchange rate crises in the past – the Latin American crisis in 1982, the Mexican crisis in 1994, the East Asian crisis in 1997 – FDI inflows were more stable than portfolio or other capital inflows. Aguiar, and Gopinath (2005) similarly note the stability of FDI flows during the Asian crisis, which they attribute to the acquisition by foreign investors of domestic firms which faced liquidity pressures.

Milesi-Ferretti and Tille (2011) analyze gross capital inflows around the 2008 global financial crisis. They find that capital flows differed across countries and types of flows; that bank flows were hit the hardest; that emerging economies experienced a shorter-lived retrenchment than developed economies; and that the magnitude of decline in capital inflows across countries was linked to the extent of international financial integration.

A recent study by Blanchard and Acalin (2016) is something of an outlier. It observes that FDI inflows and outflows are highly correlated and that FDI inflows to emerging-market economies are positively correlated with the US policy rate. They interpret this as implying that true FDI flows to emerging markets are in fact smaller than measured flows; perhaps because part of recorded FDI flows in fact transit through the country due in part to tax arbitrage. They consider several alternative hypotheses such as (i) common trend in inflows and outflows, (ii) seasonality, (iii)

outward FDI flows due to hedging, and (iv) market clearing/exchange rate effect—more inflows appreciate the exchange rate which encourage outward FDI. In the end they conclude that these do not fully explain the high correlation between inflows and outflows of FDI or the strong correlation between FDI inflows and the US policy rate. They instead find the correlation between inflows and outflows to be negatively correlated to the corporate tax rate and positively to capital controls.

3. Data

We use quarterly data from the IMF's Balance of Payments Statistics between 1990 Q1 and 2015 Q4 for 34 emerging countries.[2] The data are patchy for the earlier years; coverage improves over time, yielding an unbalanced panel. The capital flow data are in US dollars. We scale them by annual trend GDP for the purposes of analysis.

We analyze inflows and outflows separately. Data are available separately for FDI- and non-FDI flows. The latter are further decomposed into portfolio flows (and into portfolio equity and portfolio debt), versus what are labelled "other" flows. The "other" category includes flows through the banking sector (loans, deposits and banking capital), loans raised by the private sector, trade credits, official government flows, and other smaller residual components. We exclude flows to the general government and monetary authorities, retaining only private flows. The largest share of (private) other flows are made up of flows through the banking sector. Hence some researchers simply refer to them as "bank flows."[3] We represent this taxonomy in a tree diagram in the Appendix.

4. Magnitude, Persistence, and Volatility of Capital Flows

Figures 1-4 and Table 1 show that the average FDI and non-FDI inflows are roughly equal in magnitude. Median average annual flows are 2.6 percent and 2.4 percent of GDP annually.[4] Within non-FDI flows, other (bank) flows are the largest, followed by portfolio debt. Portfolio equity flows remain relatively small, averaging 0.2 percent of GDP over the entire period and just 0.16 percent a year in the last five years. Outflows are smaller than inflows on average (these being emerging markets). Figure 2, as we read it, suggests that this figure confirms that the relative magnitude of other flows has declined and that portfolio debt has increased since the Global Financial Crisis.

We measure volatility by the standard deviation and coefficient of variation. By these measures, non-FDI flows are relatively volatile. Portfolio debt flows and banking flows are among the most volatile. Non-FDI flows are more volatile than FDI flows and less persistent.

[2] The same set of countries is included in Eichengreen and Gupta (2016).

[3] See Bluedron et al (2013) e.g.

[4] These are unweighted averages for the 34 sample countries.

