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Capital Inflow Surges in Emerging Economies: How Worried Should LAC Be?

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June 2012

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Abstract[1]

This paper analyzes capital inflow surges in emerging economies from 1980 to 2005. Estimated probit models are used, which discriminate well between surges associated with banking crises or recessions, and those surges that end without such events. The results indicate that the composition of inflows and the extent of financial reform are significant determinants of outcomes. Estimated models are applied to the Latin American post-2005 inflow surge and find relatively high estimated probabilities for banking crises and recessions. This suggests that recent inflow surges characterized by high portfolio and banking inflows are a potential cause for concern and that the results constitute a prima facie case for macro prudential interventions.

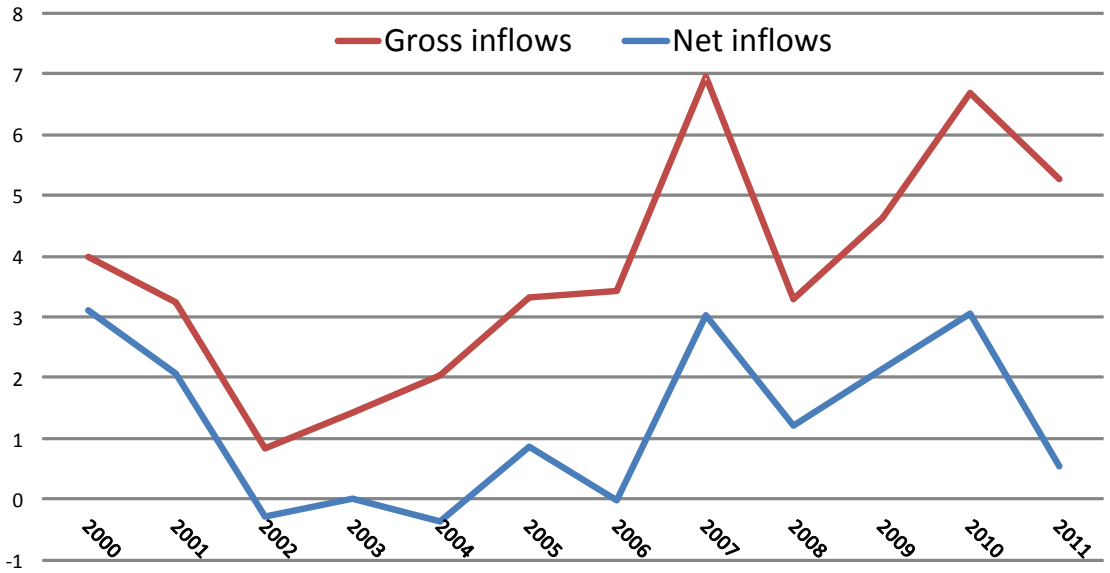
JEL classifications: E44, F34, G01, C25
Keywords: Banking crisis, Financial crisis, Probit

[1] The authors are at the Research Department of the Inter-American Development Bank. The views in this paper are strictly those of the authors and do not reflect the official views of the Inter-American Development Bank, the Board of Directors or the countries that they represent. We wish to thank Julián Caballero, Stephen Ceccetti, Augusto de la Torre, Umberto della Mea, Christian Daude, Eduardo Fernández-Arias, Arturo Galindo, Wagner Guerra, Luis Oscar Herrera, Santiago Levy, Eduardo Levy-Yeyati, Eduardo Lora, Alessandro Rebucci, Alan Taylor, Hernando Vargas and Frank Warnock for valuable comments on this work.

1. Introduction

In the years leading up to and immediately after the global economic crisis of 2008-2009, Latin America received large capital inflows. In 2010 gross inflows to LAC-7 countries (Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela) amounted to more than 6 percent of GDP, and net inflows exceeded 3 percent of GDP (see Figure 1). Nonetheless, the region survived the deep, albeit short-lived, 2008-2009 global crisis reasonably well, with no financial crisis in any of the larger economies. While in 2012 gross flows appear to have abated somewhat, assuming no new global financial crisis emerges it is likely that strong gross capital inflows to the region will resume once again. The literature on capital inflows suggests that while these flows represent an opportunity to spur investment and growth, they may also increase vulnerability to financial crises, macroeconomic instability and ultimately recession. A relevant question is, then, whether Latin America can declare victory in being able to manage large capital inflows successfully or whether there remain risks that justify strong measures to attempt to mitigate these concerns.

Figure 1. Capital Inflows to LAC-7



Includes data for: Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela

The objective of this paper is to attempt to shed some light on this area. As our starting point is that the region appears to have enjoyed, and may enjoy again, a strong surge in capital inflows, we decided to focus the analysis conditional on such a surge occurring. We do not then seek to explain the reasons for such a surge; one justification for this decision is that capital flows appear to be driven at least as much, if not more, by push than by pull factors. Rather—and more specifically—we seek to understand what determines whether such surges end in either a banking crisis or a recession.

This implies that we must first tackle the question of what a capital inflow surge is. We are helped in this regard by a growing literature. We employ one definition borrowing from the literature but extend the relevant period of analysis and find new explanatory variables. In addition, we propose a new definition for an inflow surge, explained further below. We must also consider the question of whether gross or net inflows are the most relevant. We take the view that employing net flows may discard useful information, and we argue for the use of gross inflows while including gross outflows as a potential explanatory variable.[2] This sets us apart from some of the recent literature in this area.

The empirical analysis develops a set of parsimonious models that discriminate reasonably well between the different economic outcomes. We then analyze the case of a typical LAC country and variations to a typical country to illustrate the effects of changes in certain critical variables. We suggest in the concluding policy session that, depending on the country/inflow characteristics, different policy measures may be justified. However, a caveat is that emerging economies and Latin America in particular have been experimenting with new policy measures, and we are not able to evaluate here their potential effectiveness. This remains important future work when sufficient experience and data are available. However, we suggest our results may indicate whether such experimentation may have a prima facie justification.

The paper is organized as follows. In the next section we present a brief literature review. In Section 3 we discuss the data we employ in the empirical analysis, and we discuss a set of methodological issues. In Section 4 we discuss the econometric results, and Section 5 concludes.

[2] For an analysis of inflows and outflows and their potential correlation see Powell, Ratha and Mohapatra (2005).

