An Anatomy of Credit Booms and their Demise

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Episodes in which credit to the private sector rises significantly above its long-run trend (that is, "credit booms") are often associated with periods of economic turbulence. Until recently, however, efforts at developing methodologies for identifying credit booms and characterizing the economic fluctuations that accompany them often produced mixed results (see, for example, Gourinchas, Valdés, and Landerretche, 2001). In addition, little was known about the association between economy-wide credit booms and the financial conditions of individual firms and banks, and about whether the characteristics of credit booms differ across industrial and emerging economies. This changed with the growing literature on credit booms developed over the last five years. In particular, in Mendoza and Terrones (2008) we proposed a new methodology for measuring and identifying credit booms and showed that it was successful at identifying credit booms with a clear cyclical pattern in both macro and micro data.

The method we proposed is a *thresholds method.* This method works by first splitting real credit per capita in each country into its cyclical and trend components, and then identifying a credit boom as an episode in which credit exceeds its long-run trend by more

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than a given "boom" threshold, defined in terms of a tail probability event. The duration of the boom is similarly set with "starting" and "ending" thresholds. The defining feature of this method is that the thresholds are proportional to each country's standard deviation of credit over the business cycle. Hence, credit booms reflect country-specific "unusually large" cyclical credit expansions.

In this paper, we apply this method to data for 61 countries (21 industrial countries, ICs; and 40 emerging market economies, EMs) over the 1960-2010 period. We found a total of 70 credit booms, 35 in ICs and 35 in EMs, including 16 credit booms that peaked in the critical period surrounding the recent global financial crisis between 2007 and 2010 (again with about half of these recent booms in ICs and EMs each), for comparison, see Mendoza and Terrones (2008) where we had data for 48 countries over the 1960-2006 period and found 27 credit booms in ICs and 22 in EMs.[1]

We then take the peak dates of all credit booms and construct seven-year event windows around them to examine the dynamics of macro aggregates in the upswing and downswing of credit booms. This exercise is similar to the one conducted in our 2008 paper, but the extension of the sample period to include 2007-2010 is a critical addition because it adds key evidence from the credit booms that collapsed with the 2008 global financial crisis.

The results show that credit booms are associated with periods of economic expansion, rising equity and housing prices, real appreciation, and widening external deficits in the upswing phase of the booms, followed by the opposite dynamics in the downswing. Moreover, credit booms tend to be synchronized internationally, and centered on "big events" like the 1980s debt crisis, the 1992 ERM crisis, the 1990s Sudden Stops, and the 2008 Global Financial Crisis. In addition, splitting our sample into financial crisis vs. non-crisis cases, we find that booms in the crisis group were larger.

A major deviation in the evidence reported here relative to our previous findings in Mendoza and Terrones (2008) is that adding the data from the recent credit booms and crises, we find that, in fact, credit booms in ICs and EMs are more similar than different. In contrast, in our earlier work, we found differences in the magnitude of credit booms, the size of the macro fluctuations associated with them, and the likelihood that they are followed by banking or currency crises.

1. For comparison, in Mendoza and Terrones (2008) we had data for 48 countries over the 1960-2006 period and found 27 credit booms in ICs and 22 in EMs.

Credit booms across EMs and ICs are similar in three key respects: First, although credit booms are larger in EMs (with real credit per capita peaking at about 30 percent above trend in the median of all EM credit booms versus 12 percent for IC credit booms), normalizing by each country's cyclical standard deviation of credit, credit booms are remarkably uniform in size. The normalized peak of credit booms is about 2 standard deviations for EMs, and 2.1 for ICs. A similar observation applies to the magnitude of the fluctuations that macro aggregates display during credit booms. These fluctuations are larger in EMs, but since EMs also display higher cyclical standard deviations in these variables, normalized fluctuations associated with credit booms are actually similar in size.[2]

The second similarity is that, while not all credit booms end in crisis, the peaks of credit booms are often followed by banking crises, currency crises or Sudden Stops. The frequency with which this happens is about the same for EMs and ICs (20 to 25 percent for banking and currency crises, 14 percent for Sudden Stops). This is a critical change from our previous findings, because lacking the substantial evidence from all the recent booms and crises, we had found only 9 percent frequency of banking crises after credit booms for EMs, and zero for ICs; and 14 percent frequency of currency crises after credit booms for EMs versus 31 percent for ICs. Clearly, the larger sample of credit boom events used here yields a different picture indicating that in the aftermath of credit booms, both groups of countries suffer (with about the same frequency) both types of crises; and also Sudden Stop crises.