Figure 1: FDI and non-FDI Capital Inflows

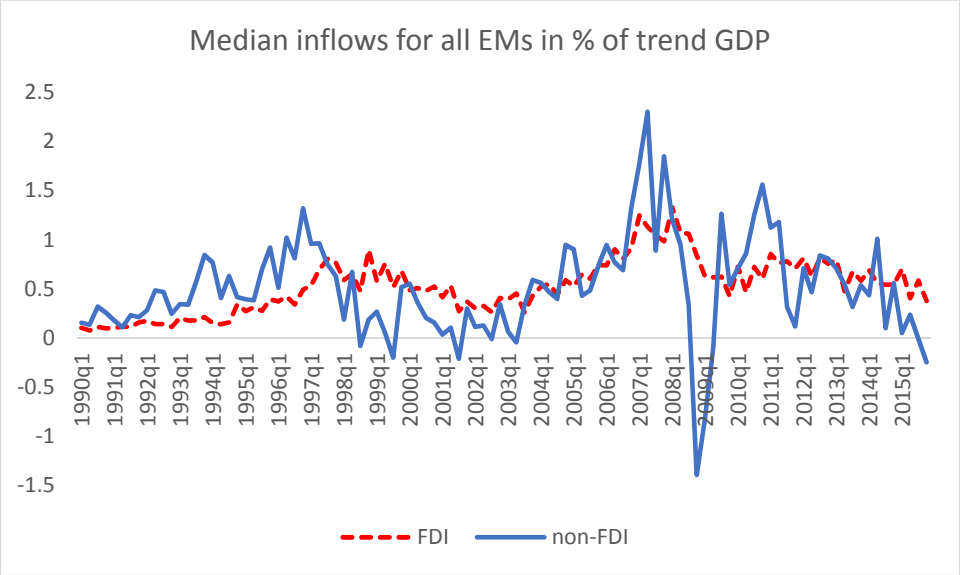


Figure 2: Components of non-FDI Capital Inflows

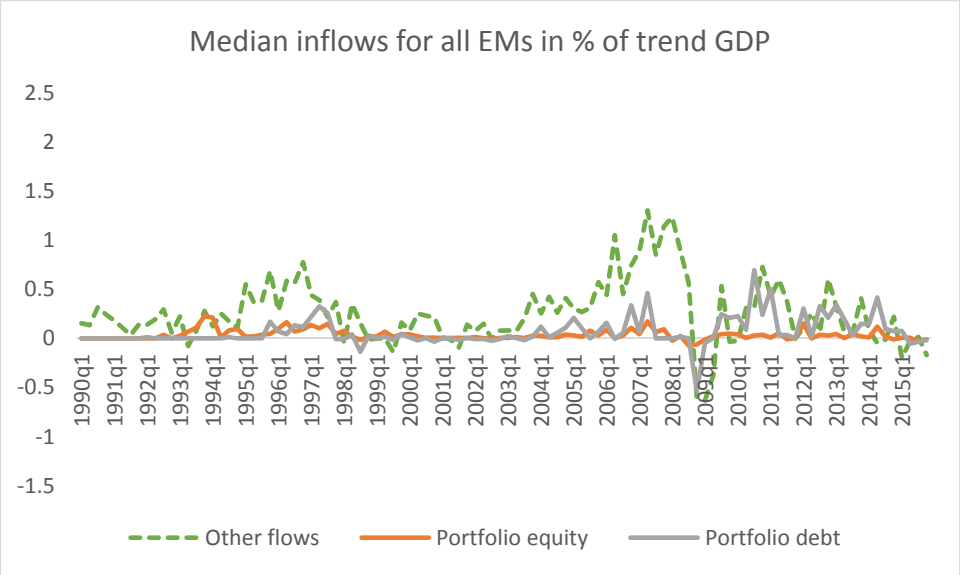


Figure 3: FDI and non-FDI Capital Outflows

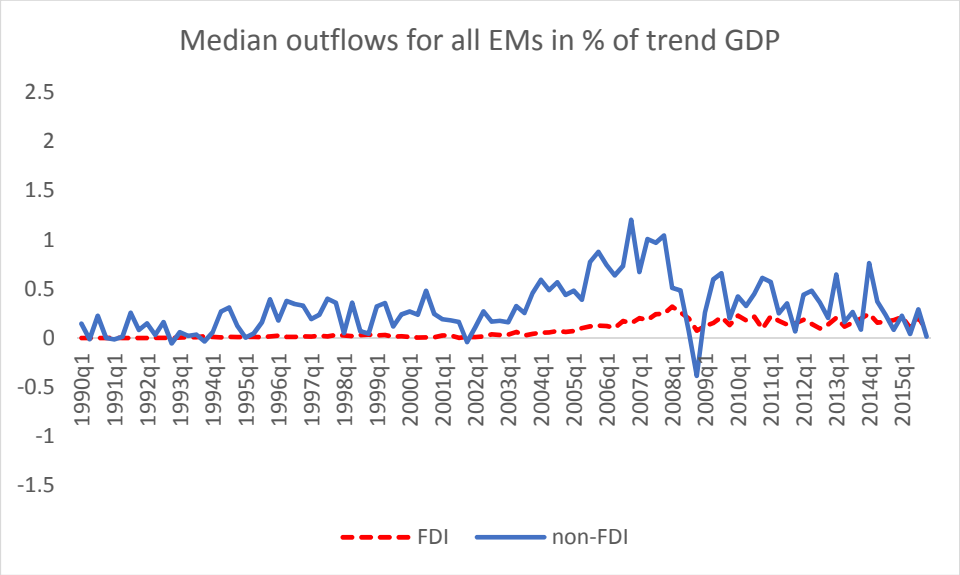
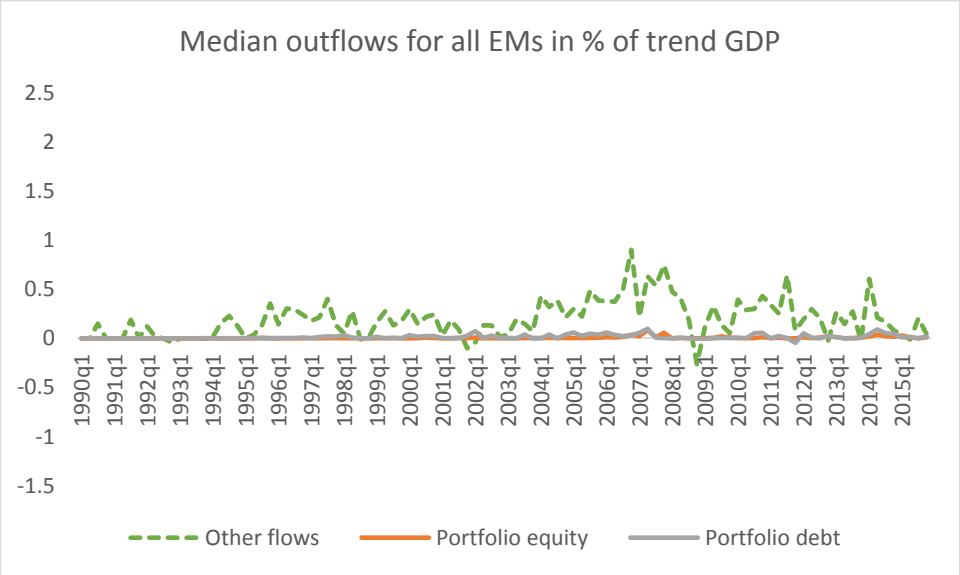


Figure 4: Components of non-FDI Capital Outflows



In Table 2 we compare consecutive five year periods. Portfolio debt inflows increased in 2006-10 and again in 2011-15. Less widely appreciated, FDI outflows from emerging markets rose strongly in 2006-10. Other flows also increased in 2006-10.

We are interested in whether the volatility of flows, as measured by the coefficient of variation (adjusting the standard deviation by their mean in the same period) has risen significantly. In Tables 3 and 4 we therefore regress the coefficients of variation for a pooled sample of 5 year

periods on dummy variables for those five year periods. We include a constant term, exclude the first five year period and add country fixed effects.

Table 1: Magnitude, Volatility and Persistence of Capital Inflows and Outflows

		Median Quarterly Average	Median Standard Deviation	Median Coefficient of Variation	Persistence
FDI	inflows	0.65	0.63	0.96	0.53
	outflows	0.14	0.28	1.64	0.26
non-FDI	inflows	0.61	1.31	2.12	0.40
	outflows	0.32	0.94	1.93	0.21
Portfolio Equity	inflows	0.05	0.22	3.15	0.31
	outflows	0.02	0.08	3.01	0.3
Portfolio Debt	inflows	0.24	0.60	3.17	0.14
	outflows	0.06	0.22	3.13	0.13
Other flows	inflows	0.32	1.08	2.90	0.43
	outflows	0.20	0.81	3.34	0.18

Notes: Mean, standard deviation and coefficient of variation are the median across all countries in the sample. Coefficient of variation is the standard deviation divided by the mean. Persistence is the AR(1) coefficient of a fixed-effects panel regression for respective capital flows. Non-FDI flows are the sum of portfolio equity, portfolio debt and private other flows. Data are quarterly from 1990 Q1 to 2015 Q4. All capital flows are expressed as % of annual trend GDP.

The results indicate few changes on the inflow side. Portfolio debt inflows are significantly higher in 2006-2010 than in 1990-1995, but there are no other changes. This is evidence of stability in the volatility of inflows over time.

In contrast, there are significant increases in the volatility of FDI outflows from emerging markets in 2001-10 and again in 2011-15. In addition, we see significant increases in the volatility of "other" (bank-related) outflows after the turn of the century. We obtain the same results at even higher levels of precision (significance) when we regress the coefficients of variation on time trends (t=1 in 1990-95, t=2 in 1996-2000 etc.).

This is a striking answer to our question about trends in volatility trends. Capital inflows into emerging markets are volatile but not increasingly so. What is new is the growing volatility of outflows from emerging markets, bank-related outflows after the turn of the century and FDI outflows after 2005 and especially after 2010. That FDI outflows are a growing source of capital account volatility in emerging markets is not adequately appreciated in the literature, in our view.

