Facing volatile capital flows: The role of exchange rate flexibility and foreign assets

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Motivation

- Gross Capital flows have become more volatile over time in recent decades (Broner et al, 2013).

- As a policy response, some countries have considered the **flexibility of the exchange rate** to be the "first line of defense" against these volatile flows. A "second line of defense" is the **simmetrical opening of the capital account** (Governor De Gregorio, 2010, for the case of Chile).

Motivation

- This paper assesses empirically these statements, by studying the role of the flexibility of the exchange rate regime and the availability of foreign assets in facing volatile capital flows.

- We can think of this in two ways:

The first line of defense

- First, foreign investors behind a potentially large and unexpected move in funds internationally will behave differently if the exchange rate they face is fixed or flexible. In the case of the latter, the impact on the price of their move should reduce the amount of the desired portfolio change as per compared to the former.

- In adittion, the risk of this price change should make the prospect of investing in a country more risky, and deter speculative movements.

- Ceteris paribus, a more flexible exchange rate should **reduce the likelihood of a large, sudden change in capital flows by non-residents**.

The second line of defense

- Secondly, the "price" signal (movement in the exchange rate) given by the large and unexpected change in non-residents desired holdings of assets in local currency, may generate a response in the desired portfolio holdings by residents; ideally, of the opposite sign.

- We test this view in two steps, by studying the role of our variables of interest in:
  - The **likelihood of a contrarian, off-setting movement in flows by residents to the initial change**, and
  - The **degree in that a change in flows by non-residents is compensated in flows by residents, i.e., that impact in net flows**.

Agenda

1. Related Literature
2. Data and Metrics
3. Probabilities of Stops and Surges
4. Probability of off-setting events
5. Magnitudes of compensations
6. Conclusions

1. Related Literature

Related literature

- Forbes and Warnok (2011) study the determinants of **gross** events over assets and liabilities (stops, surges, retrenchments and flights) for advanced and emerging economies with quarterly data.
  - Global factors (VIX, US interest rate) are the most important determinants of these episodes. Contagion, especially through trade and the bilateral exposure of banking systems, is important in determining stop and retrenchment episodes.
  - Domestic macroeconomic characteristics are generally less important.
- Gosh et al (2012) focus on **net** quarterly surges (occurrence and magnitude) in emerging market economies
  - Surges are synchronized internationally as push factors are the main determinant. The exchange rate regime is an important factor for the magnitude of a surge.

Related literature

- IMF (2013) highlight the importance of contrarian movements by residents. Adjustment to surges is mostly private (80%), while only 20% is via reserve accumulation.

- Broner et al (2013) report that gross flows are more volatile and increasingly larger than **net** flows. During expansions funds go abroad, and during contractions they return home.

2. Data and Metrics

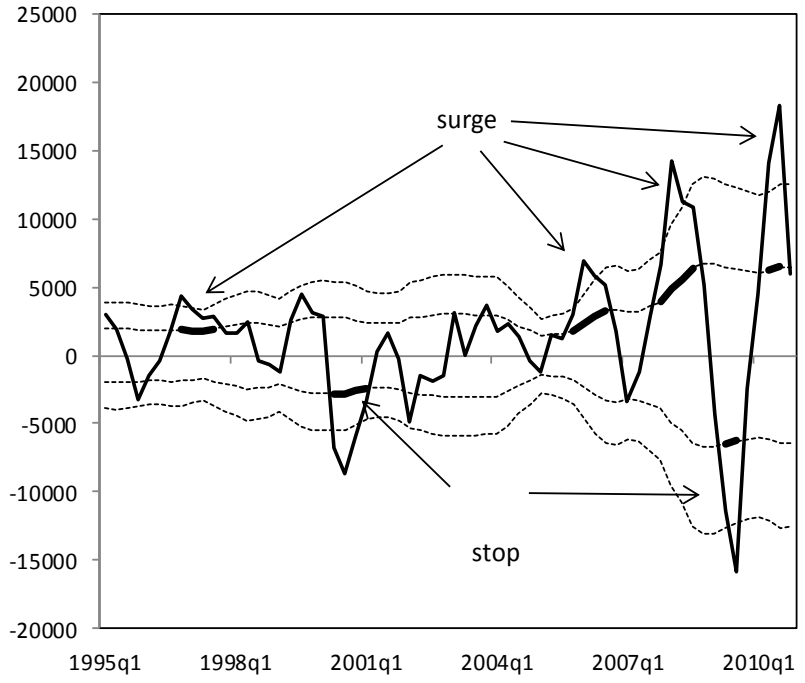
Data and Metrics

- Using Balance of Payments Data and we apply the definition of Forbes and Warnock (2011) to identify relevant changes in gross flows:
  - Surges and Stops in inflows
  - Flights and Retrenchments in outflows

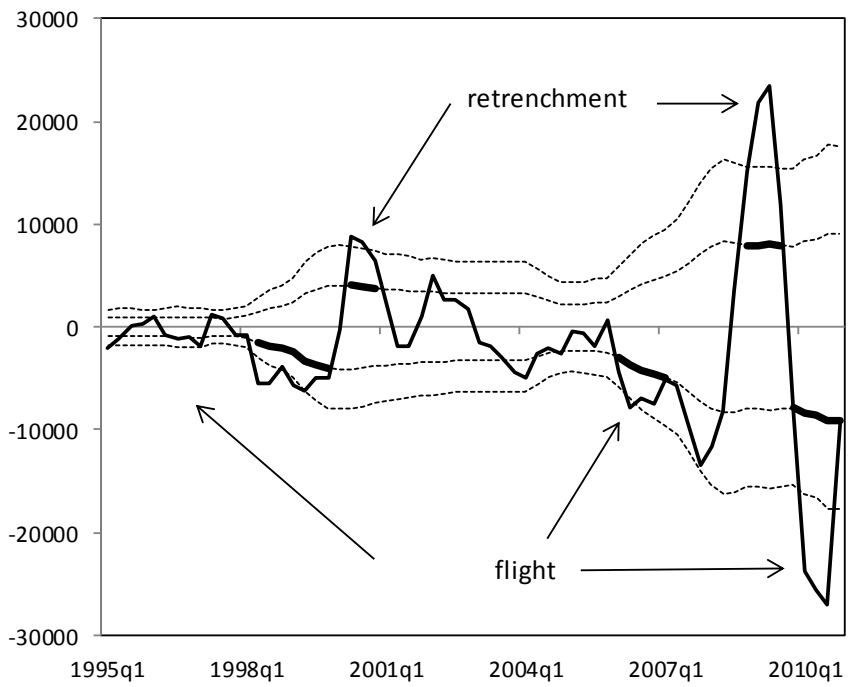
- An event is defined as a group of successive periods were flows are larger than its rolling standard deviation in all of them, and larger than twice this standard deviation at least once of the periods.