The third similarity relates to the factors that can act as potential triggers of credit booms. In particular, surges in capital inflows, gains in total factor productivity (TFP), policy reforms in the financial system, and managed exchange rates, all play a role in both ICs and EMs. There are some differences across the two groups because the frequency of credit booms in EMs is 47 percent, when preceded by periods of large capital inflows (versus 33 percent in ICs); and 30 percent for financial reforms (versus 22 percent for ICs); while TFP gains precede credit booms with a frequency of 42 percent for ICs (versus 20 percent for EMs). But the overall message is that these three factors precede the

2. Mendoza (1995) documents a similar finding for regular business cycle indicators in a sample of 23 developing countries and 7 ICs. Standard deviations of cyclical components of macro aggregates are significantly higher for developing countries than for ICs, but normalized by the standard deviation of the terms of trade, the variability of macro variables is similar across all countries.

peak of credit booms with a frequency of roughly 1/5 to 1/2. Moreover, credit booms in both ICs and EMs are far more frequent in the presence of fixed or managed exchange rates (with a frequency of about 2/3 for all countries), than in under floating or dirty floating regimes (with frequencies ranging from 3 to 20 percent).

Our work is related to the empirical literature that identifies booms in macro variables, using threshold methods and event-study techniques. Montiel's (2001) analysis of consumption booms was one of the first studies in this vein. Gourinchas, Valdés, and Landerretche (2001) introduced threshold methods to the analysis of credit booms, followed by several other studies including: Cottarelli, Dell'Ariccia, and Vladkova-Hollar (2003), International Monetary Fund (2004), Hilbers and others (2005), and Ottens, Lambregts, and Poelhekke (2005).[3] Threshold methods have also been widely used in related studies of Sudden Stops and the boom-bust cycle of capital inflows. Reinhart and Reinhart (2009) survey this literature and conduct a detailed cross-country analysis of the macroeconomic dynamics associated with surges in capital inflows. In line with our findings, they also find that booms in capital inflows are associated with periods of economic expansion, and booming credit and asset prices.

Before our 2008 working paper provided a new methodology to measure credit booms, the standard practice in empirical studies on this topic followed the method proposed by Gourincha, Valdés, and Landerretche (2001). There are three important differences between their method and ours: (1) we use real credit per capita instead of the credit-output ratio as the measure of credit; (2) we construct the trend of credit using the Hodrick-Prescott (HP) filter in its standard form, instead of using an "expanding HP trend" (see Mendoza and Terrones, 2008, for details); and (3) we use thresholds that depend on each country's cyclical variability of credit, instead of a threshold common to all countries.[4]

These differences have important implications. As shown in Mendoza and Terrones (2008), an example of both methods applied to Chilean data shows that the method of Gourinchas, Valdés, and Landerretche (2001) is not robust in the choice of credit measure, and

3. There are also other studies that examine linkages between credit and macro variables without measuring credit booms (for example, Collyns and Senhadji, 2002, Borio, Furfine, and Lowe, 2001, and Kraft and Jankov, 2005).

4. Our study also differs in that we examine credit booms in industrial countries, and study differences in the dynamics of the tradables versus non-tradables sectors.

that it treats each period's credit observation as unduly representative of its trend (because it models the long-run trend of credit as a smoothed, lagged approximation of the actual data). Moreover, the two methods yield sharply different predictions about the association between macro variables and credit booms. In particular, we find that output, consumption, and investment rise significantly above trend during the expansionary phase of credit booms, and fall below trend during the contractionary phase. In contrast, they found weak evidence of cycles, in output and absorption, associated with credit booms. We also find a clear association between credit booms and financial crises, while they found that the likelihood of financial crises does not increase significantly when credit booms are present.