Which countries are mainly responsible for this increase in the level and volatility of FDI outflows from emerging markets? Some readers will suspect that China is driving the results. But recall that all such flows in our analysis are scaled by country-specific trend GDP. The countries with the highest share of outward FDI in GDP in the most recent five year period are Chile, Malaysia, Hungary and the Russian Federation – not China. In 2015 the countries with the largest

such ratio were Chile, Israel, Malaysia and Thailand. China figures, on the other hand, when one focuses instead on the growth of the FDI/GDP ratio. The countries with the largest annual increase in FDI outflows relative to GDP in 2011-2015, in declining order, were Hungary, South Africa, Chile and China. The countries with the largest annual increase in 2014-2015 so measured, again in descending order, are Hungary, Chile, Israel, Poland and China.[5]

Table 2: Trends in the Magnitude and Volatility of Capital Inflows and Outflows

			1991-1995	1996-2000	2001-2005	2006-2010	2011-2015
FDI	inflows	Mean (quarterly average)	0.23	0.76	0.55	0.92	0.69
		Standard deviation	0.15	0.50	0.38	0.59	0.41
		Coeff. of variation	0.61	0.71	0.70	0.57	0.56
FDI	outflows	Mean (quarterly average)	0.01	0.04	0.07	0.29	0.20
		Standard deviation	0.02	0.07	0.14	0.30	0.26
		Coeff. of variation	0.93	1.25	1.49	1.11	1.17
Portfolio Equity	inflows	Mean (quarterly average)	0.06	0.05	0.03	0.05	0.04
		Standard deviation	0.10	0.12	0.09	0.21	0.14
		Coeff. of variation	1.35	1.56	2.21	1.99	2.79
Portfolio Equity	outflows	Mean (quarterly average)	0.00	0.00	0.01	0.04	0.01
		Standard deviation	0.00	0.02	0.04	0.12	0.03
		Coeff. of variation	1.91	2.44	2.19	1.80	1.68
Portfolio Debt	inflows	Mean (quarterly average)	0.03	0.11	0.10	0.20	0.38
		Standard deviation	0.23	0.39	0.40	0.63	0.63
		Coeff. of variation	1.52	1.72	1.58	2.64	1.97
Portfolio Debt	outflows	Mean (quarterly average)	0.01	0.03	0.04	0.05	0.02
		Standard deviation	0.07	0.09	0.14	0.24	0.17
		Coeff. of variation	1.95	2.08	1.85	2.38	1.44
Other flows	inflows	Mean (quarterly average)	0.22	0.32	0.20	0.56	0.17
		Standard deviation	0.97	0.79	0.59	1.09	0.67
		Coeff. of variation	1.26	1.41	0.92	1.65	1.30
Other flows	outflows	Mean (quarterly average)	0.10	0.24	0.17	0.31	0.19
		Standard deviation	0.65	0.66	0.63	1.08	0.66
		Coeff. of variation	1.64	1.56	2.11	2.42	2.29

Notes: Mean, standard deviation and coefficient of variation are the median across all countries in the sample during respective time period. Coefficient of variation is standard deviation divided by mean. Data are quarterly from 1990 Q1 to 2015 Q4. All capital flows are expressed as % of annual trend GDP.

[5] Note in addition that China is not included in most of our analysis because data on the composition of capital flows is incomplete.

Table 3: Coefficient of Variation of capital inflows

	FDI	Portfolio Equity	Portfolio Debt	Other flows
1996-2000	0.119	-0.186	0.704	0.126
	[0.83]	[0.31]	[0.93]	[0.14]
2001-2005	0.101	0.862	-0.908	-0.520
	[0.52]	[1.30]	[0.80]	[0.61]
2006-2010	-0.012	0.591	**1.336*,^^**	0.255
	[0.10]	[0.82]	**[1.76]**	[0.31]
2011-2015	0.068	0.428	1.096	-0.155
	[0.46]	[0.54]	[1.29]	[0.14]
Country fixed-effects	Yes	Yes	Yes	Yes
Observations	165	140	142	147
R-squared	0.008	0.019	0.077	0.012
# of countries	34	33	34	34

Notes: The dependent variable is the coefficient of variation of capital flows of type i in country c in period p. Five separate 5-year periods are considered: 1991-1995, 1996-2000, 2001-2005, 2006-2010 and 2011-2015. The coefficients of variation are regressed on time dummies indicating the different periods, where the first period (1991-1995) is excluded. The interpretation of the coefficient is thus in relation to this first period. We exclude observations where the coefficient of variation exceeds a value of + 10 or is below - 10. Robust t-statistics are displayed in brackets. ***, **, * indicate significance at the 1%, 5% and 10% level. Additionally, tests are conducted for whether the coefficients are significantly different from the previous period. ^, ^^, ^^^ indicate significant differences at the 1%, 5% and 10% level.

Readers may also worry that the increase in the volatility of capital outflows from emerging markets (both FDI and bank-related outflows) is driven by a few outliers, where the average outflow is small so that a limited increase in the variance can produce a large increase in the coefficient of variation. We therefore made the same statistical comparisons dropping the top and bottom 2 percent of the observations. Reassuringly, the broad patterns remained the same.

Table 4: Coefficient of Variation of Capital Outflows

	FDI	Portfolio Equity	Portfolio Debt	Other flows
1996-2000	0.285	0.475	-0.666	0.699
	[0.46]	[0.42]	[0.84]	[1.23]
2001-2005	0.931**	0.358	-1.219	1.427*
	[2.43]	[0.50]	[1.31]	[1.97]
2006-2010	0.542*	-0.164	-0.667	1.589**
	[1.86]	[0.20]	[0.53]	[2.29]
2011-2015	**1.49***, ^^	-0.136	-1.054	0.598
	[2.96]	[0.14]	[0.85]	[0.77]
Country fixed-effects	Yes	Yes	Yes	Yes
Observations	157	132	132	133
# of countries	34	32	32	34
R-squared	0.072	0.010	0.011	0.089

Notes: The dependent variable is the coefficient of variation of capital flows of type i in country c in period p. Five separate 5-year periods are considered: 1991-1995, 1996-2000, 2001-2005, 2006-2010 and 2011-2015. The coefficients of variation are regressed on time dummies indicating the different periods, where the first period (1991-1995) is excluded. The interpretation of the coefficient is thus in relation to this first period. We exclude observations where the coefficient of variation exceeds value of + 10 or is below - 10. Robust t-statistics are displayed in brackets. ***, **, * indicate significance at the 1%, 5% and 10% level. Additionally, tests are conducted for whether the coefficients are significantly different from the previous period. ^, ^^, ^^^ indicate significant differences at the 1%, 5% and 10% level.