2. Capital Inflow Surges: A Brief Review

While strong capital inflows may fuel growth and development, their links to macroeconomic and financial stability have provoked much discussion (see Díaz-Alejandro, 1985, for an early reference).[3] The literature may be divided into two (related) ideas, first that excessive capital inflows may provoke financial and particularly banking instability, and second, that they may provoke macroeconomic instability.

2.1 Capital Inflows, Lending Booms and Banking Instability

It might be thought that strong capital inflows are closely associated with lending booms and banking instability. Indeed, one strand of the banking literature suggests that lending booms are associated with subsequent banking instability. For example, Gavin and Hausmann (1996) find that credit growth is a frequent precursor to banking crises. Schularick and Taylor (2012) and Gourinchas and Obstfeld (forthcoming) give further support to this view, and in their review Demirgüç-Kunt and Detragiache (2005) claim that credit growth is one of the most robust determinants of systemic banking crises. Still, the IMF's September 2011 Global Financial Stability Report (IMF, 2011, Chapter 3) argues that although this is surely one determinant, high credit growth is still far from an accurate predictor of future problems. False alarms of crises (so-called type 1 errors) and crises missed (type 2) errors remain relatively high even in the best-performing models.

Perhaps surprisingly, however, the literature finds somewhat mixed results in attempting to link capital inflows and lending booms.[4] Sachs, Tornell and Velasco (1998) find no association between lending booms and surges in capital inflows during crises in the 1990s. Gourinchas, Valdes and Landerretche (2001), using data up to 1999, report only a small increase in capital inflows during lending booms. More recently, Calderón and Servén (2012), using quarterly data spanning 1970-2010, find mixed evidence of an association between capital inflow bonanzas, asset price booms and lending booms. Mendoza and Terrones (2008) find that half of the lending booms in their sample were accompanied by large gross capital inflows.

[3] Note that some attribute capital inflows (and large current account deficits) as a large contributing factor to the United States' financial problems of 2008-2009; see Portes (2009) and Reinhart and Rogoff (2009, Chapter 13).
[4] See Sachs, Tornell and Velasco (1998), Eichengreen and Rose (1998), Radelet and Sachs (1998), Fernández-Arias and Hausmann (2001), Eichengreen and Arteta (2002) and Mendis (2002).

However, a set of recent papers does find links between rapid capital inflows (named a surge, bonanza or boom by different authors) and financial sector instability. For example, Reinhart and Reinhart (2009) examine how economies perform during and after "capital flow bonanzas"[5] and find that they are associated with a higher probability of banking (and other) crises in developing countries, while Caballero (2010) finds surges in net inflows are associated with an increased probability of systemic banking crises. Furceri et al. (2011a) find similar results for gross debt inflows.[6]

Putting these results together suggests that, while there may be a link from capital inflow booms to lending booms to banking instability, there may also be other channels at work. For example, capital inflow booms may foster a rapid growth in asset prices. Calvo (2011) offers an explanation of how capital inflow episodes enhance the liquidity of assets and hence facilitate asset price bubbles. Asset price bubbles in turn alter the composition of bank lending, and banks may use assets (including land and housing) as collateral. Banks may then be more vulnerable to a fall in asset prices when the boom subsides, increasing the likelihood of a crisis.

Given these results, we then decided to consider the relation between capital inflow surges and banking instability while remaining agnostic about the transmission channels.

2.2 Macroeconomic Instability: Recessions

There is also a concern that capital inflow surges are associated with macroeconomic instability. Clearly, if the inflow surge creates the conditions for a banking crisis, this may well affect macroeconomic stability. However, even if there is no banking crisis, a lending boom may be followed by a period of required deleveraging as the boom subsides. Indeed, it might be argued that the deleveraging, if timely enough, precisely reduces the probability of an actual crisis. On the other hand, as discussed above, a capital inflow surge may be associated with a strong rise in asset prices and again, even if this does not create the conditions for a banking crisis, it may require a sharp adjustment in the banking sector that provokes a credit crunch and a recession. Moreover, a capital inflow surge may cause the appreciation of the real exchange rate.[7] Inflows tend to increase local absorption and increased expenditure on non-traded goods, pushing up

[5] The term "bonanza" was also used by Calvo, Leiderman and Reinhart (1992).
[6] Also see Aizenman and Jinjarak (2009) and Sá et al. (2011).
[7] Calvo et al. (1993) also document the sharp appreciation of currencies across the region in capital inflow boom of the early 1990s. Cardarelli et al. (2009) use an index of exchange market pressure and show how Latin American countries faced appreciation pressures during the inflow period of 2004-2007.

their relative prices. Latin America and the Caribbean appears to be more vulnerable than other regions, perhaps in part because inflows have tended to fuel larger increases in consumption relative to investment in the region (see Athukorala and Rajapatirana, 2003, and Calvo, Leiderman and Reinhart, 1994). Moreover, Reinhart and Reinhart (2009) document that fiscal expansion is common during inflow surges across developing countries, exacerbating real appreciations, and there is evidence that Latin America's fiscal expenditures are more pro-cyclical than those of other regions.[8]

The type of capital inflow appears to matter: foreign direct investment is generally targeted to investment projects, while debt and short-term inflows are more likely to finance consumption (both public and private). For example, Combes, Kinda and Plane (2011) estimate that portfolio investment flows have the largest appreciation effect on the exchange rate, some seven times greater than that of FDI or banking flows.[9]

A further concern is with a type of potential Dutch Disease,[10] with costs in terms of the loss in competitiveness of manufacturing and especially high value-added goods during the boom.[11] As such goods require specific skills, and there may be significant learning required for successful production and exporting, if this sector suffers due to real exchange rate appreciations it may be costly to recover. If manufacturing is rendered uncompetitive and a loss of skills implies no rapid readjustment when the boom subsides, then when the capital inflow boom subsides adjustment will be costly. The effects are quite analogous to those associated with the sudden stops literature. The resultant necessary adjustment is normally characterized by a sharp reduction in imports (increase in net exports) and by a recession. We are therefore interested in whether capital inflow booms provoke not only banking instability, but also recessions, although again we remain agnostic regarding the potential transmission channels.

[8] See Schadler, Bennett and Khan (1993), Calvo, Leiderman and Reinhart (1996) and Cardarelli, Elkda and Kose (2009).

[9] Athukorala and Rajapatirana (2003) document that FDI flows to Latin American countries during the 1990s were concentrated in non-traded sectors (construction and commercial services), while in Asia they appeared to provide relatively more finance for exports.

