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Capital flow waves: Surges, stops, flight, and retrenchment

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ABSTRACT

This paper analyzes waves in international capital flows. We develop a new methodology for identifying episodes of extreme capital flow movements using data that differentiates activity by foreigners and domestics. We identify episodes of "surges" and "stops" (sharp increases and decreases, respectively, of gross inflows) and "flight" and "retrenchment" (sharp increases and decreases, respectively, of gross outflows). Our approach yields fundamentally different results than the previous literature that used measures of net flows. Global factors, especially global risk, are significantly associated with extreme capital flow episodes. Contagion, whether through trade, banking, or geography, is also associated with stop and retrenchment episodes. Domestic macroeconomic characteristics are generally less important, and we find little association between capital controls and the probability of having surges or stops driven by foreign capital flows. The results provide insights for different theoretical approaches explaining crises and capital flow volatility.

1. Introduction

Many countries experienced waves of international capital flows in the 1980s and 1990s. In the past decade, capital flow volatility increased even more. Capital flows dried up in late 2001, surged throughout the mid-2000s, contracted sharply during the Global Financial Crisis (GFC) of 2008–2009, and then rebounded quickly in 2010. Capital flow volatility can have widespread economic consequences, such as amplifying economic cycles, increasing financial system vulnerabilities, and aggravating overall macroeconomic instability. Capital flows, however, can also be benign and even provide substantial benefits. For example, even as global liquidity contracted during the GFC, several countries received beneficial capital inflows driven by a "retrenchment" of domestic investors who liquidated foreign investments.

Waves in capital flows have generated an extensive academic literature. Several papers have examined "sudden stops" (when foreign capital inflows suddenly slow), "surges" or "bonanzas" (when foreign capital inflows increase rapidly), or capital "flight" (when domestic investors send capital abroad). Other papers have focused on explaining contagion in capital flows, current account reversals and crises, or capital flows more broadly. In addition, the GFC has spurred a resurgence of theoretical papers on capital flows. This paper synthesizes these different literatures – reviewed in detail in Sections 2 and 3 – in an effort to better understand the major ebbs and flows of international capital. It does not attempt to explain small fluctuations in capital flows, but instead focuses on extreme movements or "waves". In contrast to previous work that focused on a single type of capital flow episode in isolation (such as a stop, surge, or flight), this paper considers each of these three types of episodes, as well as periods of "retrenchment", in order to understand the full cycle of international capital flows.

Our analysis focuses on *gross* capital inflows and outflows, differentiating between capital movements viewed as being initiated by foreigners and by domestic investors. In contrast, almost all previous work on capital flow episodes relied on proxies for *net* capital flows, which cannot differentiate between changes in foreign and domestic behaviors. Fig. 1 highlights the distinction between gross and net flows by depicting net capital flows into Chile and its two components: foreign inflows into Chilean assets (gross inflows) and Chilean flows into non-Chilean assets (gross outflows).[1] The literature's earlier focus on net flows is understandable; in the early and mid-1990s net capital inflows roughly mirrored gross inflows, so the capital outflows of domestic investors could often (but not always) be ignored and changes in net inflows could be interpreted as being driven by changes in foreign flows. More recently, however, as the size and volatility of gross flows have increased while net capital flows have been more

[1] Following standard balance-of-payments accounting, an outflow is expressed as a negative value. The terminology can be confusing. "Gross inflows" and "gross outflows" are actually "net" items; gross inflows is the net of foreign purchases of domestic assets and foreign sales of domestic assets, while gross outflows is the net of domestic residents' purchases of foreign assets and domestic residents' sales of foreign assets. We follow the literature and use the standard terminology of gross inflows, gross outflows, and the net of the two (net inflows).

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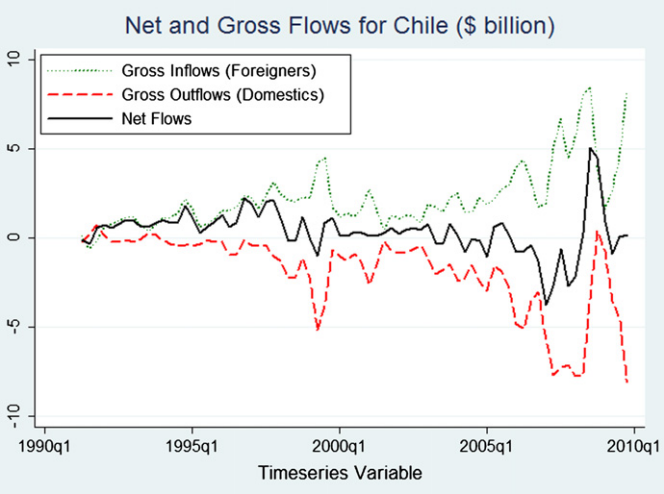


Notes: This graph shows net capital flows and gross inflows and gross outflows for Chile from 1990 through 2009. Each flow is calculated as the 2-quarter moving average. Gross outflows are reported using standard BOP definitions, so that a negative number indicates a gross outflow.

Fig. 1. Net and gross capital flows for Chile.

stable, the differentiation between gross inflows and gross outflows has become more important. Foreign and domestic investors can be motivated by different factors and respond differently to various policies and shocks. Policymakers might also react differently based on whether episodes of extreme capital flow movements are instigated by domestic or foreign sources. Analysis based solely on net flows, while appropriate a few decades ago, would miss the dramatic changes in gross flows that have occurred over the past decade and ignore important information contained in the these flows. As domestic investors' flows have become increasingly important, changes in net flows can no longer be interpreted as being driven solely by foreigners.

This paper builds a database of episodes when domestic or foreign investors substantially increase or decrease capital flows into or out of a country, what we call "surge", "stop", "flight", and "retrenchment" episodes. The underlying quarterly data on gross inflows and gross outflows covers the period from 1980 (at the earliest) through 2009 and include over 50 emerging and developed economies. Using this database, we document the incidence of each type of episode of extreme capital flow movements over time, by income level and region. We show that the recent crisis saw an unprecedented incidence of stops and retrenchment, as investors around the world liquidated foreign investment positions and brought money home.

Next, the paper shifts to its second goal of understanding the factors that are associated with episodes of extreme capital flows. We briefly review the theoretical literature, which describes capital flow episodes as being driven by specific global factors, contagion, and/or domestic factors. Our analysis indicates that waves of capital flows are primarily associated with global factors. Global risk, which incorporates both risk aversion and economic uncertainty, is the only variable that consistently predicts each type of capital flow episode; an increase in global risk is associated with more stops and retrenchments and fewer surges and flight. Other global factors are related to certain types of episodes. For example, strong global growth is associated with an increased probability of surges and decreased probability of stops and retrenchment. High global interest rates are associated with retrenchments. Contagion, whether through financial linkages, trade linkages, or just regional proximity, is strongly associated with stop and retrenchment episodes. In contrast to the important role for global factors and contagion, domestic factors are generally insignificant in explaining capital flow waves. There is some evidence that countries with a negative growth shock are more likely to experience stops and rich countries are more likely to have retrenchments, but most of the domestic variables are not consistently significant across robustness tests. In some cases, this lack of significance is noteworthy; for example, there is no significant relationship between capital controls and a country's likelihood of experiencing a surge or stop of capital inflows from abroad. There is also no significant relationship between global liquidity and any type of episode.

The results in this paper, and especially the prominent correlation between global risk and capital flow waves, provide insights for theory. Much of the theoretical literature on sudden stops, capital flow volatility, and crises emphasizes the role of domestic conditions such as current account deficits or financial system vulnerabilities. Other papers have highlighted the role of contagion or global factors (such as global interest rates, demand, or risk aversion). A more recent series of theoretical models has attempted to explain the GFC by focusing on global shocks – whether changes in risk, wealth, or liquidity/credit – with little role for domestic factors. Our finding that the primary factor associated with capital flow episodes is changes in global risk, supports this recent theoretical focus on global factors, especially risk. The results, however, do not support the widespread presumption that changes in global liquidity or interest rates in a major economy, such as the United States, are important factors driving surges in capital flows (independent of any effect on global risk and growth). Also, the emphasis of many theoretical models on productivity shocks as key determinants of capital flows (such as the real business cycle literature) might be relevant in explaining gross capital inflows, but appears to be less applicable in explaining the volatility in domestic residents' international investment; a country's economic growth is associated with surges and stops but not episodes driven by domestics.

The analysis in this paper also informs empirical research. Our more disaggregated focus on gross flows by the type of investor allows a finer delineation of different types of capital flow episodes, a delineation that is necessary to understand the underlying causes of capital flow waves. By differentiating gross inflows from gross outflows, our analysis shows that many episodes previously identified as "surges" of foreign investment are actually driven by the retrenchment of domestic residents. Similarly, the earlier methodology missed periods of sudden stops in foreign capital inflows when these stops occurred simultaneously with an increase in global risk and retrenchment by domestic investors. More generally, previous empirical research on international capital flows that focused on more aggregate data was unable to capture the complete dynamics and causes of capital flow waves.

Finally, our results on the significant relationship between global, contagion, and domestic factors and extreme movements in capital flows have important implications for economic policy. Capital flow volatility can have substantial economic costs, especially in emerging economies. For example, past work finds that surges are correlated with real estate booms, banking crises, debt defaults, inflation, and currency crises, and that sudden stops are correlated with depreciations, slower growth, and higher interest rates. For policymakers hoping to reduce these vulnerabilities and mitigate negative outcomes, a clear identification of episodes and understanding of their causes are vital. While this paper does not assess causation, the results suggest that most domestic factors only have a limited correlation with capital flow volatility. We find no evidence that capital controls insulate an economy against capital flow waves. As a result, governments concerned about the effects of capital flow volatility should prioritize strengthening their country's ability to withstand this volatility rather than trying to reduce it. Finally, the results indicate a significant role for global factors and contagion, suggesting an important role for global institutions and cross-country cooperation in reducing capital flow volatility.

The remainder of the paper is as follows. Section 2 focuses on measures of extreme capital flow episodes. It reviews the sudden stop and bonanza literatures, discusses traditional definitions of episodes, develops our new methodology based on gross capital flows, and analyzes patterns in the data. Section 3 reviews the capital flows literature; discusses the global, contagion, and domestic factors we use to explain the incidence of surges, stops, flight, and retrenchment; explains the

estimation strategy; and reports results on the factors associated with capital flow waves, including extensive sensitivity tests. These results provide insights for different theoretical models. Section 4 concludes.

2. Measuring extreme capital flow episodes

This section reviews the existing literature on stops, bonanzas and flight and describes traditional measures of sudden stops. It then develops our new measures and discusses the insights from using data on gross instead of net flows when analyzing capital flow waves.