5. Capital Flows in Sudden Stops and Capital Flight Episodes

Following Eichengreen and Gupta (2016), we classify an episode as a sudden stop when total capital inflows (FDI, portfolio equity and debt, and other inflows by nonresidents) decline below the average in the previous 20 quarters by at least one standard deviation, when the decline lasts for more than one quarter, and when flows are two standard deviations below their prior average in at least one quarter.[6] The sudden-stop episode then ends when flows recover to at least the prior mean minus one standard deviation. Analogously, we define an episode of capital flight as a sharp increase in gross outflows by residents. Specifically, a period qualifies when total capital outflows (FDI, portfolio equity and debt, and other outflows by residents) exceed the average in the previous 20 quarters by at least one standard deviation, when the increase lasts for more than one quarter, and when outflows are two standard deviations above their prior average in at least in one quarter. Capital flight episodes then end when capital outflows decline below the prior mean plus one standard deviation.

[6] One difference is that here we define sudden stops in terms of the behavior of total capital flows--FDI and non-FDI alike – whereas in Eichengreen and Gupta (2016) we defined sudden stops in terms of the behavior of non-FDI flows only.

We summarize the behavior of capital flows around country-specific stops and flights by estimating the panel regression,

$$Y_{ict} = \beta SS_{ct} + \theta_c + t_{ct} + \varepsilon_{ict} \qquad (1)$$

where *i* refers to specific capital flows, c to the country and t to quarter-year: We regress capital flows of type *i*, denoted Y_{ict}, on a dummy variable for the country-specific sudden stop (or flight), SS_{ct}, country-fixed effects, θ_c, and country-specific time trends, t_{ct}. For ease of comparison, we normalize Y_{ict} by subtracting from each observation its country specific mean and dividing it by the country-specific standard deviation.

We see in Table 5 that portfolio equity, portfolio debt and other inflows all turn negative during sudden stops. The decline in inflows is sharpest for other flows and smallest for FDI. In addition, portfolio equity and debt outflows and especially other outflows drop significantly below their average in sudden stops (Table 6). This suggests that resident flows are stabilizing. However, looking at the scale of outflows in Figure 2 and 3, it is evident that the decline in outflows during sudden stops is smaller than the decline in inflows. So even if the decline in outflows by residents partially offsets the decline in inflows by non-residents, this stabilizing impact is only partial, and net inflows still decline.

Finally, during periods of capital flight all categories of capital outflow increase (Table 7). The increase is again largest for other flows, followed by debt outflows. It is smallest for FDI.

Table 5: Capital Inflows in Sudden Stops

	FDI	Portfolio Equity	Portfolio Debt	Other flows
$Stop_{ct}$	-0.346**	-0.735***	-1.064***	-1.540***
	[2.37]	[3.33]	[7.22]	[9.40]
Country fixed-effects	Yes	Yes	Yes	Yes
Country specific trends	Yes	Yes	Yes	Yes
Observations	2,401	2,373	2,401	2,401
# of countries	34	33	34	34
R-squared	0.098	0.053	0.077	0.128

Notes: The dependent variables are capital flows of the respective type as a percentage of trend GDP. They are standardized by subtracting the country-specific mean and dividing by the country-specific standard deviation. The sample spans from 1990:Q1 to 2015:Q4. Robust t-statistics are reported in brackets. ***, **, * indicate significance at the 1%, 5% and 10% level.

Table 6: Capital Outflows in Sudden Stops

	FDI	Portfolio Equity	Portfolio Debt	Other flows
$Stop_{ct}$	-0.165	-0.328***	-0.334*	-0.353**
	[1.07]	[2.90]	[1.81]	[2.70]
Country fixed-effects	Yes	Yes	Yes	Yes
Country specific trends	Yes	Yes	Yes	Yes
Observations	2,397	2,120	2,280	2,398
# of countries	34	32	32	34
R-squared	0.143	0.062	0.032	0.045

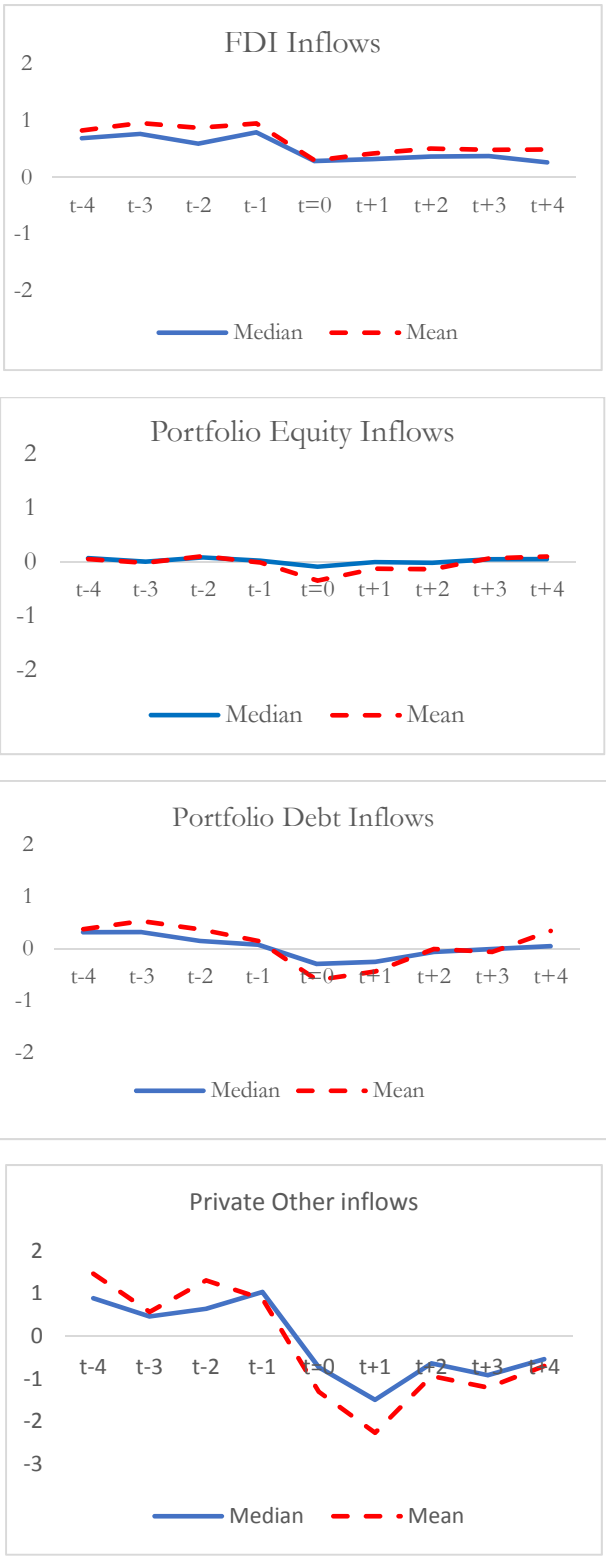
Notes: The dependent variables are capital flows of the respective type as a percentage of trend GDP. They are standardized by subtracting the country-specific mean and dividing by the country-specific standard deviation. The sample spans from 1990:Q1 to 2015:Q4. Robust t-statistics are reported in brackets. ***, **, * indicate significance at the 1%, 5% and 10% level.