[10] Dutch Disease refers to the effects of the economic boom in Holland that resulted from a large find of natural gas in the North Sea in the 1950s. This provoked strong export earnings, an appreciation of the real exchange rate and the loss in competitiveness of other exports. Once the boom was over, the country was then left with reduced commodity exports, reduced manufacturing and soaring unemployment. While Dutch Disease was thus originally related to commodity windfalls, similar effects have been argued in relation to capital inflows.

[11] See Corden (1984) for a classic reference on Dutch Disease.

3. Data and Methodology

As discussed above we consider that focusing only on net flows may limit the analysis and in particular the importance of gross inflows intermediated through local financial systems for considering issues of financial fragility, and for economic stability. However, it is surely the case that an inflow surge may also provoke higher outflows. Hence we decided to focus on gross inflows and include outflows as a further explanatory variable.[12]

Following the literature in the area we define gross inflows as the sum of i) direct investment in the reporting economy, ii) portfolio investment liabilities, iii) financial derivatives liabilities and iv) other investment liabilities and v) the credit items of the capital account.[13] We use a panel consisting of 44 emerging countries over the period 1980-2005. We also collected data for the period 2006-2010 that we will employ to conduct various out of sample simulations described below.

3.1 Defining Inflow Surges

Any study of the effects of inflow surges must address the issue of defining what constitutes a surge. We are helped by the literature in this area. One approach is to consider some smoothed or trend level of inflows and then define a year of a surge or of excessive inflows as a level above some threshold (perhaps defined using the standard deviation of inflows) above that trend. A capital inflow surge episode is then a group of years where this threshold is breached. This is the general approach taken in several papers, although some papers use net inflows, others gross inflows (using the definitions employed above), and others still the entire capital and financial account.[14]

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[12] Here following the usual convention inflows are understood as the flows of non-residents while outflows are understood as the flows of residents, we detail below exactly which elements of the balance of payments are used to estimate these flows.

[13] Outflows are defined using the same concepts but instead of liabilities we use the assets from the standpoint of the country plus the debit items of the capital account.

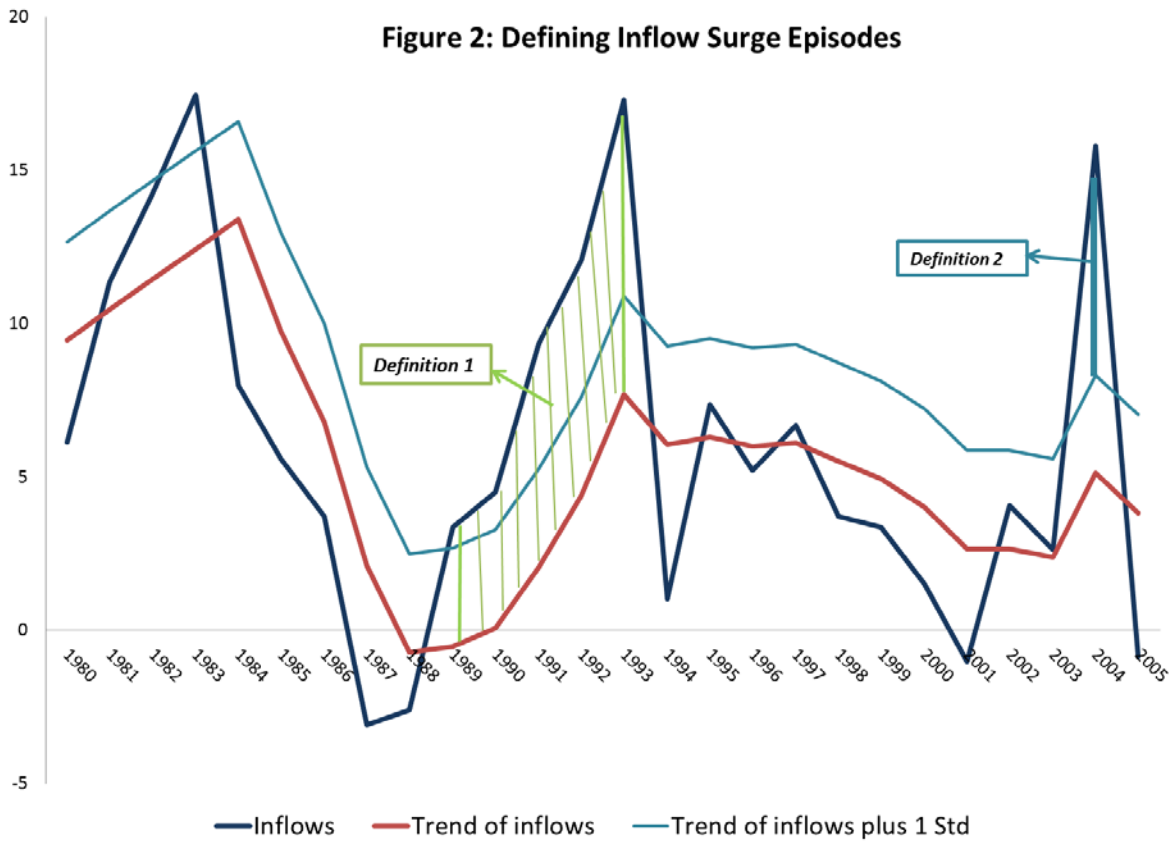
[14] For example, Gourinchas, Valdes and Landerretche (2001) and Cardarelli, Elekdag and Kose (2009) define a country specific trend and then apply the above type of methodology for the case of net capital flows. Caballero (2010) and Furcieri et al (2011) have also followed this approach. This is also closely related to the methodology adopted in the sudden stop literature, for example Calvo (1998) and Calvo, Izquierdo and Mejía (2008) consider annual changes in capital flows and compare them to the sample mean. Every time a fall of more than two standard deviations below the mean is registered, there is a sudden stop. These authors also define the start of a sudden stop episode as when the fall in capital inflows is greater than one standard deviation of the series, and the end of the episode is defined symmetrically. Forbes and Warnock (2011) define a capital inflow bonanza as the opposite, applying it to gross flows.

One issue with this type of methodology is the definition of the trend and whether information across the entire sample (i.e., after a particular surge episode) is employed to obtain the definition of that surge. We follow recent authors that avoid the use of entire sample means or other smoothing techniques that employ future information. Following Cardarelli, Elekdag and Kose (2009) and employing a Hodrick-Prescott rolling trend using only past data,[15] we define the threshold as the trend plus one standard deviation, with the additional assumption that the inflows must be greater than 1 percent of GDP. We refer to this as definition 2 in what follows.