2.1. The literature on stops, bonanzas, and flight

The literature on extreme capital flow episodes originated with Calvo (1998) in his analysis of "sudden stops", defined as sharp slowdowns in net capital inflows. Recent papers broadened this original definition by adding criteria such as (1) the requirement that the stop occurred at the same time as an output contraction in order to exclude positive terms of trade shocks (Calvo et al., 2004), or (2) that the stop had to occur in conjunction with a sharp rise in interest rate spreads in order to capture a global component and qualify as a "systemic sudden stop" (Calvo et al., 2008).[2] The mirror image of the traditional sudden stop measure is a capital flow "bonanza" or "surge" (Reinhart and Reinhart, 2009), defined as a sharp increase in net capital inflows.[3]

While not focusing specifically on extreme capital flows, two recent papers shifted attention to the importance of considering gross capital flows instead of simply net flows. Milesi-Ferretti and Tille (2010) examine capital flows during the recent crisis, while Broner et al. (2010) analyze how capital flows relate to business cycles and crises.[4] Combining this new focus on gross flows with an older literature on capital flight – such as Khan and Ul Haque (1985), Lessard and Williamson (1987), and Dooley (1988) – are recent papers that recognize that traditionally defined sudden stops may contain an element of capital flight as domestic residents send money abroad (Faucette et al., 2005; Cowan and De Gregorio, 2007). Building on this, Cowan et al. (2008) and Rothenberg and Warnock (2011) point out that measures of "sudden stops" constructed from proxies for net inflows are not able to differentiate between stops that are due to the actions of foreigners and those due to locals fleeing the domestic market; both use the standard approach to define sudden stops, and then break these down into "true sudden stops" (when gross capital inflows decrease more than gross capital outflows increase) and "sudden flight" (when gross capital outflows increase more than gross capital inflows decrease).[5]

2.2. Earlier methodology using proxies for net inflows

A "sudden stop" episode has traditionally been identified using the following approach, as in Calvo et al. (2004). First, construct a proxy for monthly net private capital inflows, P_t, by subtracting monthly changes in international reserves from the quarterly current account balance. Then define C_t to be a 12-month moving sum of lagged values and compute annual year-over-year changes in C_t:

$$C_t = \sum_{i=0}^{11} P_{t-i} \quad t = 1, 2, \ldots, N. \tag{1}$$

$$\Delta C_t = C_t - C_{t-12} \quad t = 13, 14, \ldots, N. \tag{2}$$

Sudden stop episodes were traditionally defined as periods of marked slowdowns in this proxy for net capital inflows. Anyone working in this literature must make several ad hoc decisions to operationalize "marked slowdown". For example, a slowdown relative to what? And how sharp must the slowdown be? For "relative to what", Calvo et al. (2004) compare ΔC_t (the amount of net private inflows in the last 12 months compared to the amount in the preceding 12 months) to its historical mean, with the mean computed using all available historical data up to month t (and requiring at least 24 months of ΔC_t). For "how sharp", Calvo et al. (2004) mark the beginning of an episode at the month t when ΔC_t falls one standard deviation below its rolling historical mean, providing that at some point within the episode ΔC_t falls at least two standard deviations below its mean. The episode ends once ΔC_t again exceeds one standard deviation below its mean. Surges (also called capital flow bonanzas) have been defined analogously, also with net inflow proxies (i.e., Reinhart and Reinhart, 2009).

2.3. Our methodology using gross flows

Several methodologies can be used to identify capital flow episodes; each has advantages and disadvantages. Our methodology builds on the traditional measures of sudden stops and capital flow bonanzas, allowing us to better highlight the differences from focusing on gross instead of net flows. Specifically, we make three fundamental changes to the traditional approach. First, we use data on actual flows instead of current-account-based proxies for flows. Second, we use data on gross flows from the outset to identify episodes, rather than relying on proxies for net flows.[6] Finally, we analyze both large increases and large decreases of both inflows and outflows, instead of just focusing on increases or decreases, in order to improve our understanding of all types of capital flow episodes. This approach, and especially our ability to capture distinctions in the behavior of domestic and foreign investors by using gross instead of net flows, allows a more nuanced understanding of extreme capital flow episodes.

More specifically, we use quarterly gross flows data in a sample of 58 countries over the period from 1980 through 2009 to identify four types of episodes[7]:

- "Surges": a sharp increase in gross capital inflows;
- "Stops": a sharp decrease in gross capital inflows;
- "Flight"[8]: a sharp increase in gross capital outflows; and
- "Retrenchment": a sharp decrease in gross capital outflows.

[2] Closely related to a sudden stop is a current account reversal. See Milesi-Ferretti and Razin (2000), Chinn and Prasad (2003), Edwards (2005), Freund (2005), Adalet and Eichengreen (2007), and Freund and Warnock (2007).

[3] Additional papers on bonanzas or surges include Aizenman and Jinjarak (2009), Cardarelli et al. (2009), and Caballero (2010). Related to the surge literature is a series of papers focusing on domestic credit booms and credit cycles, such as Gourinchas et al. (2001) and Mendoza and Terrones (2008).

[4] Similar in spirit to studies of gross flows is another related literature on the cross-country allocation of investment. This literature essentially studies changes in gross positions. See, for example, Bertaut and Kole (2004), Edison and Warnock (2004), Faruqee et al. (2004), Aggarwal et al. (2005), Lane and Milesi-Ferretti (2008), Leuz et al. (2009), Burger et al. (forthcoming), and Forbes (2010).

[5] Rothenberg and Warnock (2011) find that many traditionally defined sudden stops are actually sudden flight, while Cowan et al. (2008) point out that some countries tend to simultaneously experience retrenchment and stops.

[6] To be specific, whether a flow is a gross inflow or gross outflow is determined by the residency of the asset. Net foreign purchases of domestic assets are gross capital inflows, whereas net purchases of foreign assets by domestic investors are gross outflows. We will refer to gross inflows (outflows) as being driven by foreigners (domestics), although technically we only know the residency of the asset and that a trade between domestic and foreign investors occurred. Note too that the use of tax havens, or any low-tax areas, can confound residency-based capital flows data. For example, if a U.S.-based investor books a U.S. equity purchase through the Cayman Islands, this will look like a foreign inflow into U.S. equities. To our knowledge, no residency-based system can get around this issue.

[7] We start with as broad a sample as possible and only exclude countries that do not have detailed quarterly gross flows data.

[8] "Flight" has also been referred to as "starts", as in Cowan et al. (2008), or "sudden diversification".

The first two types of episodes – surges and stops – are driven by foreigners while the last two – flight and retrenchment – are driven by domestic investors.

We calculate year-over-year changes in four-quarter gross capital inflows and outflows and define episodes using three criteria: (1) current year-over-year changes in four-quarter gross capital inflows or outflows is more than two standard deviations above or below the historic average during at least one quarter of the episode; (2) the episode lasts for all consecutive quarters for which the year-over-year change in annual gross capital flows is more than one standard deviation above or below the historical average; and (3) the length of the episode is greater than one quarter.[9]

To provide a more concrete example of our methodology, consider the calculation of surge and stop episodes. Let C_t be the 4-quarter moving sum of gross capital inflows (GINFLOW) and compute annual year-over-year changes in C_t:

$$C_t = \sum_{i=0}^{3} GINFLOW_{t-i}, \quad \text{with } t = 1, 2, \ldots, N \text{ and} \tag{3}$$

$$\Delta C_t = C_t - C_{t-4} \quad \text{with } t = 5, 6, \ldots, N. \tag{4}$$

Next, compute rolling means and standard deviations of ΔC_t over the last 5 years. A "surge" episode is defined as starting the first month t that ΔC_t increases more than one standard deviation above its rolling mean. The episode ends once ΔC_t falls below one standard deviation above its mean. In addition, in order for the entire period to qualify as a surge episode, there must be at least one quarter t when ΔC_t increases at least two standard deviations above its mean.

A stop episode, defined using a symmetric approach, is a period when gross inflows fall one standard deviation below its mean, provided it reaches two standard deviations below at some point. The episode ends when gross inflows are no longer at least one standard deviation below its mean.

Episodes of flight and retrenchment are defined similarly, but using gross private outflows rather than gross inflows, and taking into account that in BOP accounting terms outflows by domestic residents are reported with a negative value. In other words, when domestic investors acquire foreign securities, in BOP accounting terms gross outflows are negative. A sudden flight episode therefore occurs when gross outflows (in BOP accounting terms) fall one standard deviation below its mean, provided it reaches two standard deviations at some point, and end when gross outflows come back above one standard deviation below its mean. A sudden retrenchment episode occurs when gross outflows increase one standard deviation above its mean, providing it reaches two standard deviations above at some point, and ends when gross outflows come back below one standard deviation above its mean.

Our primary source of flow data is the International Monetary Fund's International Financial Statistics (IFS, accessed through Haver Analytics in January 2012) on quarterly gross capital inflows and outflows. There are a number of modifications necessary, however, to transform the IFS flow data into a usable dataset; some are straightforward, whereas others involve detailed inspection of country data and the filling of gaps using source-country information. The creation of the underlying flows dataset is described in more detail in the online Appendix A.

The resulting sample consists of 58 countries listed in Table 1 in the online Appendix. The table also lists the start date for which quarterly capital flow data is available for each country. All countries have data through the end of the sample, but start dates differ: 30 countries provide data in 1980, 37 countries in 1990, 52 countries in 1995 and the full sample of 58 countries by 2000 through the sample end in 2009. In our baseline measure, we define gross capital inflows as the sum of inflows of direct investment, portfolio, and other inflows; gross private capital outflows are defined analogously as the sum of direct investment, portfolio, and other outflows. We also conduct sensitivity tests using alternative measures.[10] In 2007, our sample includes $10.8 trillion of gross capital inflows, capturing 97% of global capital inflows recorded by the IMF.

Fig. 2 shows our identification of surges and stops for one country (Brazil) from 1990 through 2009. The solid line is the change in annual gross capital inflows as defined in Eq. (4). The dashed lines are the bands for mean capital inflows plus or minus one standard deviation, and the dotted lines are the comparable two-standard-deviation bands. We classify an episode as a sudden stop if the change in annual capital inflows falls below the lowest line (the two-standard-deviation line) for at least one quarter, with the episode starting when it initially crosses the one-standard-deviation line and ending when it crosses back over the same line. Similarly, we classify an episode as a sudden surge if annual capital flows rise above the highest line (the two-standard-deviation line), with the episode starting when flows initially cross the one-standard-deviation line and ending when they cross back over the same line.

According to these criteria, four periods qualify as sudden stops since 1990: 1993Q1 to 1993Q3 (a period of hyperinflation in Brazil), 1995Q1 to 1995Q2 (the Mexican peso crisis), 1999Q1 to 1999Q2 (a devaluation in Brazil), and 2008Q2 to 2009Q3 (the GFC). Four other periods qualify as sudden surges: 1990Q2 to 1991Q1 (after Brazil's first democratic election in decades amid hopes inflation would fall), 1994Q1 to 1994Q3 (before the Mexican peso crisis), 1995Q4 to 1996Q2 (before the Asian crisis), and 2006Q3 to 2007Q4 (just before the GFC).

2.4. The episodes: surges, stops, flight, and retrenchment

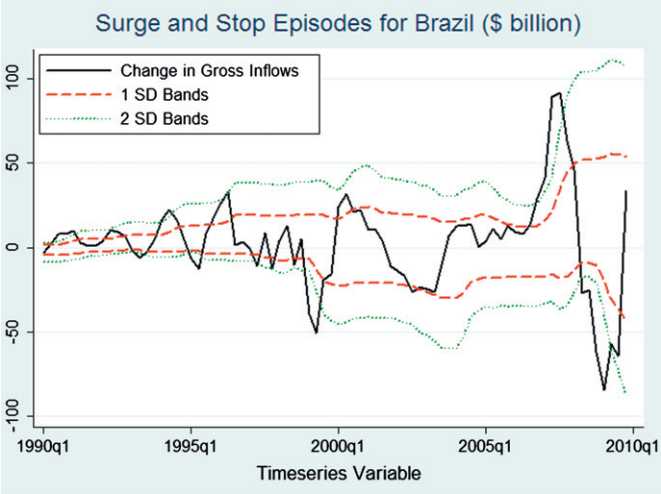
Using the quarterly gross flows data and the criteria discussed above, from 1980 through 2009, we identify 167 surge, 221 stop, 196 flight, and 214 retrenchment episodes; Table 2 in the online Appendix lists episodes by country. Table 1 aggregates these results and reports summary statistics on the incidence of episodes for the full sample and the average length of each episode by income group and region.[11] Stops are slightly more prevalent than surges, but surges last longer; for the full sample, the average length of each type of episode is roughly one year, with surges lasting the longest with an average length of 4.5 quarters and retrenchments the shortest with an average length of 3.9 quarters. The breakdown by income group indicates that lower income countries experience shorter episodes than the high income countries over the full period, on average, even for episodes such as stops and flight.