Example of events according to Forbes and Warnock (2011)

Gross inflows

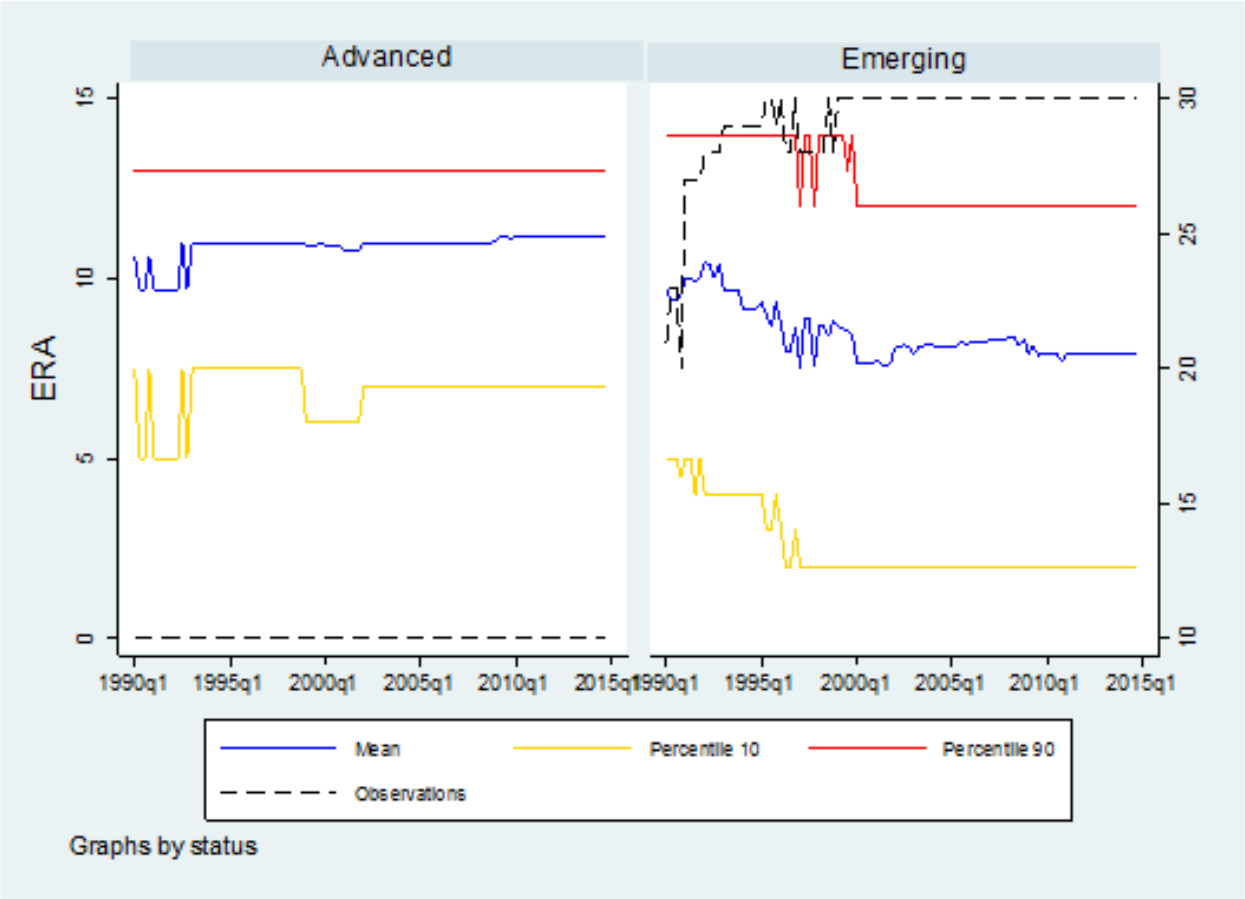


Gross outflows



Data on Flexibility of Exchange Rate Regime (Reinhart and Rogoff, 2002)

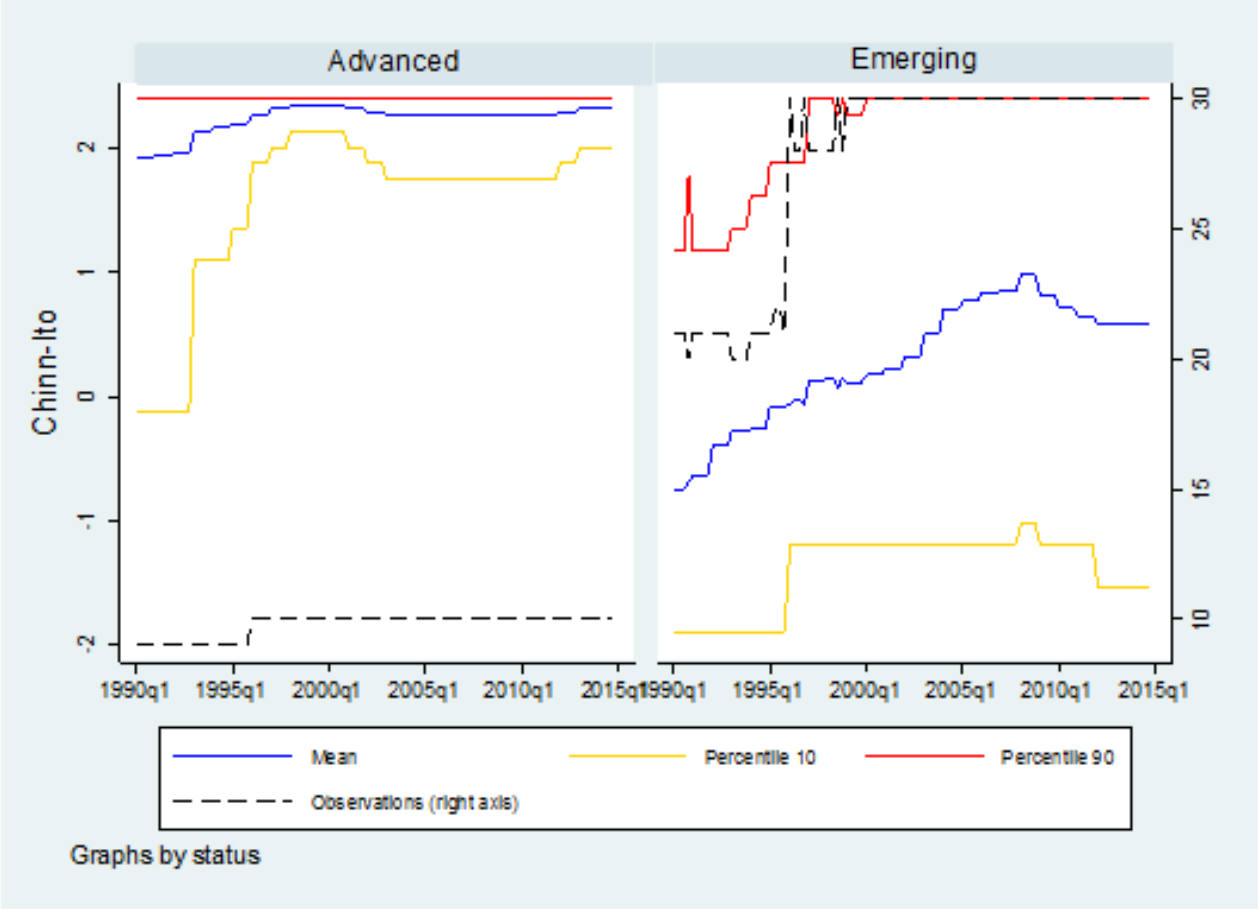
Exchange rate regime by type of economy



Based on ERA fine defined by Reinhart & Rogoff (2002).

There is a reversal in the degree of openness in Emerging Market countries around 2009.