Table 7: Capital Outflows in Capital Flight Episodes

	FDI	Portfolio Equity	Portfolio Debt	Other flows
$Flight_{ct}$	0.488***	0.627***	0.528***	1.043***
	[3.48]	[4.36]	[5.70]	[9.83]
Country fixed-effects	Yes	Yes	Yes	Yes
Country specific trends	Yes	Yes	Yes	Yes
Observations	2,040	1,920	2,036	2,040
# of countries	33	31	32	33
R-squared	0.150	0.085	0.050	0.104

Notes: The dependent variables are capital flows of the respective type as a percentage of trend GDP. They are standardized by subtracting the country-specific mean and dividing by the country-specific standard deviation. The sample spans from 1990:Q1 to 2015:Q4. Robust t-statistics are reported in brackets. ***, **, * indicate significance at the 1%, 5% and 10% level.

Figure 5: Capital Inflows around Country Specific Sudden Stops



Notes: This figure shows behavior of respective types of capital inflows, as % of trend GDP, around stop periods. t=0 is the first quarter of a stop period. For each period (t-4 to t+4) first the mean is calculated for different sudden stops for a given country. Solid line is the median of the country means, and broken line is the mean of the country means.

The panels of Figure 5 document these points further. They show that while FDI inflows decline, that decline is small relative to other types of flows, and FDI inflows remain positive during sudden stops. In contrast, average portfolio equity and debt inflows turn negative in sudden stop periods. Although the drop at t=0 is sharp, inflows recover and are back to pre-crisis levels within four quarters of the start of the episode. Other flows also turn negative at t=0, and in addition recover very slowly, much more slowly than in the case of portfolio equity and debt flows. Other flows still remain negative four quarters after the beginning of the sudden stop episode.

These patterns are summarized in panel regressions:

$$Y_{ict} = \sum_{j=-4}^{j=4} \beta_j \, SS_{ct+j} + \theta_c + t_{ct} + \varepsilon_{ict} \qquad (2)$$

where we regress capital flows (normalized by country specific mean and standard deviation) of type i, for country c in time period t, Y_{ict}, on dummy variables for different quarters before, during and after country-specific sudden stops, on country-fixed effects, θ_c, and on country-specific time trends, t_{ct}.

The estimated coefficients indicate that all types of inflows drop significantly at the start of a sudden stop period. The coefficient is largest for other inflows and portfolio debt inflows. The impact lasts longer for portfolio debt flows and other flows, with the coefficient remaining significantly negative for 3 and 4 quarters, respectively, after the start of the sudden stop episode. These results, and the sharp drop in other flows in particular, are consistent with what Levchenko and Mauro (2007) found in their earlier study.

Table 8: Capital Inflows during Sudden Stops

	FDI	Portfolio Equity	Portfolio Debt	Other flows
Stop -4	0.226	0.190	0.396*	0.426**
	[1.22]	[0.60]	[1.99]	[2.62]
Stop -3	0.465*	-0.396*	0.444*	0.243
	[1.86]	[-1.90]	[1.90]	[1.40]
Stop -2	0.331	0.131	0.081	0.358
	[1.59]	[0.67]	[0.42]	[1.68]
Stop -1	0.332	-0.437*	0.021	0.264
	[1.46]	[-1.73]	[0.10]	[1.08]
Stop	-0.381*	-1.336***	-1.089***	-1.102***
	[-2.01]	[-3.93]	[-4.98]	[-3.98]
Stop +1	-0.255	-0.741**	-1.065***	-2.029***
	[-1.49]	[-2.64]	[-5.06]	[-6.77]
Stop +2	-0.039	-0.581***	-0.404*	-1.179***
	[-0.13]	[-2.82]	[-2.03]	[-5.70]
Stop +3	-0.140	-0.198	-0.464***	-1.410***
	[-1.04]	[-1.57]	[-3.38]	[-5.28]
Stop +4	-0.176	0.070	-0.074	-0.860***
	[-0.92]	[0.61]	[-0.38]	[-3.31]
Country fixed-effects	Yes	Yes	Yes	Yes
Country specific trend	Yes	Yes	Yes	Yes
Observations	2,401	2,373	2,401	2,401
# of countries	34	33	34	34
R-squared	0.103	0.068	0.073	0.152

Notes: The dependent variables are capital inflows of the respective type as % of trend GDP. Variables are standardized by subtracting the country-specific mean and dividing by the country-specific standard deviation. Capital flows are regressed on country-specific sudden stops and dummies indicating 1-4 quarters before, the quarter when the sudden stop starts, and 1-4 quarters after the start of a sudden stop period. The sample spans from 1990:Q1 to 2015:Q4. Robust t-statistics are reported in brackets. ***, **, * indicate significance at the 1%, 5% and 10% level.

6. Capital Flows during Global Stops

We define a global stop as a period when three conditions are met: median capital inflows decline by at least one standard deviation below their mean in the preceding twenty quarters; the drop lasts for at least two quarters; and the drop exceeds the mean by two standard deviation in at least one quarter.[7] The global stop ends when capital inflows are no longer at least one standard deviation below their earlier mean. This approach identifies 1998:Q3 -1998:Q4 and 2008:Q4-2009:Q1 as global stop periods.

We again estimate a panel regression of the form:

[7] Median capital inflows are calculated as the sum of FDI, portfolio equity, portfolio debt, and other flows as a percentage of trend GDP.

$$Y_{ict} = \beta GS_t + \theta_c + t_{ct} + \varepsilon_{ict} \qquad (3)$$

where i refers to specific capital flows, c to the country and t to quarter-year. We regress Y_{ict}, capital flows of type i (normalized by subtracting from each observation its country specific mean and dividing it by the country specific standard deviation) on a dummy for the global stop, country-fixed effects, θ_c, and country-specific time trends, t_{ct}.

Table 9: Capital Inflows around Global Stops

	FDI	Portfolio Equity	Portfolio Debt	Other flows
$Global\ Stop_t$	0.262**	-0.536***	-0.712***	-0.761***
	[2.35]	[-4.59]	[-7.65]	[-5.59]
Country fixed-effects	Yes	Yes	Yes	Yes
Country specific trends	Yes	Yes	Yes	Yes
Observations	3,237	2,962	3,084	3,213
# of countries	34	33	34	34
R-squared	0.11	0.05	0.07	0.07

Notes: The dependent variables are capital flows of the respective type as a percentage of trend GDP. They are standardized by subtracting the country-specific mean and dividing by the country-specific standard deviation. The sample spans from 1990:Q1 to 2015:Q4. Robust t-statistics are reported in brackets. ***, **, * indicate significance at the 1%, 5% and 10% level.