Given how we identify episodes (using a two-standard deviation cutoff), a country's gross flows will be in an episode about one-third of the time. As the online Appendix Table 2 suggests, however, there is considerable cross-country variation in the incidence of different

[9] Summing capital flows over four quarters is analogous to the literature's focus on one year of flows and eliminates seasonal fluctuations. The historical average and standard deviation are calculated over the last five years. We require that countries have at least 4 years worth of data to calculate a "historic" average.

[10] There are reasonable alternative measures of gross flows—such as excluding currency swap arrangements by the Federal Reserve Board during the GFC or including changes in reserves to capture total rather than private outflows. Sensitivity analysis shows these alternate definitions have no significant effect on the key results, although can affect episode dates.

[11] We use income classifications in the year 2000 based on GNI per capita as reported by the World Bank, with "lower income" referring to countries classified as "Low income" and "Middle/lower income" by the World Bank, "Middle income" referring to countries classified as "Middle/higher income". "Higher income" refers to countries classified as "High income". We combine lower and middle/lower income into the group "lower income" because there are only four countries in our sample that qualify as lower income based on the World Bank classification. We focus on six regions: North America, Western Europe, Asia, Eastern Europe, Latin America, and Other. The "Other" region is South Africa and Israel.



Notes: The figure shows the construction of our measures of surges and stops for Brazil. A surge episode begins when gross inflows (the solid line) exceed one standard deviation above the rolling mean, provided they eventually exceed two standard deviations above the mean. The surge episode ends when gross inflows again cross the one standard deviation line. Stops are defined analogously; a stop episode begins when gross inflows fall one standard deviation below the rolling mean, provided that they eventually fall two standard deviations below the mean, and ends when gross inflows again cross the one standard deviation line.

Fig. 2. Construction of the surge and stop episodes.

types of episodes. For example, focusing on the gross inflows measures, Argentina has experienced many fewer surges than stops, being in a surge episode only 12% of the time from 1985 through 2009, but in a stop episode in 1 out of every 4 quarters. In contrast, other countries (such as India) were almost twice as likely to be in a surge as in a stop. This variation across countries is what this paper seeks to explain.

2.5. A comparison of episodes based on gross and net flows

Our episodes defined using gross capital flows are substantially different from those in previous work that used proxies for net capital flows and did not differentiate between the behavior of domestic and foreign investors. To better understand the differences, we use the two techniques to identify episodes during the height of the GFC — the two quarters from 2008Q4 to 2009Q1. Table 2 lists the countries defined as having a surge or stop episode using net capital inflows (similar to the measures used in previous work) and gross flows (as used in this paper). For each column we use the methodology discussed in Section 2.2, except the net flows measures of surges and stops are defined as periods when net capital inflows are above or below the threshold, respectively, while the episodes defined using gross flows are periods when gross inflows are above or below the threshold.

During the height of the GFC, net flows data identify more surge episodes and fewer stop episodes. The left half of Table 2 shows that measures based on net flows identify thirteen surges from 2008Q4 to 2009Q1, while gross flows data identify only one surge (Bolivia, for whom a surge that began in 2007 was ending in 2008Q4). For stops (the right side of the table), net flows identify less than half as many episodes as gross flows (22 stop episodes based on net flows versus 47 based on gross flows). The reason for the differences is that during the GFC many countries' residents retrenched from foreign markets, bringing money home. In fact, each country defined as having a surge based on the net flows data – but not using the gross data – had a retrenchment episode. The sudden inflow of capital as domestic investors sell foreign holdings and bring the money home is classified as "retrenchment" in our definitions based on gross flows. If the retrenchment outweighs actions by foreign investors, however, it can show up as a "surge" using the older methodology based on net flows. Similarly, most of the countries identified as having a stop episode based on the gross data, but not the net data, also had a large retrenchment in capital flows. Foreigners did pull back from these countries – gross inflows slowed – but in many cases the retrenchment by domestic investors counteracted the sudden stop of foreign investment. Even though foreign capital inflows suddenly stopped, retrenchment meant that net capital flows did not fall enough to qualify as a "sudden stop" episode based on the older methodology.

To clarify these differences, consider the example of Chile. Table 2 shows that during the GFC Chile had a surge episode based on net capital flows (but not gross flows) and a stop based on gross (but not net)

Table 1
Summary statistics for episodes (1980–2009).

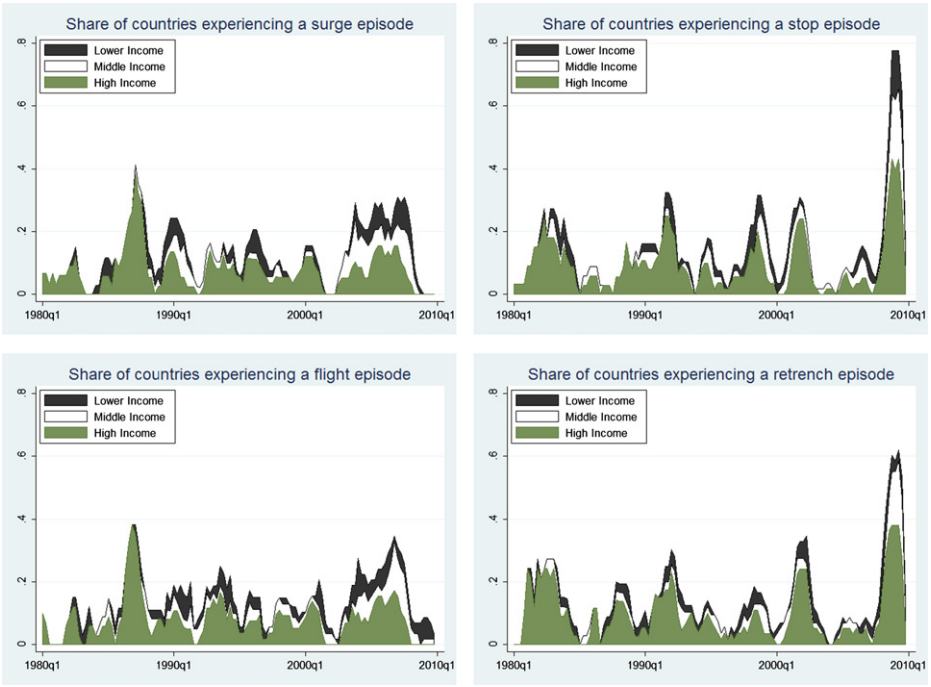
		Surge	Stop	Flight	Retrenchment
% of sample with					
Full sample		15%	18%	17%	17%
Average length of time for each (in quarters)					
Full sample		4.5	4.0	4.1	3.9
By income group	High income	4.5	4.1	4.2	4.2
	Middle income	4.6	3.8	4.4	3.3
	Lower income	4.3	3.7	3.8	3.6
By region	North America	3.8	4.0	3.8	3.9
	Western Europe	4.5	4.2	4.2	4.2
	Asia	4.5	3.8	4.3	4.0
	Eastern Europe	4.8	3.8	4.2	3.5
	Latin America	4.4	3.9	3.8	3.2
	Other	4.3	3.7	4.4	3.6

Notes: Income groups and regions, defined in the text, are based on World Bank classifications.

Table 2
Episodes during the GFC based on net and gross capital flows.

Surges		Stops		
Net flows	Gross flows	Net flows	Gross flows	
Belgium/Lux	Bolivia	Argentina	Argentina	Austria
Canada		Brazil	Brazil	Belgium/Lux
Chile		Estonia	Estonia	Canada
Finland		Guatemala	Guatemala	Chile
France		Iceland	Iceland	Colombia
Iceland		India	India	Czech Rep
Israel		Ireland	Ireland	Denmark
Netherlands		Latvia	Latvia	France
Singapore		Lithuania	Lithuania	Germany
Sweden		Malaysia	Malaysia	Hong Kong
Taiwan		New Zealand	New Zealand	Indonesia
UK		Norway	Norway	Israel
Venezuela		Peru	Peru	Italy
		Philippines	Philippines	Japan
		Poland	Poland	Korea
		Romania	Romania	Mexico
		Russia	Russia	Netherlands
		South Africa	South Africa	Panama
		Spain	Spain	Portugal
		Turkey	Turkey	Singapore
		Croatia		Slovenia
		Greece		Sweden
				Switzerland
				Taiwan
				Thailand
				UK
				US

Notes: The "net flows" columns show episodes based on the net flows data, as used in the traditional sudden stops and bonanzas literature. The "gross flows" columns show episodes based on gross flows data, as used in this paper. The difference between the two is that episodes based on net flows include the actions of domestic investors, who retrenched in many countries during the crisis. The crisis is defined as the two quarters 2008Q4 and 2009Q1.



Notes: Income groups and regions, defined in the text, are based on World Bank classifications.

Fig. 3. Percent of countries with each type of episode: by income group.

capital flows. Fig. 1 clarifies why these differences occurred. The figure shows that during the GFC, Chile's gross inflows suddenly dropped while gross outflows also fell sharply, reflecting a retrenchment as domestic investors brought money home (or ceased to send money abroad). The retrenchment by domestic investors outweighed the stop in capital inflows by foreign investors. Episodes identified using net capital flow data – which comingles these different types of flows – would describe this as a "surge", while gross capital flow data would instead define this period as a "stop" in foreign capital inflows combined with a "retrenchment" by domestic investors.

2.6. Descriptive analysis

Fig. 3 shows the evolution of the incidence of each type of episode from 1980 through 2009, broken down by income group.[12] Most episodes are in high income countries, especially in the earlier years of the sample, which is not surprising as high income countries tend to have more complete historical data. More importantly, these graphs show waves in the incidence of capital flow episodes, with large swings in the percent of the sample experiencing an episode. For example, in some years no countries experience a stop or a retrenchment, while at other times a majority of the sample experiences these episodes. These cycles suggest an important role for global factors in driving episodes of extreme capital flow movements.

One aspect of the GFC stands out: an unprecedented number of countries experienced stops and retrenchment. Retrenchment occurred during other periods, although not in so many countries at the same time. With many countries retrenching during the GFC, it is not surprising that there was a spike in the incidence of sudden stops to 78% of the sample in the 4th quarter of 2008; if most countries are retrenching, gross inflows by foreigners will fall in most countries. This strong correlation between stops and retrenchment, however, does not exist during *all* crises. For example, in 1998Q4, just following the collapse of LTCM, the incidences of stop and retrenchment episodes were elevated (at 35% and 19%, respectively). As economic risk abated, by the 3rd quarter of 1999 the number of retrenchment episodes declined rapidly to 6%, while the number of stop episodes fell more slowly to 15%.

The correlations between types of episodes in Table 3 provide further information. The strong positive correlations between stops and retrenchments (0.47) and surges and flight (0.37) are consistent with an important role for global factors.[13] Correlations between the other episodes are fairly low and do not support an important role for country-specific factors. If country-specific factors were important, we would expect that when foreigners flee, domestic residents would also (a positive correlation between stops and flight), and when there is a wave of foreign capital inflows, domestic investors would also bring money home (a positive correlation between surges and retrenchment). The correlations between stops and flight and between surges and retrenchment, however, are negative.

The information in Table 3 and online Appendix Fig. 1 suggests that episodes are related to global and possibly regional/contagion factors. A finer look at the episodes by country, however, suggests that domestic fundamentals may also play a role. For example, even though a majority

[12] Online Appendix Fig. 1 divides the sample by region instead of income group. This graph suggests that regional patterns could be important, possibly indicating common regional characteristics or other forms of contagion in explaining episodes.