The literature to date has tended to focus on definitions of inflow surges by year as described above. However, in considering the potential dangers of capital inflows, perhaps particularly for banking instability, it appears that some aggregate measure across the years of a particular episode may be important. For example, an episode of three years in a row of high inflows may be very different than receiving those same inflows in three years but spread out over two decades. We therefore develop a new and alternative definition of an inflow episode. As in the standard type of definitions above we define a trend (again only using past data) but then consider periods of years where actual inflows stay above that trend. We then construct a database of all such episodes. We then define an inflow surge as an episode where the total associated gross inflows minus the trend (i.e., the area between the actual inflows and the trend while the actual inflows are above the trend) are greater than the median of all such episodes. We refer to this as definition 1 in what follows.

Figure 2 illustrates the two different definitions. To summarize, definition 1 may be thought of as the area between the actual inflows and the trend. Definition 2 is the inflows when the inflows of a particular year are greater than a threshold defined as the trend plus one standard deviation.

[15] These authors also add surges episodes based on the 75th percentile of all (whole sample) regional surge episodes, we do not include these extra surge episodes in part as this appears to defeat the object of only using past and not future information



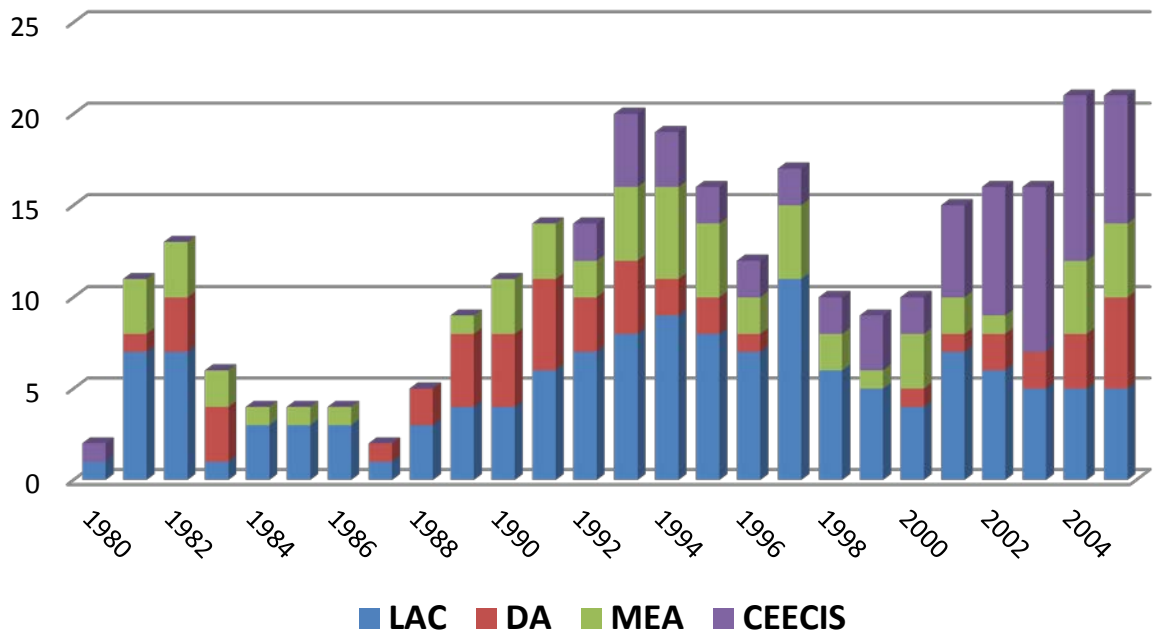
3.2 Capital Inflow Surges in the Data

Applying these two definitions of capital inflow surges we obtain a reasonable number of inflow episodes to work with. For example, for definition 1, we have 93 such inflow surge episodes from 1980 to 2005.[16] As an illustration, Figure 3 plots the number of inflow episodes taking place in each year for definition 1. Like previous authors, we find some bunching of inflow episodes across time, suggesting that push factors are a large part of the explanation rather than individual country (pull) factors. We find inflow surge episodes in each region, although LAC has the largest share of inflow episodes.

[16] There are 67 capital inflow episodes for definition 2.

Figure 3. Inflow Surge Episodes

Definition 1 - number of episodes taking place in each year



Key: LAC: Latin America and the Caribbean, DA: Developing Asia, MEA: Middle East and Africa, CEECIS: Central and Eastern Europe and the Commonwealth of Independent States.

Table 1 gives the total number of inflow episodes by region and also by country within each region, as the number of countries within each region differs. Still, LAC has more episodes per country than any other region irrespective of the definition employed.

Table 1. Capital Inflow Episodes

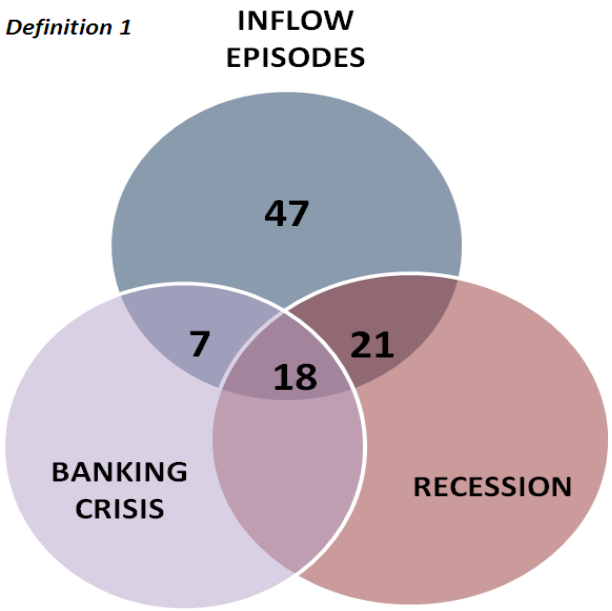
By region				
	LAC	**MEA**	**CEECIS**	**DA**
Number of countries	15	10	11	8
Definition 1	42	20	16	15
Definition 2	34	13	12	8
By country in each region				
	LAC	**MEA**	**CEECIS**	**DA**
Definition 1	2.8	2.0	1.5	1.9
Definition 2	2.3	1.3	1.1	1.0