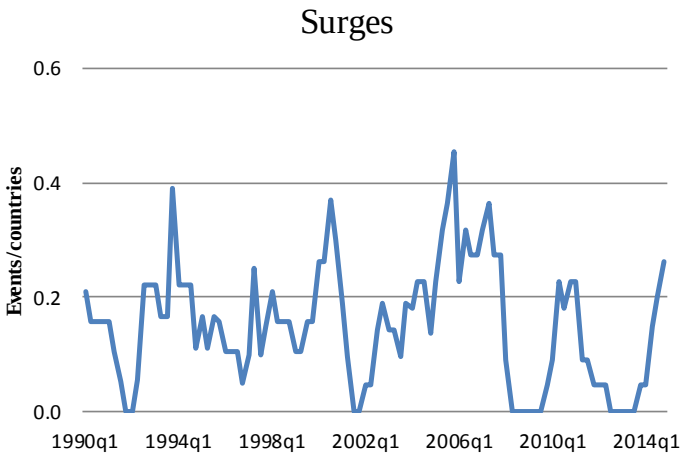
Capital account openness by type of economy

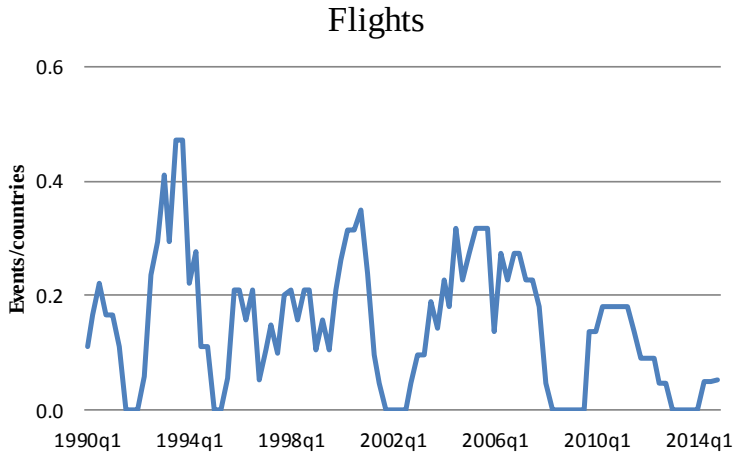


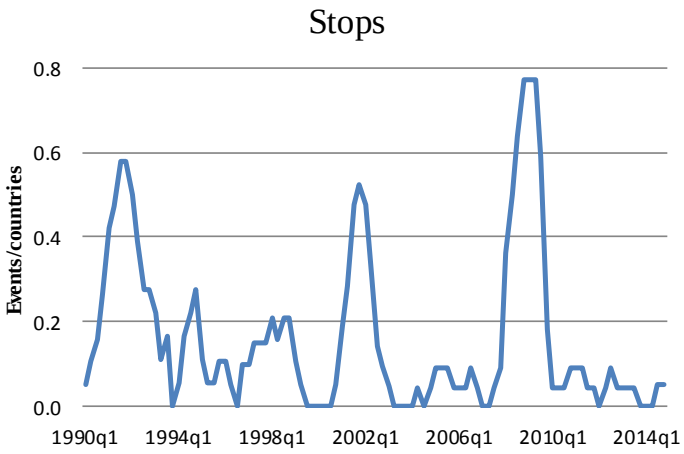
Based on Chinn & Ito (2008, 2013).

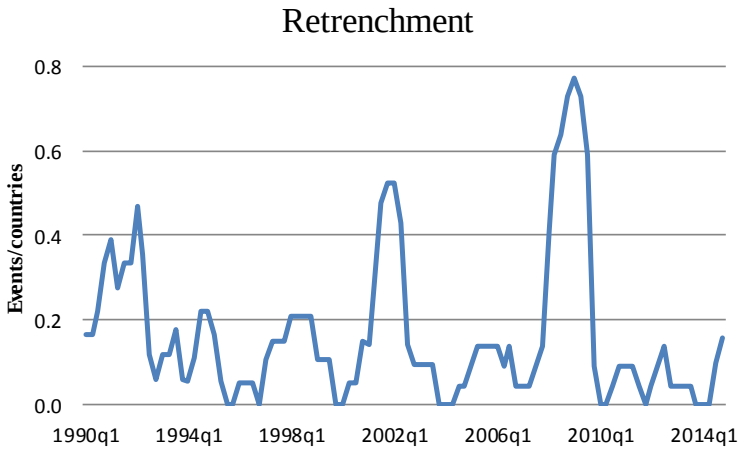
3. Probability of Stops and Surges

Frequency of events in Advanced Economies



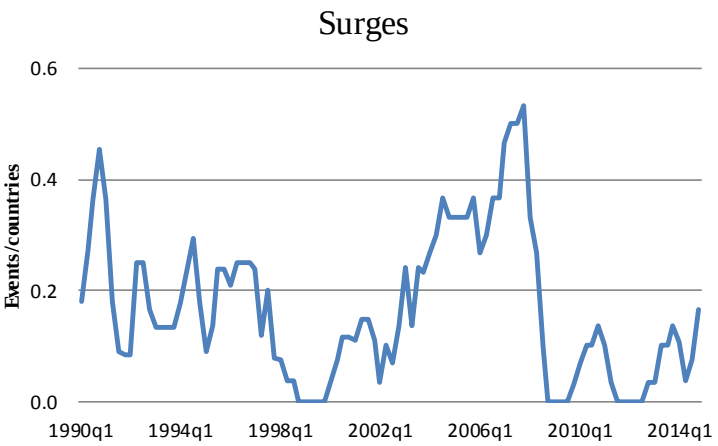


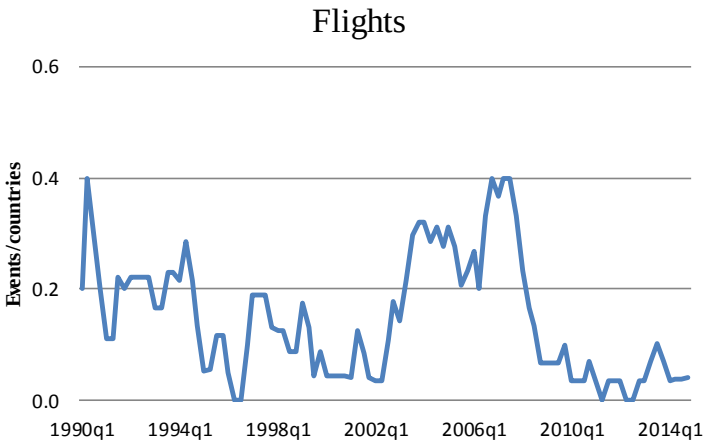


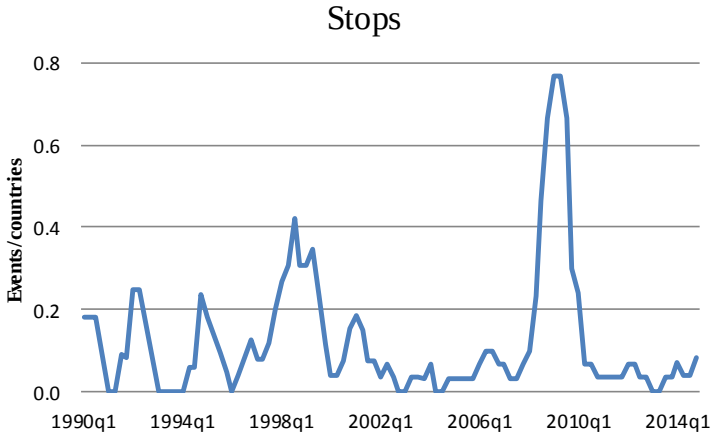


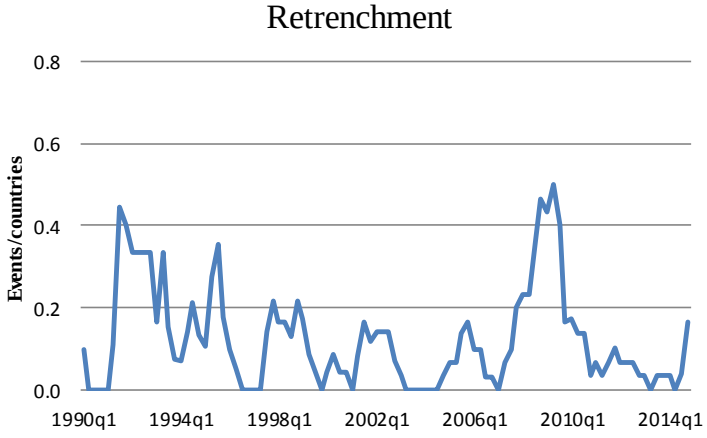
Note: Number of events over the number of countries during each period.