[13] These high correlations are not automatic due to differences in country size. For example, if all domestic investors in most countries "retrench" and invest less abroad, this would correspond to a "stop" in capital inflows from foreigners for most countries in the world. This relationship will not automatically hold, however, for countries of very different sizes. If domestic investors in many small countries follow the above pattern and retrench, but investors in one large country continue to send large volumes of investment abroad, there could be continued "surges" into most countries in the world combined with retrenchments in all countries except the large country, leading to a low correlation between stops and retrenchment.

Table 3
Correlation between probability of each type of episode.

	Surge	Stop	Flight	Retrenchment
Surge	1.000			
Stop	−0.202	1.000		
Flight	0.368	−0.134	1.000	
Retrenchment	−0.135	0.468	−0.205	1.000

of the sample experienced a retrenchment episode during the GFC, there are important differences across countries and some countries' residents did not unwind foreign positions and bring money home. More specifically, during late 2008 and early 2009, there was concern about the outlook for Eastern Europe; Poland, however, experienced a retrenchment episode, while Russian citizens sent their money abroad. Other countries that did not have a retrenchment episode during this period include Argentina, Australia, Brazil, Greece, India, Indonesia, New Zealand, Norway, Portugal, the Slovak Republic, South Africa, and Turkey. Why did this diverse group of countries not have retrenchment episodes as occurred in most of the rest of the sample? Different patterns across countries – even countries in the same region – suggest that even in the presence of substantial global shocks and possibly contagion, domestic characteristics may also be important in determining whether a country experiences an episode.

3. Global, contagion, and domestic factors

This section provides regression analysis of the relationship between our episodes of extreme capital flows and global, contagion, and domestic factors. We first review the literature on capital flows to motivate a parsimonious list of variables that might be associated with surge, stop, flight, and retrenchment episodes. We then develop the empirical framework and assess the roles of these variables. Next we compare empirical results to those when episodes are based on net flows and take a closer look at key results related to the role of risk and capital controls. We conclude with an extensive series of sensitivity tests and a summary of key results that are consistent across these tests.

3.1. The literature on capital flows

To inform our selection of variables that might be associated with surge, stop, flight, and retrenchment episodes, we draw from the literature on sudden stops and bonanzas (described in Section 2.1) as well as on capital flows in general, including work on the cross-country allocation of investment, contagion through capital flows, capital flow cycles, and the causes of financial crises. Each of these literatures is extensive and only briefly summarized below.

A major theme that runs through much of this research is whether the forces driving capital flows are "push" factors that are external to the country (including global or contagion effects) or domestic "pull" factors. The seminal papers in this literature – Calvo et al. (1993, 1996), Fernandez-Arias (1996), and Chuhan et al. (1998) – find that push factors are more important than domestic fundamentals in driving capital flows. There is also some role for domestic factors; Calvo et al. (1996) argue that the surge of capital inflows into emerging markets in the early 1990s was initially attributed to domestic developments (such as better policies and economic performance), although global factors were more important, especially cyclical movements in global interest rates. Griffin et al. (2004) argue that pull and push factors are important in understanding cross-border equity flows.

Another set of push factors outside a country's control is contagion, generally defined as resulting from circumstances in another country or group of countries (but not the entire world). The literature on contagion has identified a variety of reasons why events in one country can spread to other countries; summaries of these models and explanations for contagion are Claessens et al. (2001) and Claessens and Forbes (2001). The various transmission mechanisms for contagion can be broadly broken into contagion through trade channels (which include direct trade, competition in third markets, and changes in import prices), financial channels (including through bank lending and portfolio flows), and "country similarities" (such as a shared regional location or similar economic characteristics). Glick and Rose (1999), Forbes (2002), and Abeysinghe and Forbes (2005) focus on contagion through trade, while Peek and Rosengreen (1997), Kaminsky et al. (2001), and Broner et al. (2006) focus on the role of financial linkages. Van Rijckeghem and Weder (2001), Forbes (2004), and Blanchard et al. (2010) assess the relative importance of each of these mechanisms in explaining why a crisis spreads from one country to another, with different papers highlighting the roles of different transmission channels. Some papers consider contagion in the context of push and pull factors. Chinn and Forbes (2004) find a role for global as well as contagion effects. Dungey et al. (2011) simultaneously consider the role of domestic, contagion, and global factors in explaining crises and find a role for all three channels, although global market factors often outweigh contagion effects.

The GFC has recently spawned a surge in *theoretical* research on crises and capital flows. Much of this focuses on "push" factors driving capital flows, and especially on the role of risk (Bacchetta and van Wincoop, 2010; Gourio et al., 2010), liquidity/credit (Giannetti, 2007; Brunnermeier, 2009; Calvo, 2009; Kalemli-Ozcan et al., 2010), or how wealth and leverage amplify shocks across borders (Dedola and Lombardo, 2009; Devereux and Yetman, 2010).[14] Others focus more on pull factors. For example, the recent theoretical work of Caballero et al. (2008), Mendoza et al. (2009), Bacchetta and Benhima (2010), and Ju and Wei (2011) highlights the size, depth, and fragility of a country's financial system in either attracting capital flows from abroad (for developed financial markets) or driving capital flows out of the country (for less developed financial markets); for empirical support of these models, see Mendoza and Terrones (2008) and Forbes (2010).

Two other factors figure prominently in recent research on capital flows. One is growth — both global and domestic. A focus of several theoretical papers is the role of changes in global growth, often caused by global productivity shocks (see Albuquerque et al., 2005). Business cycle models highlight how domestic productivity or terms-of-trade shocks affect growth and in turn generate lending booms and busts and corresponding shifts in capital flows; see Aguiar and Gopinath (2007) for a theoretical model and Broner et al. (2010) for an empirical assessment. The other important factor prominent in recent research is the extent of financial market liberalization and integration with global financial markets; see Aghion et al. (2004), Calvo et al. (2008), Edison and Warnock (2008), and Milesi-Ferretti and Tille (2010).

In summary, the theoretical and empirical research reviewed here and in Section 2.1 suggests that a parsimonious list of factors that might be associated with capital flow waves would include global factors such as global risk, liquidity, interest rates, and growth; contagion through trade linkages, financial linkages, and geographic location; and domestic factors such as a country's financial market development, integration with global financial markets, fiscal position, and growth shocks.

[14] Any model of international capital flows must assume, at least implicitly, some heterogeneity across agents. If everyone were identical, there would be no need to trade upon the realization of a shock. Asset prices would adjust, as might portfolio weights, but international capital flows need not occur. But everyone is not identical. In the theoretical literature explaining international capital flows, the necessary heterogeneity can emerge from many sources, such as information asymmetries, risk, and financial sector development. Models that explicitly exploit heterogeneity are in Brennan and Cao (1997), Caballero et al. (2008), Mendoza et al. (2009), Gourio et al. (2010), Dumas et al. (2010), and Tille and van Wincoop (2011).

3.2. Estimation strategy and variables

To assess the role of these global, contagion, and domestic variables in the conditional probability of having a surge, stop, flight, or retrenchment episode each quarter, we estimate the model:

$$Prob(e_{it}=1)=F\left(\Phi_{t-1}^{\text{Global}}B_G+\Phi_{i,t-1}^{\text{Contagion}}B_C+\Phi_{i,t-1}^{\text{Domestic}}B_D\right) \quad (5)$$

where e_{it} is an episode dummy variable that takes the value of 1 if country i is experiencing an episode (surge, stop, flight, or retrenchment) in quarter t; $\Phi_{t-1}^{\text{Global}}$ is a vector of global factors lagged by one quarter; $\Phi_{i,t-1}^{\text{Contagion}}$ is a vector of contagion variables; and $\Phi_{i,t-1}^{\text{Domestic}}$ is a vector of domestic variables. The appropriate methodology to estimate Eq. (5) is determined by the distribution of the cumulative distribution function, $F(\cdot)$. Because episodes occur irregularly (83% of the sample is zeros), $F(\cdot)$ is asymmetric. Therefore we estimate Eq. (5) using the complementary logarithmic (or cloglog) framework, which assumes that $F(\cdot)$ is the cumulative distribution function (cdf) of the extreme value distribution. In other words, this estimation strategy assumes that:

$$F(z)=1-exp[-exp(z)]. \quad (6)$$

While we estimate each type of episode separately, we use a seemingly unrelated estimation technique that allows for cross-episode correlation in the error terms. This captures the fact that the covariance matrix across episodes is not zero, without assuming a structural model specifying a relationship between episodes. We also cluster the standard errors by country.

While our review of the theoretical and empirical research suggested a parsimonious list of global, contagion and domestic factors, there are a number of variables that could be used to represent each. We focus on measures that are available over the full sample period from 1985 to 2009 for most countries in the sample.[15] The variables are discussed in detail below.

3.2.1. Global variables

For our initial analysis, we measure global risk as the Volatility Index (VXO) calculated by the Chicago Board Options Exchange.[16] This measures implied volatility using prices for a range of options on the S&P 100 index and captures overall "economic uncertainty" or "risk", including both the riskiness of financial assets as well as investor risk aversion. To measure global liquidity we use the year-over-year growth in the global money supply, with the global money supply calculated as the sum of M2 in the United States, Euro-zone, and Japan and M4 in the United Kingdom, all converted into US dollars. Global interest rates are measured using the average rate on long-term government bonds in the United States, core euro area, and Japan. Global growth is measured by quarterly global growth in real economic activity. The last three variables are based on data from the IMF's *International Financial Statistics* (IFS) database.

3.2.2. Contagion variables

We use three measures to capture contagion effects. The first is a measure of geographic proximity, with a dummy variable equal to one if a country in the same region has an episode. The regions are described in Section 2.4. We also measure contagion through trade linkages (TL) as an export-weighted average of rest-of-the-world episodes:

$$TL_{xt}=\frac{\sum_{i=1}^{n}\left(Exports_{x,i,t}*Episode_{i,t}\right)}{\sum_{i=1}^{n}Exports_{x,i,t}}*\frac{Exports_{x,t}}{GDP_{x,t}} \quad (7)$$

where $Exports_{x,i,t}$ is exports from country x to country i in quarter t from the IMF's Direction of Trade Statistics, $Exports_{x,t}/GDP_{x,t}$ is a measure of country x's trade openness, and $Episode_{i,t}=1$ if country i had an episode in the quarter. TL_{xt} is calculated for each country x for each type of episode (surge, stop, flight, and retrenchment) in each quarter t.

We also include a measure of financial linkages that is as similar to the trade linkages measure as possible, given the more limited data available on bilateral financial linkages. The measure is based on banking data provided by the Bank of International Settlements and uses the algorithm underlying the analysis in McGuire and Tarashev (2006, 2007). While no measure of financial linkages is perfect, we focus on banking data because it is the only cross-country financial data that is of reasonable quality and widely available across countries and time periods. Let $BANK_{x,i}$ be total bank claims between country x and BIS reporting entity i, where some i are individual countries (the U.S., U.K., Netherlands, and Japan) but for confidentiality reasons other i are groups of countries.[17] Our measure of financial linkages (FL) first computes the GDP-weighted averages of episodes within each group; call this "group episodes", which will vary between zero and one.[18] Then for a country x, FL_x is a $BANK_{x,i}$-weighted average of the "group episodes" multiplied by a financial openness measure ($BANK_x/GDP_x$).

3.2.3. Country variables

To capture the domestic factors we use five variables. Depth of the financial system is the sum of each country's stock market capitalization divided by GDP from Beck and Demirgüç-Kunt (2009); in robustness tests we use other measures that are only available for smaller samples. Capital controls is a broad measure of the country's capital controls as calculated in Chinn and Ito (2008).[19] This statistic is one of the few measures of capital controls available back to 1985 for a broad sample of countries and we explore the impact of a range of other measures in Section 3.5. Real GDP growth is from the IFS, with the growth shock as the deviation between actual growth and the country's trend growth. Country indebtedness is public debt to GDP from the new database described in Abbas et al. (2010). We also include a control for GDP per capita.[20]

3.3. Baseline results

To assess whether global, contagion, and domestic factors are associated with surge, stop, flight, and retrenchment episodes, we estimate

[15] Most of the variables are available quarterly. For market statistics that are available at a higher frequency, we use quarterly averages. Economic statistics that are only available on an annual basis are calculated by approximating quarterly values based on the annual frequencies. Also, as specified in Eq. (5) each variable is lagged by one quarter unless noted.