Our work is also related to the analysis of the credit transmission channel in twin banking-currency crises by Tornell and Westermann (2005).[5] These authors document that twin crises are preceded by rising credit-GDP ratios, increases in output of non-tradables relative to tradables, and real appreciations, followed by declines in all of these variables. In addition, they used the World Bank's World Business Economic Survey (WBES) to document asymmetries in the access to credit markets of firms in the tradables vs. non-tradables sectors. We also look at sectoral differences in the evolution of output dynamics, but our approach differs in that we examine these dynamics as conditional on credit boom episodes, rather than conditional on a twin-crises event.

Our frequency analysis of the association of credit booms with capital inflows, financial reforms, and TFP gains is related to theoretical and empirical studies on the mechanisms that drive credit booms. These include theories in which excessive credit expansion is due to herding behavior by banks (Kindleberger, 2000); information problems that lead to bank-interdependent lending policies (Rajan, 1994; Gorton and He, 2008), the underestimation of risks (Boz and Mendoza, 2010; Borio, Furfine, and Lowe, 2001) and the lowering of lending standards (Dell'Ariccia and Márquez, 2006); the presence of explicit or implicit government guarantees (Corsetti, Pesenti, and Roubini, 1999); or limited commitment on the part of borrowers (Lorenzoni, 2008). Similarly, our analysis of the connection between credit booms and macroeconomic activity is related to the literature

5. Tornell and Westermann also study the extent financial market imperfections influences the cycle in the middle income countries during tranquil times. See also Scheneider and Tornell (2004).

on business cycle models that incorporate "financial accelerators," by which shocks to asset prices and relative good prices are amplified through balance sheet effects (see, for example, Fisher, 1933; Bernanke and Gertler, 1989; Bernanke, Gertler, and Gilchrist, 1999; Kiyotaki and Moore, 1997; and Mendoza, 2005, 2010).

The rest of the paper is organized as follows: Section 1 describes our method for identifying credit booms, implements it using our cross-country sample, and examines the main characteristics of credit booms in industrial and emerging economies. Section 2 studies the credit-boom dynamics of the cyclical components of macro aggregates. Section 3 concludes.

1. Credit Booms: Methodology and Key Features

1.1 Methodology

A credit boom is defined in general as an episode in which credit to the private sector grows by more than during a typical business cycle expansion. In Mendoza and Terrones (2008) we formalized this definition as follows. Denote the deviation from the long-run trend in the logarithm of real credit per capita in country i, date t as l_{it}, and the corresponding standard deviation of this cyclical component as $\sigma(l_i)$. The long-run trend is calculated using the Hodrick-Prescott (HP) filter with the smoothing parameter set at 100, as is typical for annual data. Country i is defined to have experienced a credit boom when we identify one or more contiguous dates for which the credit boom condition $l_{i,t} \geq \phi\sigma(l_i)$ holds, where ϕ is the boom threshold factor. Thus, during a credit boom the deviations from trend in credit exceed the typical expansion of credit over the business cycle by a factor of ϕ or more. The baseline value of ϕ is set at 1.65, because the 5 percent tail of the standardized normal distribution satisfies $\text{Prob}(l_{i,t}/\sigma(l_i) \geq 1.65) = 0.05$. We also conducted sensitivity analysis for $\phi = 1.5$ and 2 and confirmed that our main results are robust to the value of ϕ.

The date of the peak of the credit boom ($\hat{t}$) is the date that shows the maximum difference between l_{it} and $\phi\sigma(l_i)$ from the set of contiguous dates that satisfy the credit boom condition. Given $\hat{t}$, the starting date of the credit boom is a date t^s such that $t^s < \hat{t}$ and t^s yields the smallest difference $\mid l_{i,t} - \phi^s\sigma(l_i) \mid$, and the ending date t^e is a date $t^e > \hat{t}$ that yields the smallest difference $\mid l_{i,t} - \phi^e\sigma(l_i) \mid$,

where ϕ^s and ϕ^e are the start and end thresholds.[6] We use baseline values $\phi^s = \phi^e = 1$, and we also tried other values including 0, 1/4, 1/2 and 3/4.[7] Once the starting and ending dates are set, the duration of the credit boom is given by the difference $t^e - t^s$.