Frequency of events in Emerging Market Economies









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The period 2005-09 is the one with more events, followed by 1990-94.

	Stops		Surges		Retrenchments		Flights	
	All	non-fdi	All	non-fdi	All	non-fdi	All	non-fdi
Advanced	16%	16%	15%	15%	17%	16%	15%	13%
Emerging	13%	12%	16%	15%	12%	13%	14%	13%
1990-1994	19%	17%	18%	17%	20%	18%	19%	19%
1995-1999	15%	15%	13%	14%	12%	13%	13%	12%
2000-2004	9%	7%	16%	14%	10%	9%	15%	14%
2005-2009	24%	25%	24%	18%	24%	26%	20%	17%
2010-2014	5%	4%	8%	9%	6%	5%	5%	6%
Total general	**14%**	**14%**	**16%**	**14%**	**14%**	**14%**	**14%**	**13%**

Probability of Stops: Determinants

Variables	ALL	ALL	ALL	ALL
VIX (in logs)	0.6070***	0.6228***	0.6335***	0.6483***
GDP growth G3	-0.2000***	-0.1974***	-0.1968***	-0.1941***
Commodity price index (non-energy)	-0.0156***	-0.0171***	-0.0161***	-0.0175***
Global Liquidity	-0.0077	-0.0065	-0.0064	-0.0053
Short term real interest rate G3	0.1900***	0.2012***	0.1903***	0.2009***
GDP per capita	0.0749	0.1945***	0.1360**	0.2560***
Credit rating worsening	0.1031**	0.1027**	0.1013**	0.1015**
GDP growth	-0.0792***	-0.0806***	-0.0799***	-0.0812***
Surges(-4)	0.6003***	0.6126***	0.6003***	0.6114***
Capital account openness (difference w.r.t. n		-0.1595***		-0.1616***
Exchange rate regime (difference w.r.t mean			-0.1705***	-0.1731***
Log likelihood	-772.1	-764.7	-768.1	-760.8
Pseudo R-squared	0.391	0.393	0.388	0.391

All models are estimated using random effects, and they contain 2,647 observations for 38 countries.

Probability of Stops: Determinants

Variables	ALL	Advanced	Emerging
VIX (in logs)	0.6483***	1.1142***	0.4990***
GDP growth G3	-0.1941***	-0.1881***	-0.1879***
Commodity price index (non-energy)	-1.7502***	-0.8673	-2.1212***
Global Liquidity	-0.5283	-0.9904	-0.2342
Short term real interest rate G3	0.2009***	0.2490***	0.1754***
GDP per capita	0.2560***	0.1141	0.2807***
Credit rating worsening	0.1015**	0.0958	0.1084**
GDP growth	-0.0812***	-0.1030**	-0.0810***
Surges(-4)	0.6114***	0.5119***	0.6876***
Capital account openness (difference w.r.t. mean)	-0.1616***	-0.2819*	-0.1782***
Exchange rate regime (difference w.r.t mean)	-0.1731***	-0.0835	-0.1879**
Observations	2,647	688	1,959
Number of countries	38	8	30
Log likelihood	-760.8	-222.3	-527.4
Pseudo R-squared	0.391	0.479	0.341

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Probability of Surges: Determinants

Variables	ALL	ALL	Advanced	Emerging
VIX (in logs)	-0.5016***	-0.5057***	-0.4531**	-0.5844***
GDP growth G3	0.0602*	0.0585*	0.2827***	0.0103
Commodity price index (non-energy)	0.0097**	0.0102**	-0.0013	0.0106**
Global Liquidity	0.0162***	0.0155***	0.0069	0.0193***
Short term real interest rate G3	0.0891***	0.0858***	0.0797**	0.1002***
GDP per capita	0.1044*	0.0544	0.2599	0.0595
Credit rating worsening	0.0042	0.0046	-0.1030	0.0163
GDP growth	0.1158***	0.1156***	0.1018**	0.1133***
Δ International reserves (% GDP, q/q)	0.0682***	0.0691***	0.0032	0.0730***
Capital account openness (difference w.r.t. mean)		0.0627	0.0774	0.0502
Exchange rate regime (difference w.r.t mean)		0.0020	-0.0346	0.0368
Observations	2,702	2,700	713	1,987
Number of countries	38	38	8	30
Log likelihood	-1034	-1032	-274.4	-746.8
Pseudo R-squared	0.230	0.234	0.234	0.238

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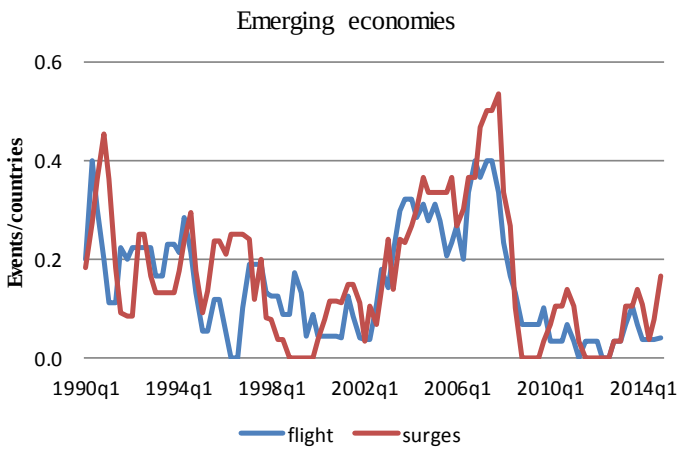
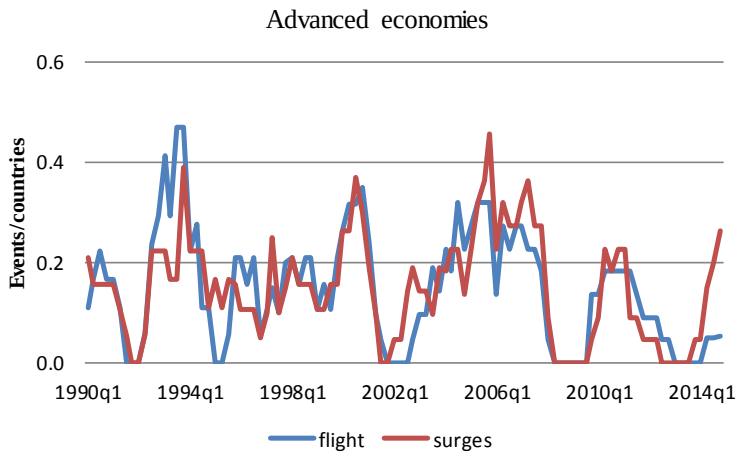
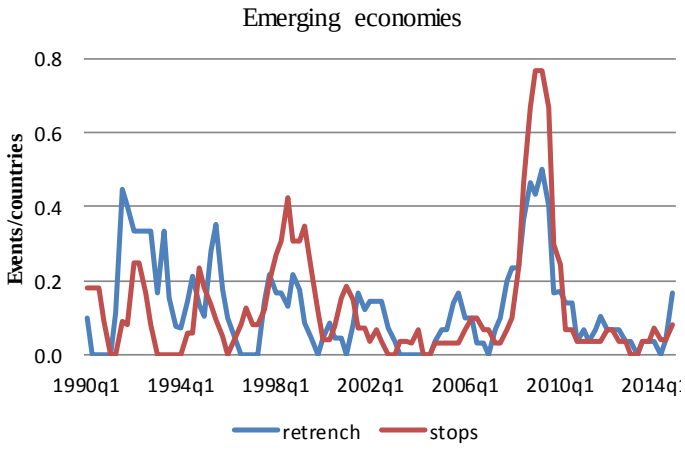
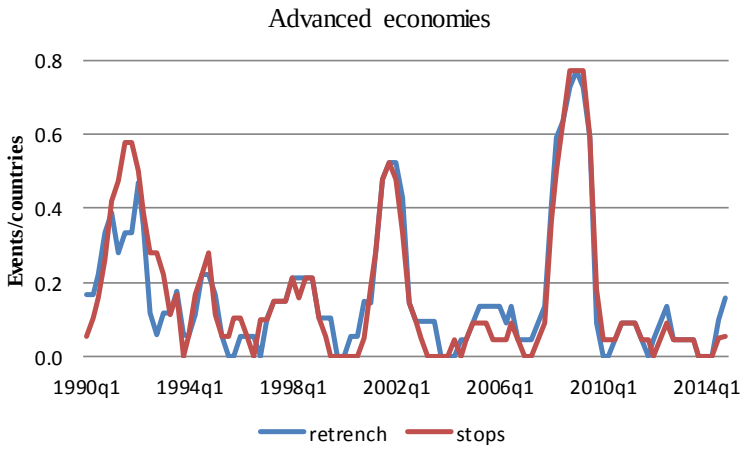
4. Probability of an off-setting event