[16] The VXO, as the old VIX is now known, is similar to the VIX. The VIX is calculated using a broader set of prices, but is only available starting in 1990. Table 6a shows that the correlation between the two measures is 99%, so we focus on the VXO for our baseline analysis to maximize sample size. Section 3.5 discusses alternative measures of risk.

[17] The groupings are: AT CY GR IE PT; BE LU; FR DE IT ES; FI DK NO SE; HK MO SG BH, BS BM KY AN PA; GG IM JE; BR CL MX; TR ZA; TW IN MY KR; and CH AU CA.

[18] The GDP-weighted average of episodes within a group is computed because we do not have the full matrix of bilateral banking claims, just claims vis-à-vis groups (and a few individual countries).

[19] We focus on the KAOPEN measure of capital controls in Chinn and Ito (2008), updated in April 2011. KAOPEN is based on the principal components from four binary variables reported by the IMF: (1) capital account openness; (2) current account openness; (3) the stringency of requirements for the repatriation and/or surrender of export proceeds; and (4) the existence of multiple exchange rates for capital account transactions. In order to be consistent with other measures of capital controls in the additional tests in Section 3.5, we reverse the sign so that a positive value indicates greater controls.

[20] All country-level variables, except for the index of capital controls, GDP per capita, and the contagion variables, are winsorized at the 1% level to reduce the impact of extreme outliers.

Table 4
Regression results: episodes of extreme capital flows.

	Surge	Stop	Flight	Retrenchment
Global factors				
Risk	–0.054**	0.023**	–0.031*	0.017**
	(0.016)	(0.004)	(0.017)	(0.006)
Liquidity	5.034	3.921	–4.535	3.806
	(4.684)	(4.744)	(4.806)	(4.688)
Interest rates	–0.007	0.058	–0.076	0.133**
	(0.051)	(0.042)	(0.063)	(0.040)
Growth	26.416**	–11.041**	4.955	–9.427**
	(9.501)	(2.594)	(5.622)	(2.852)
Contagion				
Regional	0.429	0.632**	0.474**	0.076
	(0.281)	(0.163)	(0.240)	(0.158)
Trade	0.848	1.093**	1.144	2.369**
	(0.995)	(0.541)	(1.732)	(0.658)
Financial	–0.818*	0.217**	–0.413	0.212*
	(0.444)	(0.095)	(0.409)	(0.126)
Domestic factors				
Financial system	–0.137	0.197	–0.169	–0.021
	(0.188)	(0.138)	(0.141)	(0.133)
Capital controls	0.004	–0.047	0.026	0.121**
	(0.074)	(0.052)	(0.068)	(0.059)
Debt to GDP	–0.005	0.002	–0.005**	–0.006**
	(0.003)	(0.002)	(0.003)	(0.003)
Growth shock	0.568*	–1.285**	0.657	-1.350**
	(0.328)	(0.628)	(0.558)	(0.381)
GDP per capita	0.003	0.000	0.009	0.001
	(0.006)	(0.004)	(0.007)	(0.006)
Observations	3 446	3 446	3 446	3 446

Notes: The dependent variable is a 0–1 variable indicating if there is an episode (surge, stop, flight or retrenchment). Variables are defined in Section 3.2. Estimates are obtained using the complementary logarithmic (or cloglog) framework which assumes that $F(\cdot)$ is the cumulative distribution function (cdf) of the extreme value distribution. To capture the covariance across episodes, the set of four episodes is estimated using seemingly unrelated estimation with robust standard errors clustered by country. ** is significant at the 5% level and * at the 10% level. Significant coefficients are shaded.

Table 5
Regression results: episodes based on net capital flows.

	Surge	Stop
Global factors		
Risk	-0.012	0.012
	(0.009)	(0.008)
Liquidity	7.524	-7.529
	(4.926)	(4.950)
Interest rates	-0.012	-0.008
	(0.051)	(0.039)
Growth	5.703	-10.323**
	(5.295)	(4.375)
Contagion		
Regional	-0.179	0.609
	(0.267)	(0.501)
Trade	0.988**	0.770**
	(0.256)	(0.238)
Financial	-0.978**	-1.321**
	(0.255)	(0.404)
Domestic factors		
Financial system	0.176	0.009
	(0.147)	(0.157)
Capital controls	0.026	0.121**
	(0.068)	(0.059)
Debt to GDP	-0.005**	-0.006**
	(0.003)	(0.003)
Growth shock	0.657	-1.350**
	(0.558)	(0.381)
GDP per capita	0.009	0.001
	(0.007)	(0.006)
Observations	3 501	3 501

Notes: Capital flow episodes are defined using the traditional methodology based on net capital flows instead of the methodology using gross capital flows developed in this paper. The dependent variable is a 0–1 variable indicating if there is an episode (either surge or stop). Variables are defined in Section 3.2. Estimates are obtained using the complementary logarithmic (or cloglog) framework which assumes that $F(\cdot)$ is the cumulative distribution function (cdf) of the extreme value distribution. To capture the covariance across episodes, the regressions are estimated using seemingly unrelated estimation with robust standard errors clustered by country. ** is significant at the 5% level and * at the 10% level. Significant coefficients are shaded.

Eq. (5) using a complimentary logarithmic framework that includes adjustments for covariances across episodes and robust standard errors clustered by country. Results are in Table 4.[21]

The variable that is most consistently significant in predicting all types of episodes is global risk. Higher levels of global risk are positively correlated with stops and retrenchment and negatively correlated with surges and flight (although only at the 10% significance level for flight). Extensive sensitivity tests (in Sections 3.5 and 3.6) show that these significant coefficients on risk are quite robust across a range of episode definitions, estimation frameworks, and the inclusion of other explanatory variables. Other global factors are significantly correlated with the probability of certain types of episodes, although usually not the full cycle of capital flow waves. For example, strong global growth is associated with a higher probability of surges and a lower probability of stops and retrenchment. Higher global interest rates are usually correlated with retrenchment episodes.

The middle block of Table 4 shows that contagion is also important, especially for stops and retrenchment. Countries are more likely to experience a stop or retrenchment episode if their major trading or financial partners just experienced the same type of episode. Countries are also more likely experience stops and flight if their neighbors had the same episode. These results suggest that not only global factors (the top block of Table 4), but also linkages to certain subsets of countries – through trade, finance, or just geography – also impact the probability of experiencing an extreme capital flow episode.

In contrast to these significant results for global and contagion factors, few domestic factors are consistently associated with a higher probability of an extreme capital flow episode. Stops are more likely in countries experiencing a negative growth shock; surges are more likely in countries with a positive growth shock; retrenchments are more likely in richer countries and flight episodes are more likely in countries with greater capital controls and lower debt. Moreover, as shown in the sensitivity analysis below, many of these results are not robust across alternative specifications. This series of estimates suggests that extreme capital flow episodes are associated primarily with global factors (especially risk) and contagion rather than domestic factors.

Just as noteworthy as the significant variables in Table 4 are those that are not significant. There is no evidence that capital controls reduce

[21] In the sensitivity analysis we show that the key results are robust to the inclusion of fixed effects. Country dummy variables should not be needed if we capture all of the country-specific factors determining whether a country has an episode. These dummy variables are usually jointly significant, however, indicating that we are (not surprisingly) unable to capture all country effects. Including these fixed effects, however, could cause a downward bias on coefficient estimates for country-specific variables that have a significant effect on the probability of an episode but are fairly constant over the sample period.

Table 6a
Correlations between risk measures.

	VXO	VIX	Quality spread	CSFB RAI
VXO	1.000			
VIX	0.992	1.000		
CSFB risk appetite index (RAI)	0.550	0.535	0.358	1.000
Variance risk premium (VRP)	0.692	0.712	0.443	0.428

Table 6b
Correlations between capital control measures.

	Capital controls	Fin integ.	Overall restrict.	Purch locally	Sales locally	Purch abroad	Sales abroad	Fin controls
Capital controls Chinn and Ito (2008), updated 2011	1.000							
Financial integration Lane and Milesi-Ferretti (2007)	−0.330	1.000						
Overall capital act restrictions Schindler (2009)	0.690	−0.257	1.000					
Restrictions on purchases locally by nonresidents Schindler (2009)	0.284	−0.205	0.594	1.000				
Restrictions on sale or issue locally by nonresidents Schindler (2009)	0.512	−0.210	0.624	0.332	1.000			
Restrictions on purchases abroad by residents Schindler (2009)	0.498	−0.159	0.782	0.328	0.375	1.000		
Restrictions on sale or issue abroad by residents Schindler (2009)	0.503	−0.198	0.758	0.482	0.558	0.579	1.000	
Financial controls Ostry et al. (2011)	0.486	−0.409	0.636	0.471	0.365	0.475	0.411	1.000
Forex regulations Ostry et al. (2011)	0.542	−0.459	0.602	0.457	0.426	0.381	0.275	0.618

Notes: All measures of capital controls have higher values if the country has greater capital controls, except the Lane and Milesi-Ferretti (2007) measure of financial integration which takes on a higher value if the country is more financially integrated (which usually implies fewer capital controls).

Table 7a
Coefficient on global risk variable with alternate measures of risk.

	Surge	Stop	Flight	Retrenchment	# Obs
Risk measured by:					
VXO	-0.054** (0.016)	0.023** (0.004)	-0.031* (0.017)	0.017** (0.006)	3 446
VIX	-0.070** (0.022)	0.028** (0.005)	-0.036* (0.020)	0.017** (0.006)	3 291
CSFB RAI	-0.052** (0.025)	0.129** (0.022)	-0.038 (0.028)	0.129** (0.024)	3 453
Volatility risk premium	-0.025** (0.010)	0.010** (0.002)	-0.009 (0.007)	0.003 (0.003)	3 291

See notes to Table 7b.
Significant coefficients are shaded.

a country's likelihood of having a surge or stop episode, and therefore controls do not seem to reduce the extreme volatility of foreign capital flows. Capital controls may increase the probability of domestic investors sending money abroad (flight), but this result has fluctuating significance in the sensitivity tests discussed below. Also noteworthy is that global liquidity and global interest rates are not significantly related to most extreme capital flow episodes. The only exception is that retrenchments are more likely when global interest rates are high. Finally, it is worth noting that flight episodes appear to be more idiosyncratic and harder to explain than other episodes.[22]

3.4. Regression results: gross versus net flows

As discussed in Section 2, previous work analyzing sudden surges/bonanzas and stops in capital flows focused on sudden increases or decreases in net capital flows, rather than disaggregating flows into gross flows by domestic or foreign investors. Table 5 uses our definition of extreme capital flow movements, but instead of focusing on gross flows uses the traditional measures based on net capital flows. The table shows the starkly different results when capital flows are not disaggregated by investors type. Global risk, which is associated with all types of episodes based on gross flows, is not significantly related to either surges or stops based on net flows. In fact, some of the coefficient estimates are now counterintuitive. For example, the results based on net flows suggest that countries are more likely to have stop episodes if they have more stringent capital controls and lower debt ratios.

These results support the key point raised throughout this paper that focusing on net capital flows instead of gross capital flows may miss important dynamics in capital flow movements. Although net capital flows may be the variable of interest for certain analyses, disaggregating capital flows by type of investor improves our understanding of the nature and composition of the flows. For example, global risk is not significantly related to surges or stops when measured based on net capital flows (Table 5), but is when episodes are measured based on gross flows (Table 4). This difference occurs because actions by foreign and domestic investors can counteract each other. Lower global risk is associated with an increase in both capital inflows from foreigners and capital outflows by domestic residents — and these large shifts in both flows may counteract each other so that changes in the aggregated net capital flows are small. Focusing on gross capital flows instead of net flows permits this more nuanced understanding of factors associated with extreme capital flow movements.