1.2 Credit boom episodes and their main features

We use credit data from the financial sector to the private non-financial sector obtained from the IMF's *International Financial Statistics* for a sample of 61 countries, 21 industrial and 40 emerging economies (appendix 1), for the 1960-2010 period. Our measure of credit is the sum of claims on the private sector by deposit money banks (*IFS* line 22d) plus, whenever available for the entire sample period for a given country, claims on the private sector by other financial institutions (*IFS* line 42d). Real credit per capita is calculated as the end-of-year observations of nominal credit per capita, deflated by their corresponding end-of-year consumer price index. Data sources for these, and all other variables used in this paper are listed in appendix 2.

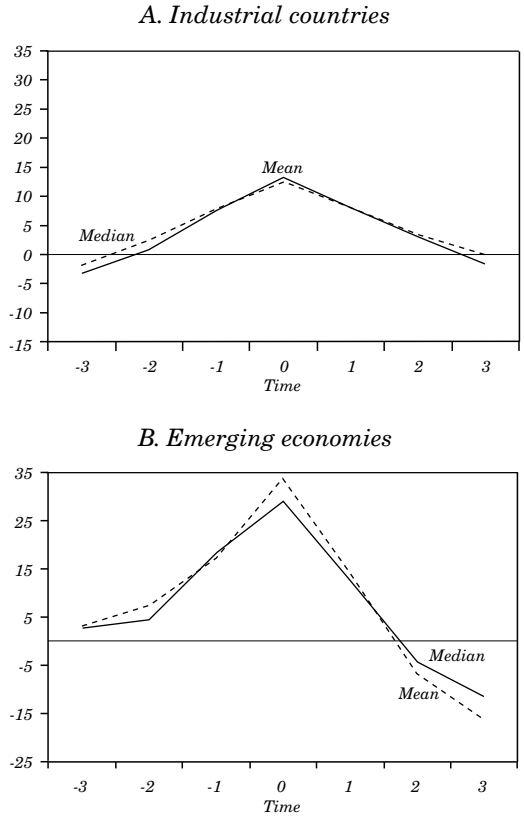
We identified 70 credit booms in our data, 35 in ICs and 35 in EMs.[8] Figure 1 provides a summary view of these credit booms by plotting the cross-country mean and median of the cyclical components of real credit per capita in seven-year event windows centered at the peak of credit booms for the two groups of countries. These graphs show that credit booms in EMs are larger than those in industrial countries in absolute terms: At the peak of the booms, the average expansion in real credit per capita reached about 30 percent above trend in EMs, twice what is observed in ICs. Normalized by the standard deviation of the cyclical component of credit in each country, however, credit booms in the two groups of countries show a similar distribution, with medians of 2 and 2.1 for ICs and EMs respectively (see figure 2). Thus, normalized by the variability of

6. These threshold conditions are set to minimize the absolute values of differences of lit relative to targets because the data are discrete, and hence in general lit does not match the targets with equality.

7. We use thresholds such that $\phi^s = \phi^e < \phi$, but notice that in principle ϕ^s and ϕ^e could differ, and one or both could be set equal to ϕ.

8. There is also one emerging economy (Hong Kong) identified as experiencing credit booms in 2010, the end of the sample period. We excluded it from the event analysis because this boom has yet to be completed (that is, the ending threshold has not been crossed yet).

Figure 1. Credit Booms: Seven-Year Event Windows
Deviations from HP-trend in real credit per-capita



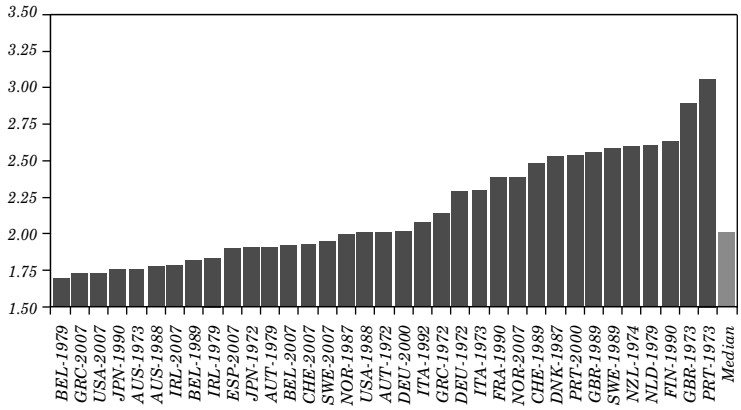
Source: Authors' elaboration.

credit, the magnitude of credit booms does not differ significantly across EMs and ICs.