Frequency of events





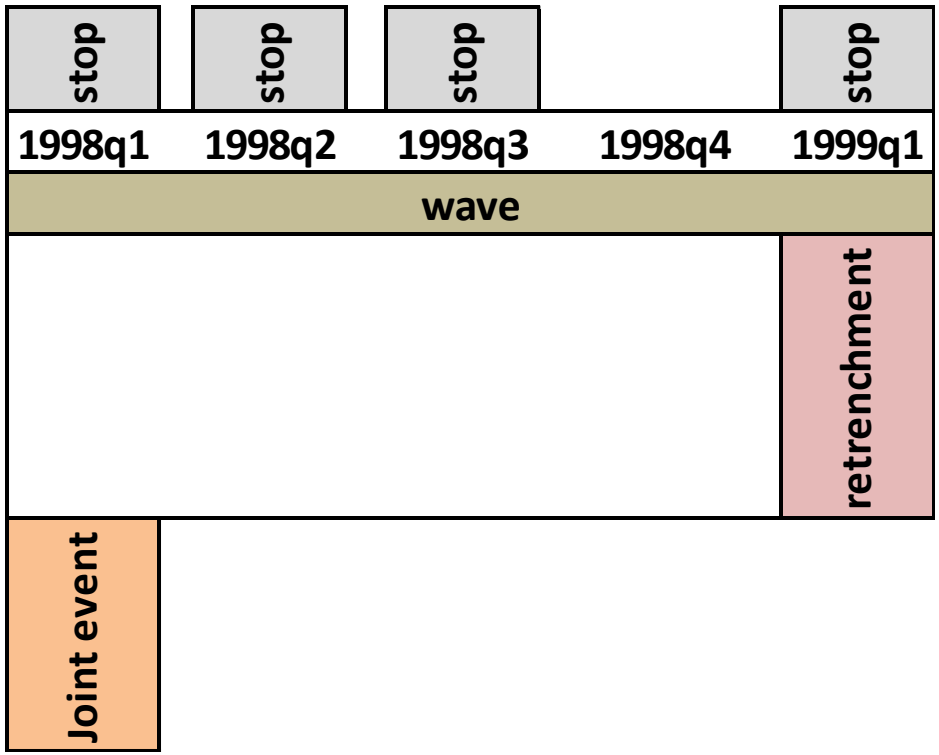




Note: Number of events over the number of countries during each period.

Definition of joint events

- A joint event is defined when a retrenchment (flight) happens during any quarter of an stop (surge) wave
- It takes the initial position of the wave. For example,



Contrarian events are substantially more frequent than reinforcing ones. The extent of this differs between Advanced and Emerging economies.

	Probability of a Retrenchment given a Stop		Probability of a Flight given a Stop		Probability of a Retrenchment given a Surge		Probability of a Flight given a Surge	
country	All	non-fdi	All	non-fdi	All	non-fdi	All	non-fdi
Africa	40%	31%	3%	2%	10%	18%	40%	33%
Emerging Asia	33%	32%	11%	17%	11%	10%	43%	38%
Eastern Europe	39%	41%	4%	6%	6%	9%	38%	33%
Europe	83%	66%	1%	1%	1%	1%	64%	52%
Latam	18%	20%	13%	13%	10%	6%	33%	28%
Odev	55%	53%	0%	1%	0%	2%	64%	51%
Total	**55%**	**49%**	**4%**	**5%**	**5%**	**6%**	**48%**	**41%**

Probability of Retrenchments given Stops: Determinants

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VIX (in logs)	0.8952**	0.9395***	0.8532**	0.9964***	0.9392**	0.9848**	0.9684**
GDP growth shock	0.0390	0.0663	0.0450	0.0428	0.0553	0.0548	0.0620
GDP per capita	0.5891***				0.3971***	0.4408**	0.2619
Stock of foreign assets (% of GDP)		1.7920***			1.0593**	1.0428**	1.3628**
Capital account openness (difference w.r.t. mean)			0.2181**			-0.0621	
Exchange rate regime (difference w.r.t mean)				0.4849***			0.3205**
Observations	104	104	104	104	104	104	104
Number of countries	38	38	38	38	38	38	38
Log likelihood	-55.89	-56.77	-65.10	-62.55	-53.12	-52.99	-51.12
Pseudo R-squared	0.265	0.249	0.126	0.159	0.298	0.302	0.324

All models are estimated using random effects. Each observation corresponds to a wave of stop events.

Probability of Flights given Surges: Determinants

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VIX (in logs)	-0.8778**	-0.8714**	-0.9271**	-0.7842**	-0.8869**	-0.9428**	-0.8320**
GDP growth shock	0.1670**	0.1565**	0.1785**	0.1618**	0.1660**	0.1788**	0.1646**
GDP per capita	0.2147**				0.1777		
Stock of foreign assets (% of GDP)		0.4159*			0.1442	0.2965	0.3410
Capital account openness (difference w.r.t. mean)			0.1450			0.0961	
Exchange rate regime (difference w.r.t mean)				0.2404*			0.1990
Observations	114	114	113	114	114	113	114
Number of countries	39	39	39	39	39	39	39
Log likelihood	-71.17	-72.14	-70.95	-72.10	-71.05	-70.27	-71.05
Pseudo R-squared	0.144	0.128	0.150	0.129	0.146	0.158	0.145

All models are estimated using random effects. Each observation corresponds to a wave of surge events.