3.5. A closer look at global risk and capital controls

Two key results from our baseline analysis of extreme capital flow episodes are the significance of global risk and insignificance of capital controls. This section looks more closely at these results.

The finding that global risk is the most consistently significant factor associated with capital flow episodes (measured based on gross flows) has important implications for understanding capital flow movements. To better understand this role of risk, we use three different measures of

[22] For example, in a simple logit specification, the pseudo-R^2 is only 0.04 for flight episodes, increasing to 0.07, 0.13, and 0.15 for surges, retrenchments, and stops, respectively.

Table 7b
Coefficient on capital control variable with alternate measures of capital controls.

	Surge	Stop	Flight	Retrenchment	# Obs
Capital controls measured by:[1]					
Capital controls	0.004	-0.047	0.136**	0.034	3446
Chinn Ito (2008)	(0.074)	(0.052)	(0.063)	(0.050)	
Financial Integration	0.026	-0.131**	-0.035	-0.119**	3446
Lane Milesi-Ferretti (2007)	(0.037)	(0.049)	(0.084)	(0.045)	
Overall capital acct restrictions	0.417	-0.132	0.460	0.343	1783
Schindler (2009)	(0.466)	(0.405)	(0.460)	(0.354)	
Specific capital acct restrictions	0.259	-0.013	-0.076	0.379	1783
Schindler (2009)	(0.266)	(0.250)	(0.282)	(0.263)	
Financial controls	-0.028	-0.174	-0.023	0.690	1210
Ostry et al. (2011)	(0.587)	(0.386)	(0.409)	(0.492)	
Forex regulations	-1.172*	0.241	0.428	0.505	1240
Ostry et al. (2011)	(0.609)	(0.483)	(0.560)	(0.486)	

Notes: Tables 7a and 7b report the coefficients on either *global risk* or *capital controls* when the base regressions reported in Table 4 are estimated except the corresponding variable is replaced with one of the alternative measures listed in the table. See Table 4 for additional information on estimation technique and additional variables included in the regressions. ** is significant at the 5% level and * at the 10% level.
(1) All measures of capital controls have higher values if the country has greater capital controls, except the Lane and Milesi-Ferretti (2007) measure of financial integration which takes on a higher value if the country is more financially integrated. Significant coefficients are shaded.

risk (in addition to our baseline measure of the VXO): the VIX, the CSFB Risk Appetite Index (RAI), and the Variance Risk Premium (VRP).[23] The most common measures of risk – such as the VXO and the VIX – capture both economic uncertainty as well as risk aversion. The RAI is constructed with the aim of capturing only risk aversion (or risk appetite) while controlling for overall risk and uncertainty. Misina (2003) shows, however, that it may not control for changes in overall risk unless a strict set of theoretical conditions are met.[24] In contrast, the VRP index is based on a less rigid set of assumptions and therefore is a more accurate measure of risk aversion independent of expectations of future volatility (i.e., future risk). A minor disadvantage of the VRP (as well as the VIX) is that it is only available starting in 1990.

Table 6a shows the correlations between these different risk measures and Table 7a reports the estimated coefficients on the risk variable if the base regression reported in Table 4 is repeated with these alternate measures of risk (with the top line replicating the baseline results from Table 4). Throughout the table, the coefficient on risk continues to be highly significant, except in regressions for flight episodes, which continue to be more idiosyncratic. Broad measures of risk (the VXO, VIX and possibly the RAI) that capture both changes in economic uncertainty as well as changes in risk aversion are positively correlated with stop and retrenchment episodes and negatively correlated with surges. The measure that most accurately isolates changes in risk aversion (the VRP) is positively and significantly related to stops and negatively related to surges. This suggests that risk aversion (and not just increased economic uncertainty) is an important factor associated with stop and surge episodes.

A second key result from the baseline regressions in Table 4 is that a country's capital controls are not significantly related to any type of extreme capital flow episode (except that countries with greater controls are more likely to have flight episodes). This does not support the recent interest in capital controls as a means of reducing surges of capital inflows and overall capital flow volatility. To further explore this result, we use several different measures of capital controls. First, instead of a direct de jure measure of capital controls, we use a broad de facto measure of financial integration — the sum of foreign assets and liabilities divided by GDP.[25] Second, we consider a broad measure of capital account restrictions from Schindler (2009) that is only available from 1995 to 2005. Third, we use measures of capital account restrictions from the same source and time period, but that focus specifically on controls on just inflows or outflows.[26] Finally, we also use two new indices of capital controls from Ostry et al. (2011) that measure capital controls in the financial sector and regulations on foreign exchange.

Table 6b shows that the correlations between the different measures of capital controls are low, in part because they measure different aspects of controls. Table 7b shows the coefficient estimates on each of these capital control measures when we repeat the base regression from Table 4, but use the alternate measure of controls or financial integration (with the top line replicating the baseline results). For surges and stops, the episodes at which capital controls are generally directed, the coefficients on capital controls continue to be insignificant, even for the more detailed measures. The only exception when the coefficient on

[23] See section 3.2.1 for details on the VXO and VIX, which are nearly identical. The RAI is the beta coefficient of a cross-sectional regression of a series of risk-adjusted asset price returns in several countries on the past variance of these assets. This calculation is based on 64 global assets, including equities and bonds for all developed countries and major emerging markets. If the beta is positive, the price of riskier assets is rising relative to the price of safer assets, so risk appetite among investors is higher. For more information, see "Global Risk Appetite Index" a Market Focus Report by Credit Suisse First Boston (February 20, 2004). To simplify comparisons with the other risk measures, we reverse the sign of the RAI. The VRP is the difference between the risk-neutral and objective expectation of realized variance, where the risk-neutral expectation of variance is measured as the end-of-month observation of VIX-squared and de-annualized and the realized variance is the sum of squared 5-minute log returns of the S&P 500 index over the month; see Zhou (2010).

[24] Misina (2003) shows that the risk appetite index will measure risk aversion only in the presence of a rank effect in which the key condition is the linear independence of asset returns used to construct the index. This assumption is unlikely to hold.

[25] The financial integration data is from an updated and extended version of the dataset constructed by Lane and Milesi-Ferretti (2007), available at: http://www.philiplane.org/EWN.html.

[26] For regressions predicting surges and stops we use the index of controls on local purchases and sales, respectively, by nonresidents. For regressions predicting flight and retrenchments we use the index of controls on purchases or sales abroad, respectively, by residents.

Table 8a
Sensitivity tests — surge episodes.

	Drop crisis[1]	Fixed effects	Add ER regime[2]	Add moodys[2]	Global credit[3]	Financial system[3]	Growth shock[4]	Inc. official flows[5]	HP filter[5]
Global factors									
Risk	-0.053**	-0.053**	-0.053**	-0.063**	-0.054**	-0.055**	-0.053**	-0.054**	-0.022**
	(0.016)	(0.020)	(0.016)	(0.020)	(0.017)	(0.019)	(0.018)	(0.017)	(0.007)
Liquidity	5.911	5.139	5.104	6.151	1.423*	0.830	4.861	4.337	1.845
	(4.729)	(5.153)	(4.649)	(5.664)	(0.771)	(5.775)	(5.640)	(4.963)	(2.375)
Interest rates	-0.012	0.028	-0.008	-0.031	-0.012	-0.016	-0.005	-0.024	-0.000
	(0.051)	(0.075)	(0.051)	(0.069)	(0.055)	(0.064)	(0.057)	(0.052)	(0.030)
Growth	24.115**	26.334**	26.007**	22.576**	24.267**	15.771*	18.399**	25.840**	3.951
	(9.350)	(11.283)	(9.679)	(11.030)	(10.295)	(8.662)	(8.631)	(9.456)	(7.095)
Contagion									
Regional	0.377	0.548	0.446	0.517	0.500*	0.625*	0.540	0.365	0.485
	(0.273)	(0.367)	(0.284)	(0.381)	(0.298)	(0.353)	(0.333)	(0.283)	(0.404)
Trade	0.816	1.860	0.832	0.446	1.037	1.084	0.727	1.515**	0.558
	(0.944)	(1.693)	(0.992)	(1.087)	(0.982)	(0.984)	(1.017)	(0.494)	(0.407)
Financial	-0.894**	-0.842	-0.686	-0.642	-0.852*	-0.725*	-0.895*	-2.118**	0.362
	(0.453)	(0.590)	(0.434)	(0.462)	(0.442)	(0.373)	(0.469)	(0.877)	(0.363)
Domestic factors									
Financial system	-0.121	-0.233	-0.156	-0.229	-0.107	0.655	-0.123	-0.229	0.085**
	(0.194)	(0.397)	(0.188)	(0.193)	(0.180)	(0.545)	(0.201)	(0.189)	(0.043)
Capital controls	0.005	-0.054	-0.010	0.058	0.020	-0.030	-0.009	0.013	0.045*
	(0.074)	(0.112)	(0.073)	(0.092)	(0.082)	(0.085)	(0.082)	(0.074)	(0.024)
Debt to GDP	-0.004	-0.009	-0.005	-0.005	-0.004	-0.005*	-0.004	-0.005	0.002*
	(0.003)	(0.007)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.001)
Growth shock	0.664**	0.289	0.576*	0.856**	0.707**	0.572*	12.658**	0.562*	0.523
	(0.334)	(0.333)	(0.324)	(0.341)	(0.296)	(0.343)	(4.056)	(0.339)	(0.415)
GDP per capita	0.005	0.001	0.004	-0.006	0.002	-0.002	0.004	0.002	0.004
	(0.006)	(0.016)	(0.006)	(0.012)	(0.007)	(0.006)	(0.007)	(0.007)	(0.003)
Observations	3 242	3 446	3 446	2 958	3 291	3 313	3 291	3 446	3 202

Notes: The dependent variable is a 0–1 variable indicating if there is an episode (either surge, stop, flight or retrenchment). Variables are defined in Section 3.2. Estimates are obtained using the complementary logarithmic framework with seemingly unrelated estimation across the four episodes and robust standard errors clustered by country. ** is significant at the 5% level and * at the 10% level. (1) Drops the recent crisis from 2008Q2 through 2009Q2 from the sample. (2) Additional control variables are included in the regression; for ER regime the control is a dummy equal to 1 if the country has a pegged exchange rate as defined in Shambaugh (2004); for Moodys the control is a numerical value for Moody's index, with a higher value indicating lower credit. (3) Global liquidity is measured as the growth in private credit by deposit money banks and other institutions to GDP. Financial system measures the soundness of the financial system as bank return on equity. Both variables are from Beck and Demirgüç-Kunt (2009). (4) Growth shock is measured as the deviation between actual growth and forecasted growth, as forecast in the IMF's WEO in the previous spring. (5) Episodes are constructed by either including reserves in order to capture private and official flows instead of just private flows or by using an HP filter with a 30% boundary. Significant coefficients are shaded.

capital controls is significant at the 5% level is the regression for stops when financial integration is measured by international exposure through foreign assets and liabilities — more a measure of openness than of capital controls. The negative coefficient on financial integration in this case suggests that countries that are more integrated with global financial markets are less likely to experience stop episodes. The only other result that is significant at the 10% level is that FX regulations may be negatively associated with surges (although this result is not robust to several sensitivity tests).

3.6. Sensitivity tests

We conduct an extensive series of sensitivity tests, focusing on different time dimensions and estimation strategies, including additional control variables, using different measures for the control variables, and calculating the episodes using different techniques.