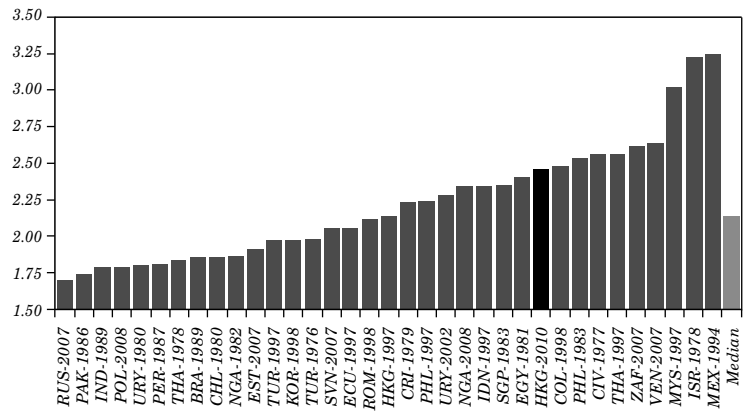
Table 1 shows the duration of credit booms for different starting and ending thresholds, and the length of the corresponding upswing and downswing phases. In general, the results based on medians indicate that EMs and ICs show booms with similar durations of about 3-6 years, and the fraction of the boom spent in the upswing and downswing phases with the duration thresholds, set at 1, is about the same. Using means, however, EMs seem to show longer and more asymmetric booms.

Figure 2. Relative Credit Booms
Deviation from trend at peak of credit boom as a ratio of the standard deviation of credit

A. Industrial countries



B. Emerging market economies[a]



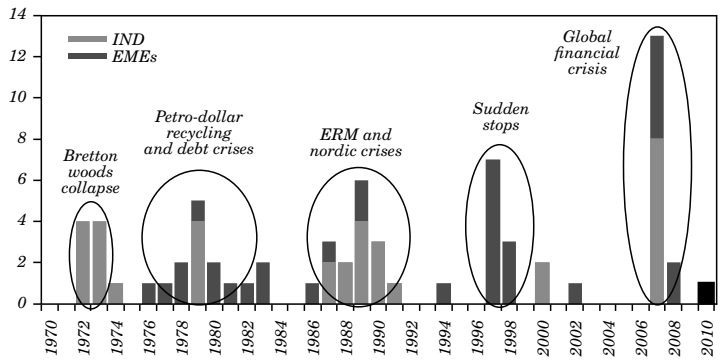
Source: Authors' elaboration.
a. Ongoing credit booms are shown in black.

Table 1. Credit Booms: Duration

Starting and ending thresholds	*Emerging market economies*			*Industrial countries*		
		Fraction spent in			*Fraction spent in*	
	Duration	*Upswing*	*Downturn*	*Duration*	*Upswing*	*Downturn*
A. Mean						
0.00	5.60	0.45	0.37	5.64	0.39	0.43
0.25	4.86	0.46	0.34	4.92	0.38	0.42
0.50	4.40	0.41	0.36	4.36	0.35	0.42
0.75	3.63	0.35	0.37	3.89	0.34	0.41
1.00	5.60	0.45	0.37	3.44	0.30	0.41
B. Median						
0.00	6.00	0.50	0.33	5.50	0.36	0.45
0.25	5.00	0.40	0.20	5.00	0.40	0.40
0.50	5.00	0.20	0.20	4.00	0.25	0.50
0.75	4.00	0.25	0.25	4.00	0.25	0.50
1.00	3.00	0.33	0.33	3.00	0.33	0.33

Source: Authors' elaboration.

Figure 3. Frequency of Credit Booms[a]



Source: Authors' elaboration.
a. Ongoing credit booms are shown in black.