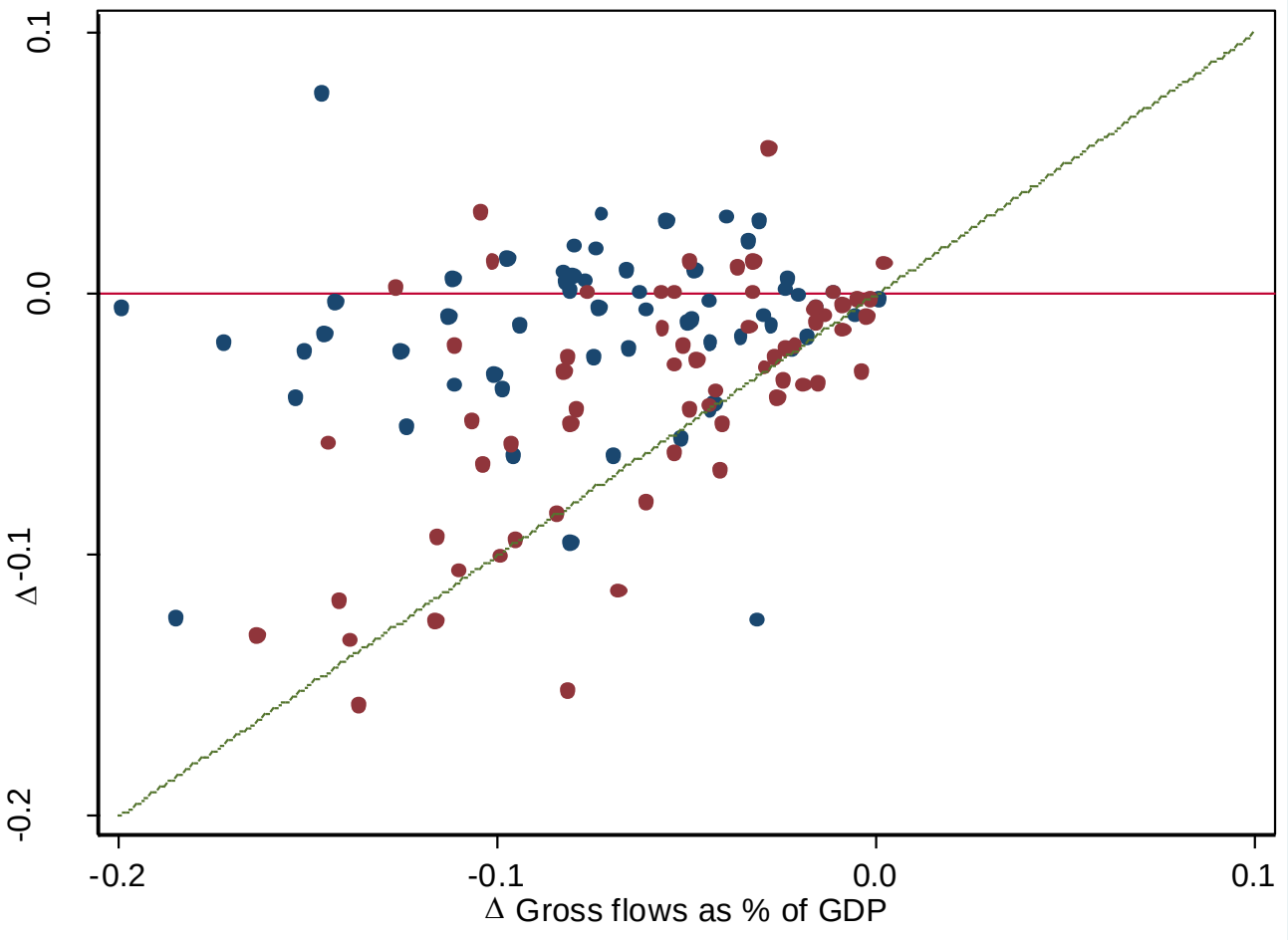
5. Magnitude of Compensations

- Rather than considering the existence of a compensating event, we measure the extent of the compensation.

$$I_i = \frac{\sum_{j=1}^{k} \Delta NetFlows_{ij}}{\sum_{j=1}^{k} \Delta GrossFlows_{ij}}$$

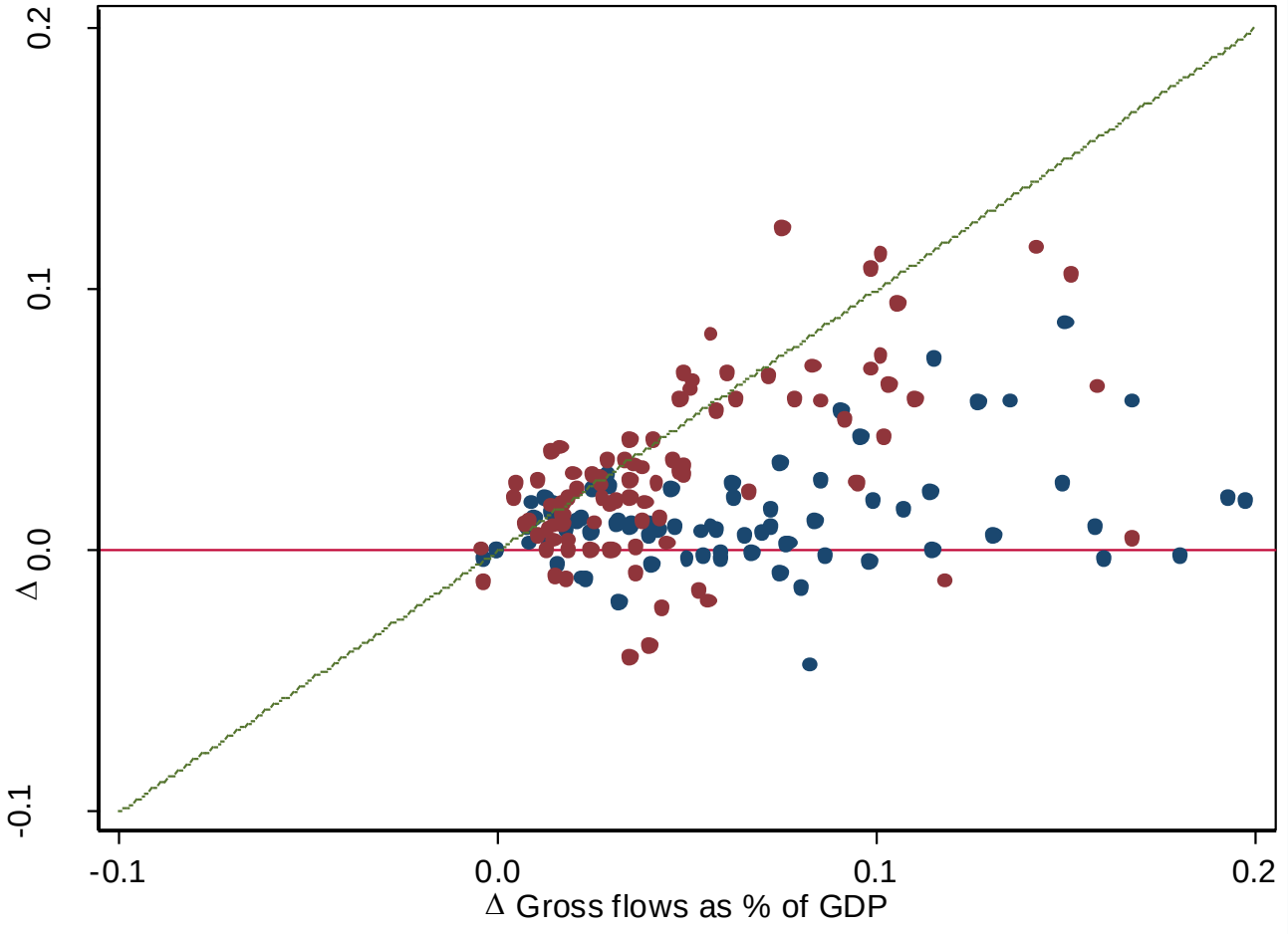
- Accumulated changes in Gross and Net flows, for event that begins in period *i* and lasts for *k* periods.

Net flows versus Gross inflows: Stops



Red stands for emerging economies, while blue stands for advanced economies.

Net flows versus Gross inflows: Surges



Red stands for emerging economies, while blue stands for advanced economies.