We begin by testing if the estimates are driven by the extreme volatility during the recent crisis (as shown in Fig. 3) by dropping the crisis period from 2008Q3 through 2009Q2 from the sample. We also estimate each of the equations using fixed effects. This strategy controls for each country's fixed characteristics over the sample period and therefore estimates how changes in each domestic variable from its mean for each country affects the probability of each country having a surge, stop, flight or retrenchment in each quarter. This is a different question than for the base estimates that do not include fixed effects and which instead estimate the effect of the level of each domestic characteristic (rather than the change from the country mean) on the probability of the country having an episode in each quarter. We also estimate the main model using a standard probit or logit estimation (instead of the cloglog) and estimate each equation in isolation instead of as part of system estimation.

In another set of sensitivity tests, we include additional control variables in the base regression to test if other factors affect the probability of having a capital flow episode. First, a number of models (Domeij and Flodén, 2006; Krueger and Ludwig, 2007) focus on the effect of demographics on capital flows. We follow Chinn and Prasad (2003) and include two controls for demographic trends — the "youth dependency ratio" and "old dependency ratio" defined as the population aged under 15 or over 65 respectively, both divided by the population aged 15 to 65.[27] Second we include a dummy variable equal to one if the country has a pegged exchange rate, based on the exchange rate classification in Shambaugh (2004).[28] Third, we include a measure of the country's credit rating to capture country risk that may not be captured in its debt ratio and other measures. We use the country's Moody's or S&P rating, with a numerical value assigned to each rating and a lower value indicating a higher ranking.[29] Fourth, we add a control for the

[27] We do not include a demographic variable in the main analysis as the theoretical and empirical works indicate that demographics affect capital flows over the medium and long term, but not necessarily over the shorter periods which are the focus of this paper.

[28] Updated classification data were kindly provided by the author. A country is classified as having a pegged exchange rate if it (a) has no fluctuation at all; (b) moves within 2% bands; or (3) has a one-time devaluation with 0% change after 11 months.

[29] For example, for Moody's an "aaa" rating is scored as a 1, a "aa1" rating is scored as a 2, etc. In each case a 1 is the lowest rating. Cantor and Packer (1996) show "that sovereign ratings effectively summarize and supplement the information contained in macroeconomic indicators."

Table 8b
Sensitivity tests — stop episodes.

	Drop crisis[1]	Fixed effects	Add ER regime[2]	Add moodys[2]	Global credit[3]	Financial system[3]	Growth shock[4]	Inc. official flows[5]	HP filter[5]
Global factors									
Risk	0.025**	0.020**	0.023**	0.024**	0.027**	0.025**	0.021**	0.016**	0.024**
	(0.006)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)
Liquidity	0.145	-0.421	3.932	7.784	2.647**	4.761	7.396*	-1.804	-1.858
	(4.932)	(5.196)	(4.748)	(5.333)	(0.865)	(4.030)	(4.296)	(4.633)	(2.391)
Interest rates	0.085*	0.062	0.057	0.099**	0.074*	0.071**	0.094**	0.034	0.031
	(0.045)	(0.056)	(0.041)	(0.049)	(0.043)	(0.033)	(0.035)	(0.043)	(0.020)
Growth	-12.389**	-4.092	-10.899**	-10.480**	-11.085**	-10.893**	-10.820**	0.192	-6.141**
	(2.772)	(3.099)	(2.606)	(3.014)	(2.728)	(2.853)	(2.692)	(3.248)	(1.853)
Contagion									
Regional	0.594**	0.654**	0.638**	0.531**	0.601**	0.580**	0.491**	0.420**	0.195**
	(0.156)	(0.168)	(0.162)	(0.177)	(0.166)	(0.163)	(0.157)	(0.141)	(0.093)
Trade	0.882	2.277**	1.090**	1.017*	1.101**	1.062**	0.623	0.583	0.547**
	(0.673)	(1.043)	(0.542)	(0.523)	(0.489)	(0.507)	(0.515)	(0.502)	(0.224)
Financial	0.159	0.812**	0.233**	0.246**	0.210**	0.252**	0.281**	1.521**	0.183
	(0.120)	(0.233)	(0.095)	(0.096)	(0.091)	(0.100)	(0.092)	(0.484)	(0.222)
Domestic factors									
Financial system	0.164	0.750**	0.195	0.187	0.249**	-1.008**	0.314**	0.289**	-0.030
	(0.141)	(0.234)	(0.137)	(0.132)	(0.122)	(0.378)	(0.121)	(0.107)	(0.045)
Capital controls	-0.061	-0.022	-0.054	-0.007	-0.049	-0.025	-0.020	-0.061	-0.048**
	(0.056)	(0.114)	(0.057)	(0.061)	(0.057)	(0.048)	(0.047)	(0.051)	(0.019)
Debt to GDP	0.002	-0.007	0.002	0.003	0.003	0.001	0.003*	0.001	-0.001
	(0.002)	(0.005)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
Growth shock	-1.282*	-1.422**	-1.289**	-1.322**	-1.310**	-1.199**	-23.516**	- 1.485**	-0.433
	(0.711)	(0.691)	(0.631)	(0.585)	(0.620)	(0.574)	(3.302)	(0.639)	(0.378)
GDP per capita	-0.000	-0.009	0.000	-0.001	-0.006	0.003	-0.000	0.002	-0.004*
	(0.005)	(0.011)	(0.004)	(0.006)	(0.005)	(0.003)	(0.004)	(0.004)	(0.002)
Observations	3 242	3 446	3 446	2 958	3 291	3 313	3 291	3 446	3 202

Notes: The dependent variable is a 0–1 variable indicating if there is an episode (either surge, stop, flight or retrenchment). Variables are defined in Section 3.2. Estimates are obtained using the complementary logarithmic framework with seemingly unrelated estimation across the four episodes and robust standard errors clustered by country. ** is significant at the 5% level and * at the 10% level. (1) Drops the recent crisis from 2008Q2 through 2009Q2 from the sample. (2) Additional control variables are included in the regression; for ER regime the control is a dummy equal to 1 if the country has a pegged exchange rate as defined in Shambaugh (2004); for Moodys the control is a numerical value for Moody's index, with a higher value indicating lower credit. (3) Global liquidity is measured as the growth in private credit by deposit money banks and other institutions to GDP. Financial system measures the soundness of the financial system as bank return on equity. Both variables are from Beck and Demirgüç-Kunt (2009). (4) Growth shock is measured as the deviation between actual growth and forecasted growth, as forecast in the IMF's WEO in the previous spring. (5) Episodes are constructed by either including reserves in order to capture private and official flows instead of just private flows or by using an HP filter with a 30% boundary. Significant coefficients are shaded.

country's terms-of-trade as measured by the World Bank's "Net Barter Terms of Trade Index". Finally, we control for a country's level of reserves to GDP.[30]

Then we use a number of different measures for the control variables (in addition to the different measures of risk and capital controls in Section 3.5). First, to measure global interest rates, instead of using the average rate on long-term government bonds in the United States, euro area, and Japan, we simply use the rate for the United States. Second, to measure global liquidity, we use private credit growth by deposit money banks and other financial institutions from Beck and Demirgüç-Kunt (2009). Third, to measure the size of the financial system, instead of using just the country's stock market capitalization to GDP, we use the sum of the country's stock market capitalization and private and public bond market capitalization to GDP (which limits the sample size). Fourth, to measure the strength of a country's financial system instead of its size, we use the return on equity for the banking system (also from Beck and Demirgüç-Kunt, 2009). Fifth, instead of measuring domestic growth shocks as the country's GDP growth versus a historic trend, we measure the shock versus growth as forecast in the spring WEO. Finally, we also exclude the control for GDP per capita.

As a final series of sensitivity tests, we implement different techniques for identifying the episodes of surges, stops, flight, and retrenchment. First, instead of using a historic moving average to calculate the episodes, we use an HP filter with episodes defined by 30% deviations from the stochastic trend. Second, instead of the traditional two-standard deviation cutoff we use a three-standard deviation cutoff for changes in capital flows to qualify as an episode, which greatly decreases the number of episodes. Third, we exclude transactions by the monetary authorities from the 3rd quarter of 2008 through the end of the sample in order to remove any effect of the currency swap arrangements by the Federal Reserve Board.[31] This has a minimal effect on the definitions of episodes. Fourth, we include reserves in our definition of outflows by domestic residents, thereby focusing on movements in both official and private capital flows instead of just private flows. This can affect the definition of flight and retrenchment episodes. Finally, we include errors and omissions in the underlying gross flows data, as specified in the online Appendix A, as a check on data quality issues.

The results of a sample of these sensitivity tests are reported in Tables 8a–8d and confirm the baseline results discussed above. We will focus on variables significant at the 5% level, a significance level that implies some degree of robustness; the tables also show which factors are significant at the 10% level. Most consistent across episodes is the importance of global variables, and especially global risk. Global risk is significantly related to surge, stop, and retrenchment episodes in each of the robustness tests, and is often (although not always) significantly related to flight episodes. This supports the focus of much of the recent theoretical literature that models how changes in global risk can be a key factor driving crises. This is also in line with Fratzscher (2011), which finds that global factors, and especially risk, account for a large

[30] Data from 2000 to 2010 are the sum of monthly reserve data as reported by the IMF. Pre-2000 data are quarterized versions of the annual Lane and Milesi-Ferretti (2007) dataset.

[31] See McGuire and von Peter (2009) for analysis of the swap arrangements.

Table 8c
Sensitivity tests — flight episodes.

	Drop crisis[1]	Fixed effects	Add ER regime[2]	Add moodys[2]	Global credit[3]	Financial system[3]	Growth shock[4]	Inc. official flows[5]	HP filter[5]
Global factors									
Risk	-0.038**	-0.036	-0.031*	-0.037**	-0.036**	-0.037**	-0.034**	-0.050**	-0.009
	(0.016)	(0.023)	(0.017)	(0.018)	(0.016)	(0.015)	(0.017)	(0.019)	(0.011)
Liquidity	-3.797	-3.273	-4.360	-1.785	0.900	-4.934	-2.304	-8.361	-2.596
	(4.824)	(5.274)	(4.750)	(5.683)	(0.792)	(5.761)	(5.403)	(5.822)	(2.679)
Interest rates	-0.073	-0.096	-0.074	-0.089	-0.053	-0.049	-0.059	-0.125**	-0.024
	(0.062)	(0.106)	(0.064)	(0.078)	(0.059)	(0.074)	(0.070)	(0.063)	(0.032)
Growth	7.724	1.844	4.737	5.986	3.368	2.766	4.026	16.456**	2.674
	(5.565)	(6.813)	(5.665)	(6.272)	(5.444)	(5.135)	(5.333)	(7.878)	(6.766)
Contagion									
Regional	0.456*	0.668**	0.479**	0.428	0.378	0.329	0.435*	0.022	0.593
	(0.255)	(0.259)	(0.238)	(0.266)	(0.231)	(0.218)	(0.237)	(0.246)	(0.366)
Trade	1.014	0.808	1.162	1.071	1.330	1.282	1.237	0.583	0.450
	(1.306)	(3.083)	(1.759)	(1.767)	(1.828)	(1.518)	(1.718)	(0.601)	(0.404)
Financial	-0.566*	0.083	-0.314	-0.352	-0.429	-0.463	-0.365	-0.723	0.472
	(0.295)	(2.460)	(0.465)	(0.421)	(0.391)	(0.388)	(0.436)	(0.970)	(0.382)
Domestic factors									
Financial system	-0.152	-0.346	-0.183	-0.277*	-0.184	0.626	-0.196	-0.660**	0.029
	(0.164)	(0.403)	(0.141)	(0.145)	(0.139)	(0.572)	(0.142)	(0.215)	(0.060)
Capital controls	0.124*	0.216	0.120*	0.161**	0.162**	0.105*	0.135**	0.140**	0.038
	(0.064)	(0.135)	(0.063)	(0.074)	(0.066)	(0.061)	(0.067)	(0.066)	(0.025)
Debt to GDP	-0.006**	-0.010*	-0.005**	-0.007**	-0.005**	-0.004**	-0.005**	-0.002	0.001
	(0.002)	(0.006)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.001)
Growth shock	0.074	-0.148	-0.006	0.182	0.035	-0.100	2.043	1.469**	0.225
	(0.402)	(0.430)	(0.388)	(0.391)	(0.411)	(0.434)	(3.795)	(0.423)	(0.324)
GDP per capita	0.012*	0.000	0.010	0.006	0.010	0.002	0.009	0.019**	0.005*
	(0.007)	(0.017)	(0.007)	(0.010)	(0.007)	(0.005)	(0.007)	(0.007)	(0.003)
Observations	3 242	3 446	3 446	2 958	3 291	3 313	3 291	3 446	3 202