Credit booms tend to be clustered geographically and not limited to a single region: 40 percent of the booms experienced by emerging economies were observed in East Asia and 32 percent in Latin America. Likewise, 33 percent of the credit booms in industrial countries were observed in the G7 and 18 percent in the Nordic countries (Denmark, Finland, Norway, and Sweden). In addition, figure 3 shows that credit booms tend to be synchronized internationally, and centered around big events—for example, the Bretton Woods collapse of the early 1970s, the petro-dollars boom in the prelude to the 1980s debt crisis, the ERM and Nordic country crises of the early 1990s, the 1990s Sudden Stops, and the recent Global Financial Crisis. It is interesting to note that, excluding the recent crisis, the figure would have misleadingly suggested that the frequency of credit booms in ICs had declined over time. Adding the turbulent period of the past few years it is clear that this is not the case. Still, it is possible that the credit measure from *IFS* misses important elements of the securitization boom occurring via non-bank financial intermediaries, and thus leads us to underestimate the magnitude and frequency of credit booms in countries with more developed financial systems.[9]

9. For example, Rajan (2005) argues that technical change, deregulation, and institutional change have resulted in an increasing number of arm's length transactions away from banks in the financial system. Indeed, the growing securitization of sub-prime mortgages in the US in recent years was accompanied by an increase in the off-balance sheet operations of bank entities.

2. Credit Booms and Macroeconomic Dynamics

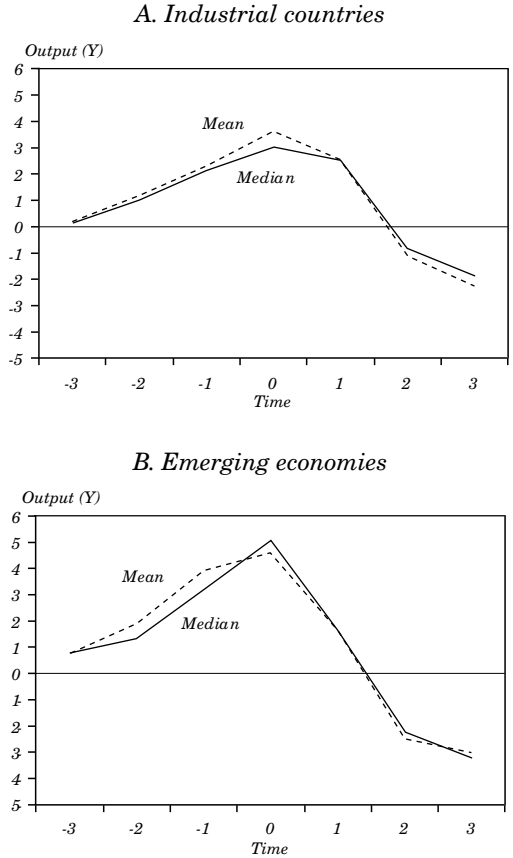
This section examines the business cycle behavior of the economy during credit boom events, and conducts a frequency analysis of the association between credit booms and financial crises, and between credit booms and some of their potential determinants.

2.1 Event analysis

We construct seven-year event windows of the cyclical components of macro aggregates centered on the peak of credit booms (that is $\hat{t}$ is normalized to date $t = 0$). The windows show the cross-country means and medians of output (Y), private consumption (C), public consumption (G), investment (I), the output of non-tradables (YN), the real exchange rate (RER), the current account-output ratio (CAY) and total capital inflows as share of output (KI). All these variables are at constant prices, expressed in per-capita terms and detrended with the HP filter setting the smoothing parameter at 100, except for RER (which is not in per-capita terms) and the current account-output and capital inflows-output ratios (which are at current prices and not expressed in per capita terms).