The literature also suggests a set of variables that may determine whether a capital inflow surge may result in financial or economic instability. These might be divided into variables that represent the capital inflows, macroeconomic variables and variables that characterize the nature of the financial system intermediating the flows. Regarding the inflows themselves, we focus on measures of the size of the inflow episode and of the composition of inflows. Regarding composition, there has been a particular focus on the magnitude of portfolio debt inflows, which are considered to be potentially volatile and to have poor risk sharing properties, on the size of banking inflows, particularly given the focus on the reliance of external (cross-border) funding of banks in foreign currency, and also on portfolio equity flows, given their potentially fickle nature. In terms of macroeconomic variables, we include international reserves and the real exchange rate and gross outflows (the flows of non-residents), and regarding the characteristics of the financial system that intermediates the flows we include credit growth[17] and institutional variables, namely whether there is an explicit deposit insurance scheme in place; this variable is taken from Demirgüç-Kunt and Detragiache (2005). Secondly, we include the degree of "financial reform" and its various components including the "quality of banking supervision;" these data are taken from Abiad, Detragiache and Tressel (2008).[18]

[17] The data on capital flows data are taken from the IMF's International Financial Statistics and the macroeconomic data are taken from the World Bank's World Development Indicators.

[18] It would be desirable to include data on the strength of financial systems such as capital and liquidity. While the IMF's Financial Soundness Indices are now one source (see Majnoni and Powell, 2011, for the use of this data in another context) this does not cover the longer period of this analysis necessary to obtain a large enough number of inflow surge episodes in this paper.

Figure 4. Number of Inflow Episodes and Economic Outcomes



Our empirical methodology is to estimate a set of probit models to explain why some capital inflow episodes conclude with a banking crisis or a recession.[19] The dependent variable is then a dummy indicating whether the capital inflow surge is associated with either of these events. We use the Laeven and Valencia (2008) dataset on systemic banking crises for that variable and statistics on real growth from the International Financial Statistics to create the recession dummy variable. We follow the rule that if a banking crisis or a recession occurs within a period up to two years after the end of the capital inflow surge period then it is associated with that capital inflow surge. We do not include any banking crises or recessions that commence before the capital inflow surge commences. As an illustration, taking definition 1 of the capital inflow surges, we find that 35 of the 93 episodes do not end in either a recession or a banking crisis, we find that 25 end in a banking crisis, 39 end in a recession and 18 end in both a banking crisis and a recession. These statistics are illustrated in Figure 3. We start from a

[19] We do this separately for banking crises and for recessions. However, we experiment by testing a banking crisis as an explanatory variable in some of the specifications for recessions. We find it is always significant but one concern is endogeneity in that the banking crisis may have been "caused" by the recession. Hence we prefer to employ specifications without the banking crisis in the model for recessions and without recession in the model for banking crisis.

general specification for the probit estimations. Some variables are aggregates, and thus we run different specifications to disaggregate as far as possible, attempting to identify which specific variables are most significant in those aggregates. We also eliminate variables following a standard reduction procedure considering the statistical significance of the variable and the relevant statistics regarding how the model fits the data.[20] As is commonplace in such econometric exercises, there is no unique accepted model reduction strategy. We thus present several models, although there is considerable consistency across the models in terms of the statistically significant coefficients.

4. Results

4.1 Econometric Results

Tables 2 and 3 provide summaries of the econometric results. As a robustness test we also present a further set of results in the Appendix based on a more restricted sample. The restricted sample is generated by additional cleaning of the dataset, by taking out outliers and data points where there is ambiguity between zeros and missing values. The main results discussed below are found in both sets of regressions and, if anything, the results are stronger in the regressions presented in the Appendix, albeit with fewer observations. In each of the tables below and in the Appendix, the first three columns pertain to the first definition of inflow surges and the second group of three columns to the second definition of inflow surges as reviewed above.

[20] For an explanation of probit regressions see, for example, Maddala (1983).

Table 2. Results of Probit Estimation for the Probability of a Banking Crisis

	Definition 1			Definition 2		
	I	II	III	I	II	III
Inflow Surge	0.028	0.011		-0.155	-0.036	-0.010
	(0.383)	(0.660)		(0.264)	(0.511)	(0.915)
Banks/Inflows	0.464**	0.367*	0.403**	0.787	0.142	
	(0.035)	(0.065)	(0.043)	(0.377)	(0.791)	
Portfolio/Inflows	0.589*	0.518		1.918*	1.344**	
	(0.078)	(0.104)		(0.070)	(0.039)	
Portfolio Equity/ Inflows			0.280			-4.634
			(0.737)			(0.184)
Portfolio Debt / Inflows			0.526*			1.548*
			(0.097)			(0.090)
Financial Reform	-3.192***		-3.126***	-3.679*		
	(0.005)		(0.000)	(0.060)		
Banking Supervision		-0.943**			-0.991	-1.519**
		(0.017)			(0.121)	(0.028)
Entry Barriers		0.097			0.322	
		(0.622)			(0.252)	
Security Markets		0.148			-0.163	
		(0.592)			(0.652)	
Directed Credit		-0.224			-0.241	
		(0.329)			(0.368)	
Restrictions on Capital Account		-0.431*			-0.049	
		(0.088)			(0.856)	
Deposit Insurance	-0.090			0.265		
	(0.852)			(0.685)		
Outflows	-0.042			-0.013		
	(0.140)			(0.889)		
Credit Growth	-0.238			3.146		4.441*
	(0.584)			(0.127)		(0.093)
Reserves Growth	-0.475			-1.608		-1.282
	(0.249)			(0.259)		(0.285)
Real Exchange Rate Growth	-0.320			0.837		
	(0.721)			(0.772)		
N	70	79	77	54	59	52
Adjusted R2	0.31	0.31	0.23	0.554	0.396	0.543

Note : P-values are reported in parenthesis. Significance at the one, five and ten percent levels is indicated by ***, ** and *, respectively.