Notes: The dependent variable is a 0–1 variable indicating if there is an episode (either surge, stop, flight or retrenchment). Variables are defined in Section 3.2. Estimates are obtained using the complementary logarithmic framework with seemingly unrelated estimation across the four episodes and robust standard errors clustered by country. ** is significant at the 5% level and * at the 10% level. (1) Drops the recent crisis from 2008Q2 through 2009Q2 from the sample. (2) Additional control variables are included in the regression; for ER regime the control is a dummy equal to 1 if the country has a pegged exchange rate as defined in Shambaugh (2004); for Moodys the control is a numerical value for Moody's index, with a higher value indicating lower credit. (3) Global liquidity is measured as the growth in private credit by deposit money banks and other institutions to GDP. Financial system measures the soundness of the financial system as bank return on equity. Both variables are from Beck and Demirgüç-Kunt (2009). (4) Growth shock is measured as the deviation between actual growth and forecasted growth, as forecast in the IMF's WEO in the previous spring. (5) Episodes are constructed by either including reserves in order to capture private and official flows instead of just private flows or by using an HP filter with a 30% boundary. Significant coefficients are shaded.

share of global capital flow patterns immediately before and during the recent crisis. Other global factors are significantly related to some, but not all, types of episodes. As in the baseline regression, global growth is often (but not always) significantly associated with surges, stops and retrenchments and higher global interest rates are associated with retrenchments.

The results for the contagion variables are also largely consistent with the baseline regressions and suggest that cross-country linkages through trade and finance are important in explaining stop and retrenchment episodes, with an additional role for geographic location in explaining stops. Domestic variables also continue to show less consistent patterns. There is some evidence that: country's with stronger domestic growth are less likely to experience stops and more likely to experience surges; wealthier countries are more likely to experience retrenchments; country's with lower debt burdens and greater capital controls are more likely to experience flight; and countries with larger financial systems may be more likely to experience stops. The significance of each of these results, and often the sign, however, fluctuate across specifications. Other relationships between domestic variables and episodes are weak or vary greatly by specification.

Finally, just as noteworthy are some coefficients that are consistently insignificant. Capital controls are not significantly related to the probability of having surge, stop, or retrenchment episodes. There is no evidence that reduced integration with global financial markets, including through the use of capital controls, is associated with a reduced vulnerability to episodes caused by foreigners. Greater global liquidity is rarely associated with an increased probability of any type of episode. This does not support recent concerns that increased liquidity from major economies (such as through quantitative easing) significantly increases the probability of surges of capital inflows into other countries after controlling for other variables. A country's financial system (whether measured by size or efficiency) does not have any significant relationship with surge, flight, or retrenchment episodes. This does not support a recent focus of the theoretical literature on global imbalances on the role of the financial system in driving capital inflows from abroad and outflows by domestic investors. Global interest rates have no significant relationship with surges or flight after controlling for other factors.

4. Conclusions

This paper has developed a new methodology to analyze extreme movements in capital flows using data on both inflows and outflows by domestic and foreign investors. Compared to previous work that focused only on net capital flows, this new methodology yields substantially different definitions of periods of "surges" and "stops" when foreign investors substantially increase or decrease capital flows to a country. We also identify periods of "flight" and "retrenchment" when domestic investors substantially increase or decrease their capital flows abroad. This more detailed disaggregation of capital flows is critically important to understand what drives capital flow waves.

The analysis finds that global factors, and especially global risk, are key to understanding periods of extreme capital flows by domestic and foreign investors. Increases in global risk predict sudden stops in capital flows by foreigners and retrenchments in capital flows by

Table 8d
Sensitivity tests — retrenchment episodes.

	Drop crisis[1]	Fixed effects	Add ER regime[2]	Add moodys[2]	Global credit[3]	Financial system[3]	Growth shock[4]	Inc. official flows[5]	HP filter[5]
Global factors									
Risk	0.030**	0.015**	0.017**	0.017**	0.022**	0.018**	0.014**	0.016**	0.012**
	(0.009)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)
Liquidity	1.042	1.848	3.848	5.375	2.255**	3.533	4.708	3.869	3.176
	(4.747)	(5.011)	(4.722)	(5.648)	(0.855)	(4.701)	(4.847)	(5.133)	(2.033)
Interest rates	0.154**	0.153**	0.134**	0.136**	0.129**	0.119**	0.135**	0.043	0.064**
	(0.043)	(0.058)	(0.040)	(0.045)	(0.040)	(0.041)	(0.038)	(0.039)	(0.019)
Growth	-11.812**	-3.449	-9.371**	-7.930**	-9.417**	-10.741**	-8.859**	1.582	-4.213**
	(2.999)	(3.210)	(2.845)	(2.998)	(3.083)	(2.980)	(2.926)	(3.138)	(1.593)
Contagion									
Regional	0.077	0.011	0.080	0.205	-0.042	0.063	0.097	0.649**	0.091
	(0.154)	(0.191)	(0.159)	(0.154)	(0.154)	(0.167)	(0.156)	(0.130)	(0.149)
Trade	1.856**	4.287**	2.369**	2.150**	2.489**	2.434**	2.106**	1.338**	0.741**
	(0.710)	(1.001)	(0.658)	(0.647)	(0.653)	(0.657)	(0.660)	(0.453)	(0.191)
Financial	0.112	0.628**	0.220*	0.243*	0.213	0.187	0.254**	0.538	0.036
	(0.133)	(0.193)	(0.125)	(0.125)	(0.133)	(0.128)	(0.124)	(0.437)	(0.198)
Domestic factors									
Financial system	0.007	0.349	-0.022	0.002	0.006	-0.773**	0.041	0.168*	0.058
	(0.135)	(0.244)	(0.134)	(0.143)	(0.136)	(0.393)	(0.136)	(0.090)	(0.064)
Capital controls	0.033	-0.054	0.031	0.047	0.056	0.027	0.049	-0.004	-0.030*
	(0.053)	(0.108)	(0.053)	(0.063)	(0.053)	(0.050)	(0.052)	(0.054)	(0.018)
Debt to GDP	-0.002	-0.008*	-0.001	-0.001	0.000	0.001	-0.000	-0.002	-0.000
	(0.002)	(0.005)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Growth shock	0.399	0.186	0.263	0.135	0.282	0.318	-12.798**	-1.087**	-0.147
	(0.595)	(0.597)	(0.519)	(0.603)	(0.492)	(0.508)	(3.015)	(0.476)	(0.303)
GDP per capita	0.013**	0.011	0.016**	0.018**	0.012**	0.013**	0.016**	0.008*	-0.003
	(0.005)	(0.011)	(0.004)	(0.005)	(0.005)	(0.003)	(0.004)	(0.004)	(0.002)
Observations	3 242	3 446	3 446	2 958	3 291	3 313	3 291	3 446	3 202

Notes: The dependent variable is a 0–1 variable indicating if there is an episode (either surge, stop, flight or retrenchment). Variables are defined in Section 3.2. Estimates are obtained using the complementary logarithmic framework with seemingly unrelated estimation across the four episodes and robust standard errors clustered by country. ** is significant at the 5% level and * at the 10% level. (1) Drops the recent crisis from 2008Q2 through 2009Q2 from the sample. (2) Additional control variables are included in the regression; for ER regime the control is a dummy equal to 1 if the country has a pegged exchange rate as defined in Shambaugh (2004); for Moodys the control is a numerical value for Moody's index, with a higher value indicating lower credit. (3) Global liquidity is measured as the growth in private credit by deposit money banks and other institutions to GDP. Financial system measures the soundness of the financial system as bank return on equity. Both variables are from Beck and Demirgüç-Kunt (2009). (4) Growth shock is measured as the deviation between actual growth and forecasted growth, as forecast in the IMF's WEO in the previous spring. (5) Episodes are constructed by either including reserves in order to capture private and official flows instead of just private flows or by using an HP filter with a 30% boundary. Significant coefficients are shaded.

domestic investors. Decreases in global risk predict surges in capital inflows by foreigners and flight in capital outflows by domestic investors. The relationship between global risk and capital flows appears to work primarily through changes in economic uncertainty, although changes in risk aversion are also significantly related to stops and surges of foreign capital flows. Global growth can also predict certain types of episodes (surges, stops and retrenchments). Contagion through financial linkages, trade flows, or simple geographic proximity is also important. The results indicate a less important role for domestic factors in explaining episodes. Flight episodes, when domestic investors send more money abroad, appear to be more idiosyncratic and harder to explain than other types of extreme capital flow movements.

Our results provide insights that inform theoretical approaches to modeling sharp movements in capital flows. The primary role of global risk supports the recent focus in several theoretical papers on global factors, and especially global risk, as a primary cause of crises. Our results are less supportive of theoretical models that focus mainly on changes in interest rates or liquidity in a major economy, such as the United States, as the major factor driving capital flows. Higher global interest rates are associated with more retrenchment episodes, but global liquidity is rarely significant in predicting any type of episode.[32] Finally, the results show that positive domestic growth shocks affect foreign but not domestic investors, thereby providing mixed support for theoretical work focusing on domestic productivity shocks as key determinants of capital flows (such as the real business cycle literature).

The results also have important implications for policymakers concerned about capital flow volatility. Waves of capital flows can present substantial macroeconomic challenges, whether from waves of capital inflows that cause currency appreciation and/or asset bubbles or "undertows" as capital outflows cause a collapse in exchange rates and asset prices. One country characteristic that has recently received substantial support in order to reduce this volatility – capital controls – is not significantly associated with a reduced occurrence of surges, stops, or other capital flow episodes. Most factors related to capital flow volatility – such as changes in global risk, global growth, and contagion – are outside the control of policymakers in most countries. This suggests that governments may wish to focus more on strengthening their country's ability to withstand capital flow volatility rather than to attempt to directly reduce this volatility. This also suggests an important role for global institutions and cross-country cooperation for policymakers that hope to reduce the sharp volatility of global capital flows.

Finally, our results suggest that to understand the dynamics of capital flow waves it is important to disaggregate capital flows by foreign and domestic investors. Domestic and foreign agents can respond differently to shocks, due to factors such as different exposures to the domestic exchange rate or different degrees of access to liquidity. In some cases their responses could partially counterbalance each other, leading to greater stability in net flows. In other cases their actions could magnify each other, increasing the instability of net flows. In yet other cases, only one set of investors may show any significant response to certain shocks or policy actions. (For example, higher domestic growth is correlated

[32] Bekaert et al. (2010) find that a lax monetary policy decreases risk aversion after about 5 months, so it is possible that the risk measure may be capturing a lagged effect of monetary policy.

with stronger inflows of investment from foreigners, but has no significant effect on capital flow episodes driven by domestics.) A more complete understanding of these dynamics of not only how, but why, domestic and foreign investors respond to different types of shocks is critically important to better understand the drivers of extreme capital flow episodes.

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Appendix A. Supplementary data

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