Table 10: Capital Outflows around Global Stops

	FDI	Portfolio Equity	Portfolio Debt	Other flows
$Global\ Stop_t$	0.006	-0.028	-0.342**	-0.473***
	[0.06]	[-0.24]	[-2.61]	[-4.21]
Country fixed effects	Yes	Yes	Yes	Yes
Country specific trends	Yes	Yes	Yes	Yes
Observations	3,201	2,709	2,871	3,209
# of countries	34	32	32	34
R squared	0.176	0.071	0.038	0.042

Notes: The dependent variables are capital flows of the respective type as a percentage of trend GDP. They are standardized by subtracting the country-specific mean and dividing by the country-specific standard deviation. The sample spans from 1990:Q1 to 2015:Q4. Robust t-statistics are reported in brackets. ***, **, * indicate significance at the 1%, 5% and 10% level.

Results are in Tables 9 and 10. While portfolio equity, portfolio debt and other inflows all decline in global stops, FDI inflows do not, suggesting that they are heavily influenced by other factors. Strikingly, FDI inflows behave "countercyclically," rising significantly during global stops. On the other hand, resident outflows decline around global stops only in the case of portfolio debt and other flows (the change in outward FDI and portfolio equity outflows is essentially zero). To the extent that there is stabilizing behavior during episodes of global stops, it comes through rising

inward FDI by nonresidents and declining portfolio debt and other financial outflows by residents alike.

7. Correlates of Capital Inflows

To analyze the drivers of capital flows, we estimate regressions in the form of Equation (4), where the dependent variable Y_{ict} is capital flows of type i, in country c, in quarter t. As before, flows are normalized by subtracting from each observation the country-specific mean and dividing by the country-specific standard deviation.

$$Y_{ict} = \beta_1 Fed\ Fund\ Rate_t + \beta_2 \ln(VIX_t) + \beta_3 Z_{ct-1} + \theta_c + \epsilon_{ct} \qquad (4)$$

Capital flows are regressed on global factors: the Federal Funds Rate and the VIX (converted in log scale).[8] We also include a vector of country-specific variables, Z_{ct-1}. Domestic variables include quarterly real GDP growth, capital account openness (the Chinn-Ito Index); financial sector depth (stock market capitalization or bank assets as percent of GDP); and proxies for the business environment (the ICRG rating on investment risk, which is an index ranging from 0 to 12, a score of 12 points equates to very low risk and a score of 0 points to very high risk).[9] We lag these by one quarter (or one year for the variables that are available at annual frequency).[10]

Regressions are estimated with country-fixed effects and robust standard errors. Since some of the structural variables are slow-moving, the fixed effects estimates may not be very precise, hence we also estimate the same equations excluding the fixed effects. The results turn out to be very similar, hence we do not report them in order to save space.

The first four columns of Tables 11-14 suggest that FDI is driven mainly by pull factors, but that portfolio flows seem to be driven mainly by push factors, and so-called other flows are driven both by push and pull factors.

Most inflows are not strongly correlated with the federal funds rate, with the prominent exception of portfolio debt inflows (an increase in the US policy rate predictably dampens debt flows). Higher global risk aversion as measured by VIX reduces portfolio capital inflows but not FDI inflows (the coefficient of VIX is negative and significant for all non-FDI flows and largest for portfolio debt and portfolio equity flows). FDI seems to be affected more by domestic than external factors (for example, GDP growth appears to act as a pull factor for FDI). A better investment

[8] In variations of these regressions we include 10-year US bond yield as an indicator of the US monetary policy. Results are similar to those obtained with the federal funds rate.

[9] As an alternative to GDP growth, we included one year ahead growth forecast from WEO in the regressions. Its coefficient is insignificant in all regressions.

[10] To limit multicollinearity we estimate our regressions with a parsimonious set of control variables.

climate is associated with larger FDI inflows, as we have come to expect. Growth and the investment climate do not appear to act as pull factors for portfolio flows, in contrast.

As a measure of the co-movement of capital flows across emerging countries, we include median flows to all other emerging countries or to all other emerging markets within the region.[11] Global capital flows are highly significant for all types of flows, but the effect is strongest for the specific subcategory of capital flows under consideration. Again this points to factors other than country-specific growth and the country-specific investment climate in driving capital flows. Global flows are also more influential than regional flows. Including global or regional median capital flows also reduces the impact of VIX, since all of these variables capture global risk appetite to some extent.

Finally, we ask whether the effects of these variables have changed in recent years, using 2003 as the year when the estimated relationship may have changed (consistent with Eichengreen and Gupta, 2016). For this we construct a time dummy for the post 2003 period, and interact it with the variables included in the regressions. We do not find much evidence of a change in the coefficients after 2003. Dummies for different periods, before and after 2000, 2008 and 2010 respectively, similarly do not yield significant interactions with the explanatory variables.

8. The Behavior of Outflows

We analyzed the correlates of outflows analogously. Some of the patterns for outflows are broadly similar to those for inflows. Non-FDI outflows are higher during periods of lower risk aversion. In addition, global risk aversion as measured by the VIX is also a significant determinant of FDI outflows from emerging markets (in contrast to FDI inflows to emerging markets, where the VIX was not significant as noted above). Both FDI and non-FDI outflows are strongly correlated with median global and regional outflows.

One of our key findings is that capital outflows from emerging markets, FDI and bank-related outflows in particular, have grown not just larger but also more volatile. We can use these regression results to ask which of the significant determinants of these outflows have themselves grown more volatile over time. The one determinant of outflows that is robustly significant and also becomes more variable over time is the VIX. The coefficient of variation of the VIX rises by more than half between 1990- 2000 and 2001-2010; although it comes down slightly in 2011-2015, it is still significantly higher than in the earlier 1990-2000 period. There is also an increase in the volatility of GDP growth, which translates into more volatile capital outflows, in the 2006-2010 period relative to other years, although this change is not statistically significant relative to other periods.

These results thus point to variations in global risk aversion as a factor in the growing volatility of FDI and bank-related outflows from emerging markets, although they beg the question of which those variations in global risk appetite do not have a similar effect in raising the volatility of FDI inflows into those same markets. Econometrically, the answer is that the VIX has a smaller

[11] We calculate these global or regional median flows for total capital flows, as well for the specific types of capital flows, and include them separately in the regressions. These results are available from the authors on request.

coefficient and is less significant for FDI inflows than FDI outflows. In addition, any impact of an increasingly variable VIX in amplifying the volatility of FDI inflows into emerging markets in the recent period is offset at least partially by a less volatile investment climate in emerging markets.[12] Economically, we do not have a good answer for why FDI to emerging markets is less sensitive to global risk appetite than FDI from emerging markets.