The first column of each group represents a general specification including the aggregate variables of portfolio flows divided by total flows and financial reform, and the set of macroeconomic variables. The results are fairly consistent across the different definitions. In particular, it seems that while the size of total inflows (the first variable, inflow surge) is not significant, higher portfolio inflows lead to a higher probability of a banking crisis. Secondly, financial reform reduces the likelihood of a banking crisis. Third, none of the macroeconomic variables appears as significant. Of course, this does not necessarily mean that, say, real appreciation is not important, rather that once the other variables are taken into account (including for example portfolio inflows) there is no evidence that real appreciation is significant. In other words, the important aspects (if any) of real appreciations are already taken into account given the other variables. There is also no evidence that an explicit deposit insurance scheme increases the probability of a banking crisis. Perhaps somewhat surprisingly, the evidence that credit growth is important, over and above the other variables, is mixed to say the least. It is not significant in any of the specifications for the first definition, but it is significant in some specifications for the second definition. In addition, higher banking inflows appear to increase the probability of a banking crisis across all specifications for the first definition of capital inflow surges.

We then attempted to investigate which aspect of portfolio inflows and which aspects of financial reform may be important. Again, the evidence is fairly consistent across the different definitions. Within portfolio inflows it appears that debt inflows are particularly risky, as that variable is significant once portfolio inflows are disaggregated, whereas portfolio equity flows tend not to be significant. Within financial reform there is consistent evidence that what matters is the quality of banking supervision; this is found to be statistically significant in specifications with both definitions. In addition, in one specification for definition 1, removing restrictions on the capital account also appears to lower the risk of banking crises.

Our conclusion is that what appears to matter in controlling the likelihood of a banking crises given a capital inflow surge is i) the composition of inflows—in particular, lower portfolio inflows would decrease the likelihood of crises and for the first definition also lower banking inflows; and ii) a higher quality of the supervision of the financial system intermediating those capital inflows.

We now consider the probability of recessions. In Table 3 below, we present a similar set of regressions for the likelihood of a recession conditional on a capital inflow surge.

Table 3. Results of Probit Estimations of a Recession

	Definition 1			Definition 2		
	I	II	III	I	II	III
Inflow Surge	0.011	0.011	0.002	-0.034	-0.055	
	0.679	0.687	0.949	(0.453)	(0.555)	
Banks/Inflows	-0.103	-0.145	-0.344	0.682	-0.319	
	0.569	0.520	0.198	(0.243)	(0.654)	
Portfolio/Inflows	0.419		0.265	0.317	0.071	0.321
	0.162		0.437	(0.506)	(0.648)	(0.497)
Portfolio Equity/ Inflows		0.122				
		0.863				
Portfolio Debt / Inflows		0.464				
		0.211				
Financial Reform	-1.780**	-1.591*		-3.341**		-2.802**
	(0.047)	(0.067)		(0.015)		(0.010)
Banking Supervision			-1.078***		-1.223	
			(0.007)		(0.132)	
Entry Barriers			0.255		0.314	
			0.240		(0.490)	
Security Markets			-0.106		-0.566	
			0.729		(0.370)	
Directed Credit			-0.291		-0.334	
			0.194		(0.380)	
Restrictions on Capital Account			0.333		0.083	
			0.199		(0.802)	
Deposit Insurance	0.106			0.741		
	0.790			(0.160)		
Outflows	-0.016	-0.017	0.009	0.048	0.164*	0.049
	0.447	0.406	0.716	(0.201)	(0.053)	(0.133)
Credit Growth	-0.204	-0.210	0.112	3.488**	6.053**	3.182**
	0.556	0.552	0.778	(0.019)	(0.047)	(0.018)
Reserves Growth	-0.650**	-0.702**	-0.670*	-0.209	0.595	-0.321
	(0.046)	(0.037)	(0.074)	(0.732)	(0.492)	(0.487)
Real Exchange Rate Growth	1.135	1.150	1.075	-0.088	0.557	
	0.142	0.143	0.217	(0.952)	(0.732)	
N	70	68	70	52	37	55
Adjusted R2	0.183	0.195	0.313	0.320	0.341	0.295

Note : P-values are reported in parenthesis. Significance at the one, five and ten percent levels is indicated by ***, ** and *, respectively.

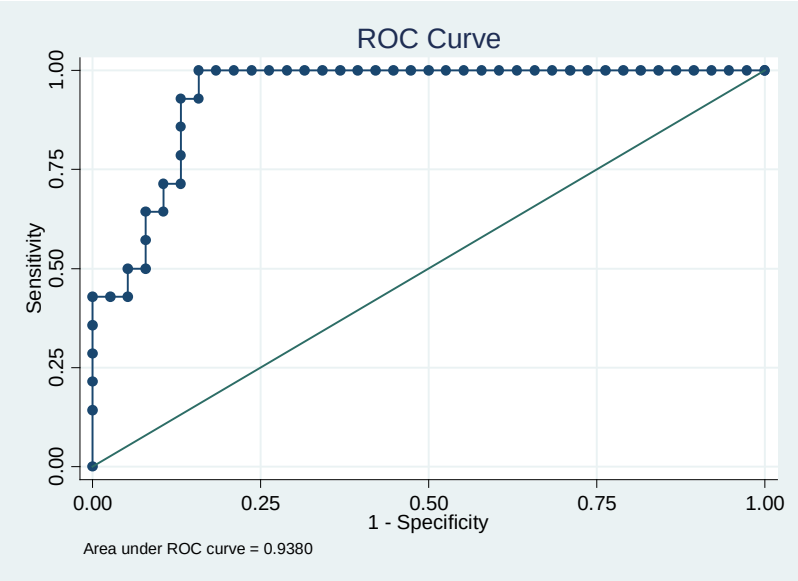
The results of the probit regressions for the likelihood of a recession are quite different than those for a banking crisis. In general, we find fewer variables significant, and there is little evidence that the size or the composition of the inflows matter for the probability of a recession emerging. For definition 2 there is strong evidence that faster credit growth increases the likelihood of a recession. For the first definition there is evidence that fast growth in international reserves is a mitigating factor. Again we do not find evidence that a real appreciation increases the likelihood of a recession. In contrast, financial reform appears to reduce the likelihood of a recession although, when we attempt to disaggregate this variable, we cannot distinguish clearly which elements of financial reforms are driving the result. All in all, the results are somewhat weaker than those for banking crises, with some evidence that some for the macroeconomic variables matter more (reserves or credit growth depending on the specification) and that financial reform reduces the likelihood of a recession.

4.2 Model Fit

To determine whether the models fit the data well and discriminate effectively between outcomes, we consider the so-called ROC curves for the probit estimations.[21] The ROC curves illustrate the sensitivity and the specificity of the respective model, where the sensitivity is one minus the fraction of type 1 errors and the specificity is one minus the fraction of type 2 errors. There is then a tradeoff between the specificity and sensitivity. The ROC curve is an illustration of this tradeoff and also gives an indication of how well the model discriminates across different economic outcomes. As an example, the ROC curve for one of the probit specifications (definition 2, specification 3) is plotted in Figure 5 below.