Determinants of the magnitude of compensation of Stops

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP per capita	-0.2623***				-0.1954*	-0.2930**	-0.2388***	-0.1683
	(0.006)				(0.074)	(0.014)	(0.009)	(0.115)
Stock of foreign assets (% of GDP)		-0.4975***			-0.2699**			-0.2820**
		(0.000)			(0.015)			(0.014)
Capital account openness (difference w.r.t. mean)			-0.1182*			0.0438		
			(0.056)			(0.549)		
Exchange rate regime (difference w.r.t mean)				-0.1944***			-0.1483**	-0.1526**
				(0.009)			(0.022)	(0.018)
Observations	98	98	98	98	98	98	98	98
Number of countries	37	37	37	37	37	37	37	37
Log likelihood	-140.2	-141.5	-144.1	-143.1	-139.4	-140.1	-138.8	-137.9
R2-adjusted	0.0898	0.0663	0.0154	0.0347	0.0964	0.0824	0.106	0.114

All models are estimated with robust errors. Each observation corresponds to a wave of stop events.

Determinants of the magnitude of compensation of Surges

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP per capita	-0.1329***				-0.0521	-0.1605***	-0.1302***	-0.0787
	(0.001)				(0.336)	(0.008)	(0.001)	(0.336)
Stock of foreign assets (% of GDP)		-0.3812***			-0.3042***			-0.3061***
		(0.000)			(0.006)			(0.009)
Capital account openness (difference w.r.t. mean)			-0.0566			0.0386		0.0410
			(0.185)			(0.535)		(0.560)
Exchange rate regime (difference w.r.t mean)				-0.0484			-0.0131	-0.0124
				(0.497)			(0.854)	(0.877)
Observations	124	124	122	124	124	122	124	122
Number of countries	40	40	40	40	40	40	40	40
Log likelihood	-152.1	-150.8	-152.4	-154.4	-150.5	-150.3	-152	-148.7
R2-adjusted	0.0336	0.0535	0.00111	-0.00400	0.0496	0.0274	0.0259	0.0354

All models are estimated with robust errors. Each observation corresponds to a wave of surge events.

6. Conclusions

- The impact of the flexibility of exchange rate regime and of foreign assets on the likelihood of events on non-resident flows and ocurrence and magnitude of off-setting events, varies widely depending on the event being a Stop or a Surge.
- The expected signs are significant for the three approaches relating Stops.
- For the case of Surges, only foreign assets is significant in explaining a high degree of compensation of gross flows.
- We also find that a more open capital account reduces the likelihood of Stops occurring.

Facing volatile capital flows: The role of exchange rate flexibility and foreign assets

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Central Bank of Chile

Reykjavík, April 28 2016

Extra slides

Probability of quarterly events vary between 10% and 19%. In most regions, the difference between all flows and non-fdi is small.

Frequency of events
(Quarters, 1990q1 2014q4)

	Stops		Surges		Retrenchments		Flights	
	All	non-fdi	All	non-fdi	All	non-fdi	All	non-fdi
Africa	13%	17%	19%	11%	16%	14%	11%	13%
Emerging Asia	15%	14%	17%	15%	11%	14%	16%	17%
Eastern Europe	13%	12%	19%	15%	12%	14%	15%	13%
Europe	16%	16%	15%	15%	17%	16%	15%	13%
Latam	10%	10%	13%	14%	11%	11%	13%	11%
Odev	17%	14%	16%	12%	14%	16%	14%	15%
Total general	**14%**	**14%**	**16%**	**14%**	**14%**	**14%**	**14%**	**13%**

Surges and Flights are (slightly) more frequent than Stops and Retrenchments

Frequency of events
(Quarters, 1990q1 2014q4)

	Stops		Surges		Retrenchments		Flights	
	All	non-fdi	All	non-fdi	All	non-fdi	All	non-fdi
Argentina	16%	14%	8%	10%	12%	12%	15%	11%
Brazil	12%	12%	18%	19%	18%	12%	15%	10%
Chile	11%	3%	9%	9%	11%	11%	16%	14%
Colombia	0%	12%	19%	26%	13%	7%	10%	10%
Costa Rica	13%	13%	29%	23%	4%	11%	7%	20%
Ecuador	16%	14%	14%	14%	6%	6%	12%	12%
Indonesia	12%	8%	16%	15%	4%	12%	16%	25%
India	14%	13%	24%	23%	9%	12%	23%	21%
Korea	12%	11%	11%	12%	13%	18%	13%	9%
Malaysia	22%	22%	11%	8%	11%	11%	25%	17%
Mexico	5%	9%	9%	11%	18%	20%	9%	4%
Pakistan	16%	16%	22%	15%	20%	17%	7%	11%
Peru	13%	14%	15%	8%	5%	5%	19%	20%
Philippines	14%	13%	18%	13%	8%	10%	19%	25%
Thailand	21%	20%	11%	15%	13%	12%	13%	12%
Uurugay	0%	0%	8%	8%	10%	10%	0%	0%
Venezuela	9%	8%	9%	9%	7%	7%	13%	11%
Total	**13%**	**12%**	**16%**	**15%**	**12%**	**13%**	**14%**	**13%**

Frequency of events
(Quarters, 1990q1 2014q4)

	Stops		Surges		Retrenchments		Flights	
	All	non-fdi	All	non-fdi	All	non-fdi	All	non-fdi
Australia	18%	15%	21%	16%	16%	17%	11%	13%
Canada	15%	9%	18%	12%	9%	16%	16%	18%
Denmark	19%	22%	8%	16%	18%	18%	13%	6%
Japan	18%	18%	11%	11%	16%	17%	12%	10%
Norway	21%	19%	19%	14%	19%	13%	14%	14%
New Zealand	14%	10%	13%	10%	11%	14%	15%	17%
Sweden	14%	16%	9%	7%	16%	14%	8%	11%
Switzerland	9%	9%	9%	7%	14%	14%	7%	7%
United Kingdom	15%	15%	13%	13%	20%	20%	12%	10%
United States	19%	16%	15%	10%	17%	17%	17%	15%
Total	**16%**	**16%**	**15%**	**15%**	**17%**	**16%**	**15%**	**13%**

Euro-zone countries

Frequency of events
(Quarters, 1990q1 2014q4)

	Stops		Surges		Retrenchments		Flights	
	All	non-fdi	All	non-fdi	All	non-fdi	All	non-fdi
Belgium	9%	16%	11%	11%	23%	27%	9%	9%
Finland	18%	15%	15%	24%	15%	18%	27%	18%
France	18%	18%	11%	6%	19%	16%	9%	9%
Germany	15%	17%	13%	13%	20%	19%	10%	10%
Portugal	14%	11%	20%	17%	13%	14%	17%	15%
Slovenia	7%	7%	18%	22%	14%	14%	15%	15%
Spain	16%	17%	11%	18%	19%	13%	19%	13%
Total	**16%**	**16%**	**15%**	**15%**	**17%**	**16%**	**15%**	**13%**

Frequency of retrenchments given stops is higher in 2005-09

	Probability of a Retrenchment given a Stop		Probability of a Flight given a Stop		Probability of a Retrenchment given a Surge		Probability of a Flight given a Surge	
	All	non-fdi	All	non-fdi	All	non-fdi	All	non-fdi
Advanced	75%	63%	1%	1%	1%	1%	64%	52%
Emerging	32%	33%	8%	11%	8%	8%	38%	33%
1990-1994	49%	50%	7%	7%	6%	6%	44%	46%
1995-1999	34%	33%	5%	3%	5%	3%	56%	46%
2000-2004	70%	35%	4%	5%	2%	3%	47%	46%
2005-2009	67%	61%	3%	6%	6%	9%	53%	42%
2010-2014	37%	34%	0%	0%	5%	5%	35%	24%
Total	**55%**	**49%**	**4%**	**5%**	**5%**	**6%**	**48%**	**41%**