9. Conclusion

According to conventional wisdom as distilled in the literature and from past experience, capital flows are volatile. They are volatile independent of time and place. But different capital flows exhibit different degrees of volatility: FDI-related flows are least volatile, while bank-intermediated flows are most volatile. Other portfolio capital flows rank in between, and within this intermediate category debt flows are generally considered to be more volatile than equity-based flows.

In this paper we revisit this conventional wisdom, focusing on emerging markets. We ask how much of the conventional view survives recent changes in market structure and regulation. We investigate how the magnitude and volatility of various kinds of capital flows compare and how they have evolved over time. We analyze the empirical correlates of different flows.

In terms of inflows into emerging markets, our results suggest that most of the patterns identified in earlier work persist despite recent structural and regulatory changes and that much of the conventional wisdom survives. FDI inflows into emerging markets remain more stable than non-FDI inflows: FDI inflows have lower volatility; are more persistent; and decline by smaller amounts in country-specific sudden stop and global stop episodes. Within non-FDI inflows, bank-intermediated flows, which rose in the mid-2000s, are most volatile, least persistent, and decline most sharply during country-specific sudden stop and global stop episodes.

But outflows from emerging markets, which are increasingly important, behave differently. In contrast to inflows, we document important changes since the turn of the century and in the most recent decade in particular in the behavior of outflows. FDI outflows from emerging markets have grown and become significantly more volatile. Similarly, there is a significant increase in the volatility of bank-intermediated capital outflows from emerging markets since the turn of the century. In terms of shocks to the capital account of the balance of payments, our findings underscore that outflows from emerging markets, both FDI and bank-related flows, have come to play a growing role and deserve greater attention from emerging-market analysts and policy makers.

[12] Our measure of the investment climate improved sharply in some emerging markets in the 1990s while deteriorating in others, before settling down, generally at improved levels, after the turn of the century.

Table 11: Correlates of FDI Flows

	FDI Inflows				FDI Outflows			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Federal Funds Rate	0.008	0.038**	0.022	0.044	-0.090***	-0.061***	-0.080***	-0.063*
	[0.39]	[2.12]	[0.97]	[1.50]	[4.35]	[3.02]	[3.38]	[1.90]
Log(VIX)	0.020	-0.082	0.023	-0.023	-0.142	-0.215**	-0.152*	-0.155
	[0.21]	[0.88]	[0.25]	[0.23]	[1.63]	[2.58]	[1.78]	[1.61]
GDP growth	0.035***	0.025***	0.034***	0.040***	0.019***	0.012**	0.017**	0.024***
	[3.72]	[3.10]	[3.67]	[3.84]	[2.83]	[2.19]	[2.41]	[3.23]
Investment environment		0.168***				0.138***		
		[6.09]				[5.91]		
Chinn-Ito index of capital account openness			0.191***				0.115**	
			[4.52]				[2.15]	
Bank assets, % of GDP				0.023***				0.016***
				[5.02]				[3.07]
Country fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,256	2,234	2,148	2,001	2,256	2,234	2,148	2,001
R-squared	0.023	0.071	0.049	0.094	0.039	0.069	0.049	0.086
# of countries	29	29	29	29	29	29	29	29

Notes: The dependent variable is FDI inflows as % of trend GDP, in Columns 1-4 and FDI outflows as % of trend GDP in Columns 5-8. The dependent variables are standardized by subtracting the country-specific mean and dividing by the country-specific standard deviation. The sample spans from 1990:Q1 to 2015:Q4. Robust t-statistics are reported in brackets. ***, **, * indicate significance at the 1%, 5% and 10% level.

Table 12: Correlates of Portfolio Equity Flows

	Portfolio Equity Inflows				Portfolio Equity Outflows			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Federal Funds Rate	0.018	0.014	0.007	0.015	-0.007	0.011	0.003	0.011
	[1.06]	[0.69]	[0.38]	[0.71]	[0.38]	[0.58]	[0.15]	[0.41]
Log(VIX)	-0.561***	-0.562***	-0.582***	-0.614***	-0.341***	-0.412***	-0.324***	-0.301**
	[8.17]	[8.10]	[7.82]	[8.13]	[2.87]	[3.43]	[2.83]	[2.55]
GDP growth	0.006	0.007	0.006	0.004	-0.010	-0.016**	-0.013*	-0.006
	[1.23]	[1.20]	[1.16]	[0.73]	[1.46]	[2.29]	[1.93]	[0.66]
Investment environment		-0.017				0.102***		
		[0.59]				[4.16]		
Chinn-Ito index of capital account openness			-0.046				0.100**	
			[1.45]				[2.45]	
Bank assets, % of GDP				0.001				0.007*
				[0.16]				[1.76]
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,197	2,175	2,093	1,945	1,945	1,923	1,853	1,702
R-squared	0.039	0.040	0.042	0.044	0.012	0.030	0.020	0.019
# of countries	29	29	29	29	27	27	27	27

Notes: The dependent variable is portfolio equity inflows as % of trend GDP in Columns 1-4 and portfolio equity outflows as % of trend GDP in Columns 5-8. The dependent variables are standardized by subtracting the country-specific mean and dividing by the country-specific standard deviation. The sample spans from 1990:Q1 to 2015:Q4. Robust t-statistics are reported in brackets. ***, **, * indicate significance at the 1%, 5% and 10% level.

Table 13: Correlates of Portfolio Debt Flows

	Portfolio Debt Inflows				Portfolio Debt Outflows			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Federal Funds Rate	-0.062***	-0.063***	-0.071***	-0.067***	0.001	0.009	0.006	-0.001
	[3.50]	[3.40]	[3.99]	[3.63]	[0.08]	[0.76]	[0.62]	[0.09]
Log(VIX)	-0.590***	-0.584***	-0.641***	-0.664***	-0.453***	-0.483***	-0.446***	-0.441***
	[9.54]	[8.54]	[10.13]	[8.90]	[3.65]	[3.83]	[3.65]	[3.54]
GDP growth	-0.002	-0.002	-0.005	-0.001	-0.006	-0.009	-0.006	-0.010*
	[0.31]	[0.24]	[0.66]	[0.09]	[1.06]	[1.56]	[1.10]	[1.83]
Investment environment		-0.008				0.051**		
		[0.27]				[2.43]		
Chinn-Ito index of capital account openness			0.019				0.040	
			[0.69]				[1.29]	
Bank assets, % of GDP				0.002				0.000
				[0.90]				[0.01]
Country fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,173	2,151	2,069	1,921	2,055	2,033	1,957	1,807
R-squared	0.047	0.046	0.060	0.062	0.021	0.025	0.023	0.021
# of countries	29	29	29	29	28	28	28	28

Notes: The dependent variable is Portfolio debt inflows as % of trend GDP in Columns 1-4 and portfolio debt outflows as % of trend GDP in Columns 5-8. The dependent variables are standardized by subtracting the country-specific mean and dividing by the country-specific standard deviation. The sample spans from 1990:Q1 to 2015:Q4. Robust t-statistics are reported in brackets. ***, **, * indicate significance at the 1%, 5% and 10% level.