[21] For an explanation of the ROC ("Receiver Operating Characteristic") curve see Greene and Hensher (2010).

Figure 5. ROC Curve for a Probit Model of the Probability of a Banking Crisis (Definition 2, Specification 3 of Table 2)



If the ROC curve lies on the 45 degree line then, in terms of discrimination, the model does not improve on a pure random draw. On the other hand if the area under the curve is 1.0, then the model discriminates perfectly between the different outcomes. The area under the ROC curve then gives an indication of how well the model discriminates across economic outcomes. As detailed in the figure, the area under the ROC curve graphed is 0.9380. Table 4 below details the area under the ROC curves for the various specifications in Tables 2 and 3.

Table 4. Areas under the ROC Curves for the Probit Models for Tables 2 and 3

Specifications	Definition 1	Definition 2
Banking Crisis		
I	0.85	0.95
II	0.85	0.90
III	0.81	0.94
Recession		
I	0.79	0.86
II	0.79	0.84
III	0.86	0.84

A value of greater than 0.8 for this area is considered exceptionally good and, as can be seen, all the values for banking crises are greater than this level and some are above the 0.9 level. The models for recession are also very close to, or above 0.8, although these models do not discriminate quite as well as those for banking crises.[22]

4.3 Simulations

We now use the model to attempt to gauge the risks in Latin America given the recent (post-2005) capital inflow surges. Our procedure is the following. We first calculate how many capital flow surges have taken place since 2005 given the two definitions we employ in this paper. The result is nine episodes in the region for definition 1, and seven episodes for definition 2. We then take the median values for all of the explanatory variables for the first model of each definition in Tables 2 and 3 above. We then compute the probability of a banking crisis and the probability of a recession obtained for this median or typical country in Latin America. We illustrate the results in the first column of Table 5 below. We then replace the median value with the worst value (i.e., the one that gives the highest probability of a banking crisis or a recession) for a set of explanatory variables across the country cases to give an idea of the sensitivity of the result to changes in the parameter values. The results are illustrated in the subsequent columns of Table 5. The results suggest a significant probability of a banking crisis (7 percent for a typical LAC country) and an even higher probability of a recession (between 24 percent and 38 percent, depending on the definition employed).[23] We attribute the wider variation in the probability of a recession to the poorer fit of the model in this case and the equal estimation of the probability of a banking crisis to greater robustness of the model for banking crises.

Moreover, there is considerable variation in the probabilities replacing the median values with the worst values across the inflows being received by Latin American countries during this inflow episode. In part this stems from the wide variation in the explanatory variables for the different inflow surges across Latin America since 2005. For example, the highest bank flows are

[22] We do have some cases of countries with more than one capital inflow surge in the database, and we treat these as independent in our analysis. As a separate exercise we also conducted the regressions above with a country dummy only and found the country dummy not to be significant in all cases, and when we construct the ROC curve from those results we find that it hardly improves on the 45-degree line with the area under the curve only marginally above 0.5 for both banking crises and for recessions. This implies that the variables we use, rather than a simple country dummy, is giving us the power to discriminate between crisis and no crisis cases.

[23] We consider 8 percent to be a relatively high probability of a systemic banking crisis. Note that Basel II is calibrated to a 99.9 percent value at risk or, in other words, the probability of a bank failure in 1 of 1,000 years.

some two standard deviations (of the whole sample before 2005) above the median for that variable. More generally, as can be seen from the table, replacing the median with these alternative "worst values" considerably increases the probability of a banking crisis or a recession. This suggests that different countries experiencing different types of inflow surges or in different positions with respect to the degree of financial reform may be in quite different positions. In some cases inflow surges may not constitute a serious cause for concern, while in other cases the risks may be relatively high.

Table 5. Simulated Probability of a Banking Crisis & Recession in a Typical LAC Country and Variations

Banking Crisis

	Typical LAC Country	Max Portfolio	Max Banks	Min FinReform	Max FinReform
Definition 1	0.07	0.15	0.30	0.16	0.01
Definition 2	0.08	0.69	0.12	0.11	0.01

Recession

	Typical LAC Country	Max Portfolio	Min FinReform	Min Reserves Gwth	Max Credit Gwth	Max FinReform
Definition 1	0.38	0.49	0.48	0.47	0.35	0.23
Definition 2	0.24	0.35	0.28	0.25	0.47	0.07

Furthermore, an important caveat is in order when interpreting these results. The data on financial reform, including banking supervision, end in 2005. Many countries in LAC, however, have continued to reform financial sectors and improve regulation and supervision. Moreover, several countries have introduced new macro prudential tools or are using those tools more actively. For example, Peru actively increased liquidity requirements on banks both before and after the Lehman crisis. Brazil has introduced a type of tax on consumer credit and has prudential measures on capital inflows, as does Colombia. Colombia and Uruguay both introduced systems of dynamic provisions to attempt to smooth credit cycles.

It has not been possible to capture these types of policy changes in our work. However, as an indication of how improvements in the financial infrastructure might affect the above probabilities, in the final column of Table 5 we replace the median value of the financial reform variable with the best value of financial reform among the nine countries that have been experiencing a capital inflow surge. As can be seen, this reduces the probability of a financial crisis (and that of a recession for definition 1) sharply.

5. Conclusions

In this paper we defined capital inflow surges and investigated their effects considering data for emerging economies over the period 1980 to 2005. We found a considerable number of such surges were associated with a banking crisis, a recession, or both. We developed probit models to attempt to explain why some inflow surges appear to be associated with these negative outcomes, while others ended without problems. In general we found the composition of the inflows and the extent of financial reform, and in particular the quality of banking supervision, to be significant explanatory factors for banking crises, while some macroeconomic variables (credit growth or the growth of reserves as a mitigating factor) played an important role in relation to the likelihood of a recession. While in general the models discriminated well, the models for predicting banking crises appeared to be somewhat superior to those for predicting recessions.