Figures 4-8 illustrate business cycle dynamics around credit boom episodes in EMs and ICs. Except for RER in the EMs group, there is little difference in the dynamics produced by country means and medians, indicating that the results are not driven by outliers. Consider first the plots for EMs in the right side of the figures. Y, C and G rise 2 to 5 percentage points above trend in the build-up phase of the credit boom, and drop to between 2 to 3.5 percent below trend in the recessive phase. I, YN and RER follow a similar pattern, but display significantly larger expansions and recessions. Investment rises up to about 20 percent above trend at the peak of credit booms, and drops below trend by a similar amount by $t = 2$. YN rises to about 5.5 percent above trend by $t = 0$ and then drops to almost 4 percent below trend by $t = 3$. The median RER appreciates 7 percent above trend at date t, and drops to a low of about 4 percent below trend when the credit boom unwinds. CAY displays the opposite pattern: it declines to a deficit of about 2 percentage points of GDP in the expanding phase of the boom, and then rises to a surplus of 1 percentage point of GDP in the declining phase. In line with these current account dynamics, the median KI rises by up to 2 percentage points of GDP by $t = –1$ and then drops by 1 percentage point of GDP by $t = 2$.

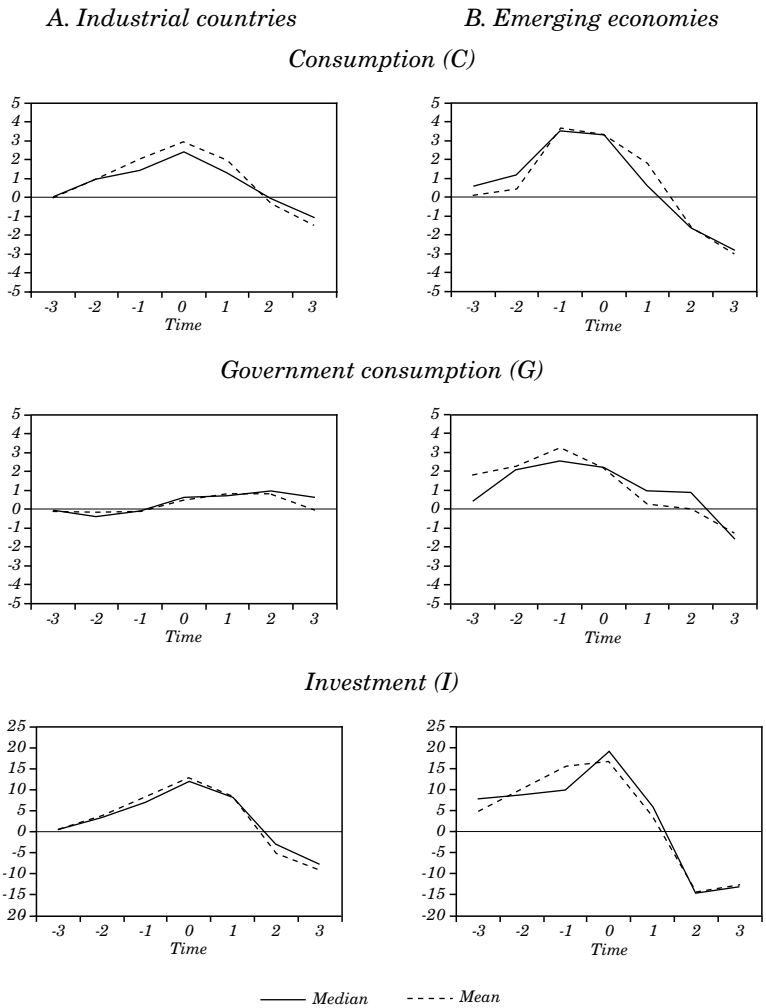
Figure 4. Credit Booms and Economic Activity
Cross-country means and medians of cyclical component of real GDP



Source: Authors' elaboration.