Table 14: Correlates of Other Flows

	Other Inflows				Other Outflows			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Federal Funds Rate	0.037*	0.053**	0.037*	0.031	0.023	0.033*	0.026	0.034*
	[2.01]	[2.68]	[1.84]	[1.28]	[1.51]	[1.91]	[1.51]	[1.87]
Log(VIX)	-0.415***	-0.455***	-0.428***	-0.506***	-0.306***	-0.328***	-0.334***	-0.362***
	[4.02]	[4.46]	[4.18]	[4.86]	[3.00]	[3.06]	[3.34]	[3.15]
GDP growth	0.063***	0.058***	0.062***	0.063***	0.016**	0.013**	0.012**	0.019***
	[5.69]	[5.89]	[5.74]	[4.97]	[2.67]	[2.09]	[2.37]	[2.95]
Investment environment		0.078**				0.048**		
		[2.53]				[2.29]		
Chinn-Ito index of capital account openness			0.044				0.056	
			[1.05]				[1.60]	
Bank assets, % of GDP				0.007*				0.008**
				[1.73]				[2.61]
Country fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Ye	Yes
Observations	2,232	2,210	2,128	1,980	2,229	2,207	2,125	1,977
R-squared	0.123	0.134	0.126	0.124	0.022	0.026	0.025	0.035
# of countries	29	29	29	29	29	29	29	29

Notes: The dependent variable is "other" inflows as % of trend GDP in Columns 1-4 and other outflows as % of trend GDP in Columns 5-8. The dependent variables are standardized by subtracting the country-specific mean and dividing by the country-specific standard deviation. The sample spans from 1990:Q1 to 2015:Q4. Robust t-statistics are reported in brackets. ***, **, * indicate significance at the 1%, 5% and 10% level.

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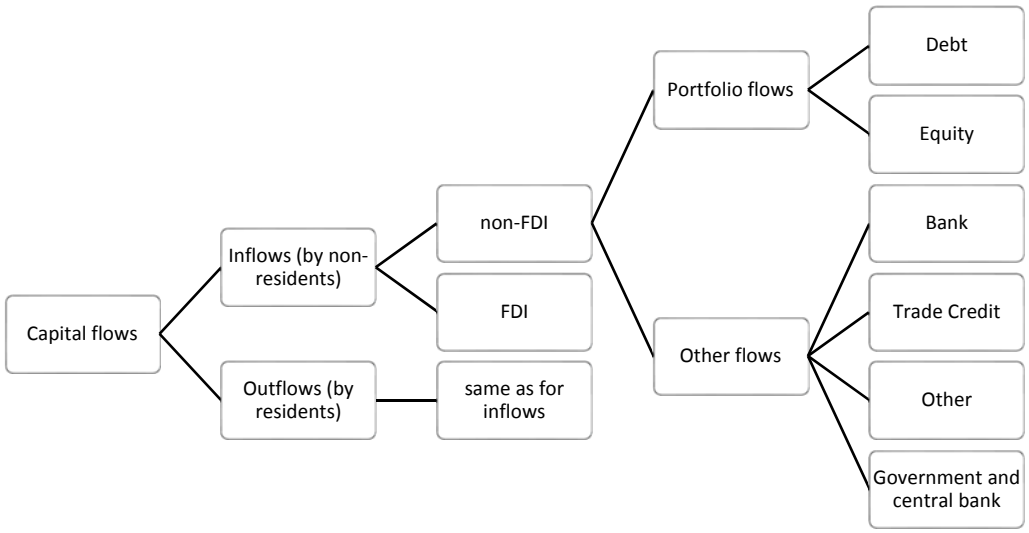
Taxonomy of Capital Flows



Data Appendix

Variable/ Set of Variables	Source	Details
Capital flows (FDI, portfolio equity, portfolio debt, other flows)	Haver	Original source is IFS. Old series BPM5 and new series BPM6 are spliced in the first year when the new series is available for each country; quarterly frequency
Nominal GDP	World Development Indicators, World Bank	in USD (at market exchange rates); annual frequency
Trend GDP (USD)	Generated	Estimated using Hodrick-Prescott filter over annual GDP in USD
Federal Funds Rate (FFR)	Haver	US Policy Rate; quarterly frequency
VIX index	DataStream	CBOE Volatility Index; quarterly frequency
GDP growth	Haver	Real GDP in local currency seasonally adjusted, Year-on-Year growth in %; quarterly frequency
Investment Profile	International Country Risk Guide (ICRG), PRS Group	Index on a country's investment risk profile ranging from 0 to 12: a score of 12 points equates to very low risk and a score of 0 points to very high risk
Chinn-Ito Index	Authors' website	Index of capital account liberalization ranging from -1.89 to 2.39. Higher values indicate higher capital account openness; annual frequency
Bank Assets	Global Financial Development Database (GFDD), World Bank	% of GDP; annual frequency

Countries included in the sample and data availability

	Start	End	# of observations
Argentina	1990:Q1	2015:Q4	104
Armenia	1993:Q1	2015:Q4	92
Belarus	1996:Q1	2015:Q4	80
Brazil	1990:Q1	2014:Q4	104
Bulgaria	1991:Q1	2015:Q2	98
Chile	1991:Q1	2015:Q4	100
Colombia	1996:Q1	2014:Q4	80
Croatia	1993:Q1	2015:Q4	92
Czech Republic	1995:Q1	2015:Q4	84
Guatemala	1990:Q1	2015:Q4	104
Hungary	1990:Q1	2015:Q4	104
India	1990:Q1	2015:Q2	102
Indonesia	1990:Q1	2015:Q3	103
Israel	1990:Q1	2015:Q4	104
Jordan	1990:Q1	2015:Q4	104
Kazakhstan	1996:Q1	2015:Q1	77
Latvia	1993:Q1	2015:Q4	92
Lithuania	1995:Q1	2015:Q4	84
Malaysia	1999:Q1	2015:Q4	68
Mexico	1990:Q1	2014:Q4	104
Pakistan	1990:Q1	2015:Q4	104
Peru	1991:Q1	2015:Q4	100
Philippines	1990:Q1	2015:Q4	104
Poland	1990:Q1	2015:Q4	86
Republic of Korea	1990:Q1	2015:Q4	104
Romania	1991:Q1	2015:Q4	100
Russian Federation	1994:Q1	2015:Q4	88
South Africa	1990:Q1	2014:Q4	104
Sri Lanka	1990:Q1	2014:Q4	104
Thailand	1990:Q1	2015:Q4	104
Turkey	1990:Q1	2015:Q4	104
Ukraine	1994:Q1	2015:Q4	88
Venezuela, RB	1994:Q1	2014:Q4	88
Vietnam	1996:Q1	2015:Q3	79

Notes: The table displays the maximum number of observations. Observations for specific flows in some countries are slightly lower than reported here.