We then applied the models to post-2005 data for Latin America and the Caribbean. According to the definitions of capital inflow surges, there were between seven and nine episodes. For the typical episode, we found that the model for banking crises estimated an 8 percent probability of a banking crisis and the model for recessions estimated at least a 24 percent probability of a recession. These are fairly high figures, although there is considerable variation regarding the nature of the inflow surges and the extent of financial reform across these episodes. However, a caveat of the results is that they do not take into account recent macro prudential measures by a number of countries precisely to attempt to curtail the risks involved.

We suggest that our results indicate that there is considerable variation in the types and experiences regarding capital inflow surges in emerging economies. The mere fact that a country today is experiencing a capital inflow surge does not mean that the risks of a banking crisis or a recession are high. Indeed, we find that the size of such a surge conveys little information regarding the risks. Rather, it is the particular nature of the inflow surge that must be analyzed to assess the risks. Moreover, our results suggest that if the financial system has undergone substantial reforms, and in particular if the quality of banking supervision is high, then the risks may also be mitigated. However, for those countries where capital inflows are characterized by large portfolio inflows, particularly portfolio debt inflows and banking inflows, then this is indeed a potential cause for concern. For countries in this situation, our results suggest a strong prima facie justification for interventions that may affect the composition of

inflows and a clear justification for considering further financial reforms, including further strengthening of banking sector oversight. These results may go some way toward explaining the quite different reactions to the current capital inflow surge across the region.

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Appendix

Here we present two tables (A1 and A2) similar to Tables 2 and 3 above with the results of probit regressions for the likelihood of a banking crisis and the likelihood of a recession for a restricted sample generated by further cleaning of the database. The results are consistent with those presented in the body of the paper and the r-squared's are considerably higher.

Table A1: Results of Probit Estimation for the Probability of a Banking Crisis. Restricted Sample

	Definition 1			Definition 2		
	I	II	III	I	II	III
Inflow Surge	-0.003	-0.016		-0.109	-0.012	-0.048
	(0.940)	(0.638)		(0.428)	(0.816)	(0.613)
Banks/Inflows	0.607*	0.360	1.699*	0.823	-0.008	
	(0.066)	(0.173)	(0.099)	(0.425)	(0.989)	
Portfolio/Inflows	0.666*	0.762*		2.497*	1.110*	
	(0.075)	(0.070)		(0.087)	(0.073)	
Portfolio Equity/ Inflows			1.516			
			(0.311)			
Portfolio Debt / Inflows			1.329**			1.780*
			(0.026)			(0.099)
Financial Reform	-4.010**		-5.251**	-3.741		
	(0.016)		(0.031)	(0.166)		
Banking Supervision		-0.944**			-1.458*	-1.232*
		(0.040)			(0.088)	(0.053)
Entry Barriers		0.189			0.462	
		(0.486)			(0.273)	
Security Markets		-0.280			-0.098	
		(0.502)			(0.826)	
Directed Credit		-0.106			-0.108	
		(0.712)			(0.727)	
Restrictions on Capital Account		-0.315			-0.093	
		(0.327)			(0.759)	
Deposit Insurance	-0.023			0.688		
	(0.970)			(0.401)		
Outflows	-0.027			-0.058		
	(0.450)			(0.648)		
Credit Growth	-0.003			3.109		2.969
	(0.995)			(0.201)		(0.113)
Reserves Growth	-0.444			-2.226		
	(0.432)			(0.192)		
Real Exchange Rate Growth	-0.865			6.604		
	(0.500)			(0.241)		
N	53	59	42	46	48	46
Adjusted R2	0.389	0.396	0.683	0.586	0.456	0.540

Note : P-values are reported in parenthesis. Significance at the one, five and ten percent levels is indicated by ***, ** and *, respectively.

Table A.2: Results of Probit Estimations of a Recession. Restricted Sample

	Definition 1			Definition 2		
	I	II	III	I	II	III
Inflow Surge	0.022	-0.093	0.004	-0.221	0.001	
	(0.527)	(0.286)	(0.928)	(0.129)	(0.995)	
Banks/Inflows	0.048	0.368	-0.039	0.935	-0.480	
	(0.776)	(0.211)	(0.874)	(0.337)	(0.487)	
Portfolio/Inflows	0.480		0.365	0.299		0.165
	(0.172)		(0.363)	(0.745)		(0.734)
Portfolio Equity/ Inflows		5.357**			-4.900	
		0.032			(0.143)	
Portfolio Debt / Inflows		1.597*			1.545	
		(0.089)			(0.239)	
Financial Reform	-3.018**	-3.731*		-6.910**	-2.159	-4.717*
	(0.026)	(0.073)		(0.077)	(0.135)	(0.057)
Banking Supervision			-1.370***			
			(0.015)			
Entry Barriers			0.244			
			(0.462)			
Security Markets			-0.217			
			(0.604)			
Directed Credit			0.107			
			(0.707)			
Restrictions on Capital Account			-0.089			
			(0.776)			
Deposit Insurance	0.065					
	(0.899)					
Outflows	-0.017	0.024	0.006	0.154*	0.086	0.087*
	(0.540)	(0.522)	(0.871)	(0.090)	(0.189)	(0.050)
Credit Growth	-0.282	0.500	0.080	15.661**	4.590**	7.690***
	(0.479)	(0.500)	(0.867)	(0.014)	(0.028)	(0.008)
Reserves Growth	-1.887**	-3.120**	-1.554*	-6.783**	0.283	-4.183***
	(0.005)	(0.035)	(0.046)	(0.039)	(0.702)	(0.009)
Real Exchange Rate Growth	0.423	0.441	0.309	-7.195	0.319	
	(0.687)	(0.836)	(0.807)	(0.129)	(0.824)	
N	55	37	55	44	35	47
Adjusted R2	0.304	0.491	0.408	0.742	0.295	0.625

Note : P-values are reported in parenthesis. Significance at the one, five and ten percent levels is indicated by ***, ** and *, respectively.

Table A3 below reproduces Table 4, or in other words the areas under the ROC curves for the specifications detailed in Tables A1 and A2. The areas are greater than those in Table 4, indicating that the discrimination of these models is greater than those of the models presented in the body of the paper. All values are greater than 0.8, and many are greater than 0.9, indicating high discrimination between the different economic outcomes.

Table A.3: Areas under the ROC Curves for the Probit Models for Tables 2 and 3

Specifications	Definition 1	Definition 2
Banking Crisis		
I	0.89	0.94
II	0.90	0.92
III	0.97	0.93
Recession		
I	0.84	0.98
II	0.84	0.82
III	0.90	0.95