	Probability of a Retrenchment given a Stop		Probability of a Flight given a Stop		Probability of a Retrenchment given a Surge		Probability of a Flight given a Surge	
country	All	non-fdi	All	non-fdi	All	non-fdi	All	non-fdi
Argentina	13%	29%	13%	14%	0%	0%	75%	60%
Brazil	25%	25%	25%	0%	28%	11%	39%	26%
Chile	60%	100%	0%	0%	13%	13%	63%	50%
Colombia		0%		0%	0%	0%	46%	33%
Costa Rica	0%	0%	14%	29%	6%	8%	0%	0%
Ecuador	0%	0%	0%	0%	0%	0%	14%	14%
India	0%	0%	44%	88%	13%	21%	53%	36%
Indonesia	25%	0%	0%	43%	0%	11%	29%	11%
Korea	75%	91%	0%	0%	0%	0%	73%	50%
Malaysia	50%	38%	13%	13%	0%	0%	0%	33%
Mexico		44%		0%	0%	0%	56%	27%
Pakistan	0%	0%	8%	0%	39%	27%	22%	36%
Peru	0%	0%	18%	42%	23%	29%	0%	0%
Philippines	57%	54%	21%	15%	0%	8%	22%	23%
Thailand	24%	25%	0%	0%	0%	0%	91%	60%
Venezuela	14%	17%	14%	17%	0%	0%	57%	57%
Total	**24%**	**26%**	**12%**	**16%**	**8%**	**8%**	**40%**	**32%**

	Probability of a Retrenchment given a Stop		Probability of a Flight given a Stop		Probability of a Retrenchment given a Surge		Probability of a Flight given a Surge	
country	All	non-fdi	All	non-fdi	All	non-fdi	All	non-fdi
Australia	56%	40%	0%	7%	0%	6%	52%	25%
Canada	33%	44%	0%	0%	0%	0%	72%	33%
Denmark	84%	55%	0%	0%	0%	0%	38%	13%
Japan	72%	67%	0%	0%	0%	0%	82%	91%
Norway	61%	44%	0%	0%	0%	0%	50%	58%
New Zealand	7%	10%	0%	0%	0%	0%	54%	60%
Sweden	86%	63%	0%	0%	0%	0%	33%	29%
Switzerland	100%	100%	0%	0%	0%	0%	80%	100%
United Kingdom	100%	80%	0%	0%	0%	0%	92%	62%
United States	89%	81%	0%	0%	0%	0%	67%	60%
Total	**69%**	**58%**	**0%**	**1%**	**0%**	**1%**	**62%**	**53%**

All countries

	GDP per capita (log)	Stock of foreign assets	Capital Account Openness	Exchange rate regime
GDP per capita (log)	1			
Stock of foreign assets	0.5979*	1		
Capital Account Openness	0.6350*	0.4159*	1	
Exchange rate regime	0.1088*	0.0217	-0.0235	1

Advanced no Euro Zone

	GDP per capita (log)	Stock of foreign assets	Capital Account Openness	Exchange rate regime
GDP per capita (log)	1			
Stock of foreign assets	0.4829*	1		
Capital Account Openness	0.044	0.2462*	1	
Exchange rate regime	-0.0444	-0.1881*	-0.1343*	1

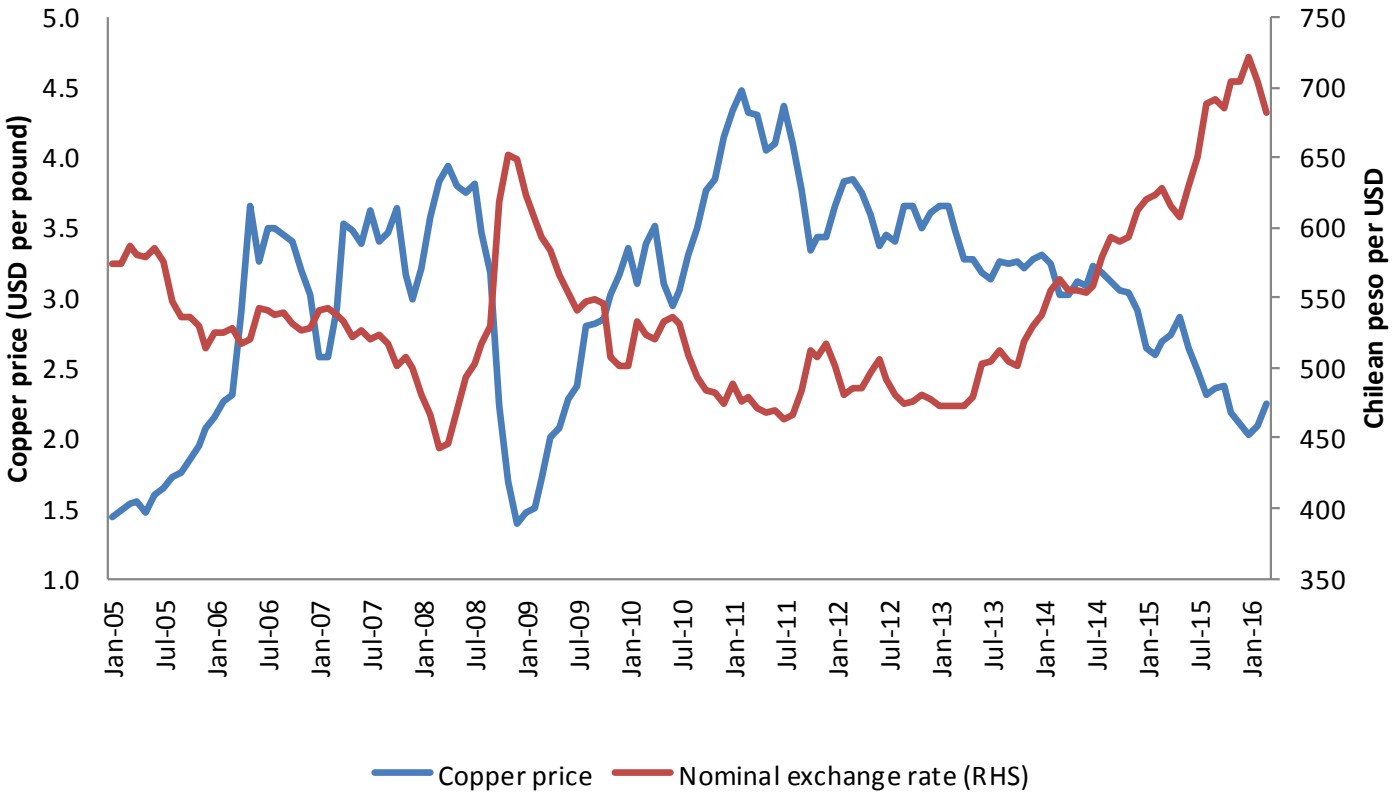
Emerging Economies

	GDP per capita (log)	Stock of foreign assets	Capital Account Openness	Exchange rate regime
GDP per capita (log)	1			
Stock of foreign assets	0.4607*	1		
Capital Account Openness	0.4232*	0.2213*	1	
Exchange rate regime	-0.0857*	-0.1625*	-0.2140*	1

List of advanced non Euro and emerging economies involved in the probability of surges and stops regressions.

Advanced countries non Euro	**Emerging countries**			
Australia	Argentina	Ecuador	Malaysia	Slovak Rep.
Canada	Brazil	Estonia	Mexico	Thailand
Japan	Bulgaria	Hungary	Pakistan	Turkey
New Zealand	Chile	India	Peru	Ukraine
Norway	Colombia	Indonesia	Philippines	Uruguay
Sweden	Costa Rica	Korea	Poland	Venezuela
United Kingdom	Croatia	Latvia	Romania	
United States	Czech Rep.	Lithuania	Russia	

Price of Cooper and Nominal Exchange Rate



Nominal and Real Exchange Rate