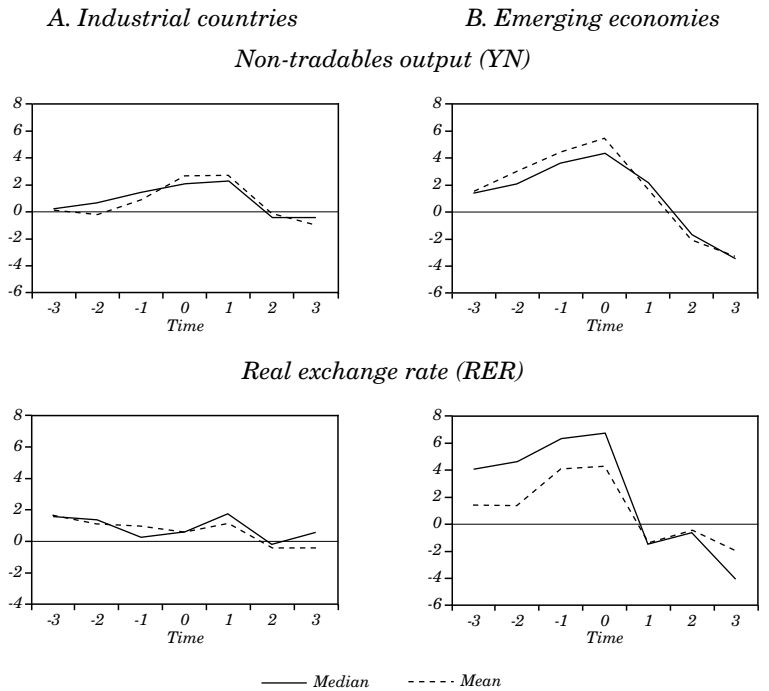
The plots for industrial countries in the left-side panels of figures 4-8 show several similarities with those of emerging economies, but also some important differences. Output, expenditures and the current account in the industrial countries follow a cyclical pattern similar to that observed in the emerging economies, but the amplitude of these fluctuations is smaller (particularly for *YN* and *RER*), and government consumption shows a different pattern (just about at trend in the expanding phase and slightly above trend in

Figure 5. Credit Booms and Domestic Demand
Cross-country means and medians of cyclical components



Source: Authors' elaboration.

Figure 6. Credit Booms and the Non-tradables Sector
Cross-country means and medians of cyclical components

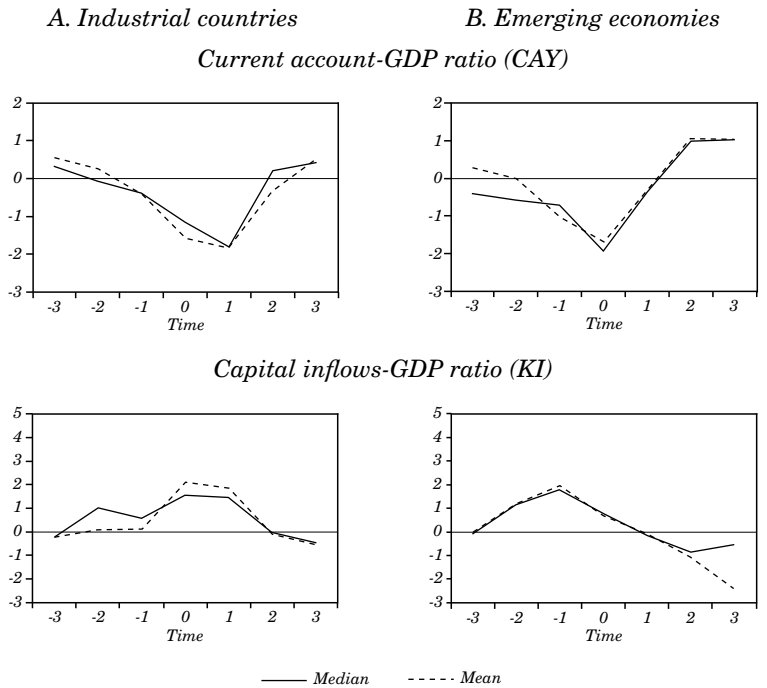


Source: Authors' elaboration.

the contraction phase). However, if we were to normalize the macro data using standard deviations of cyclical components, and take into account that EMs display higher business cycle variability in all their macro-aggregates (see, for example, Mendoza, 1995), we would see again that credit booms display similar features across EMs and ICs.

Two important caveats apply to the event study graphs of macro dynamics. First, they illustrate the cyclical dynamics of macro variables, but do not show if these variables are undergoing a boom themselves (that is, an unusually large expansion as defined by our thresholds method). Table 2 provides evidence to examine this issue by listing the fraction of credit booms associated with booms in output, and expenditures that occur at any time inside the seven-year window of the credit boom events. The results show that between 30 to 60 percent of the credit booms are associated with booms in *Y*,

Figure 7. Credit Booms, Current Account, and Capital Inflows
Cross-country means and medians of cyclical component

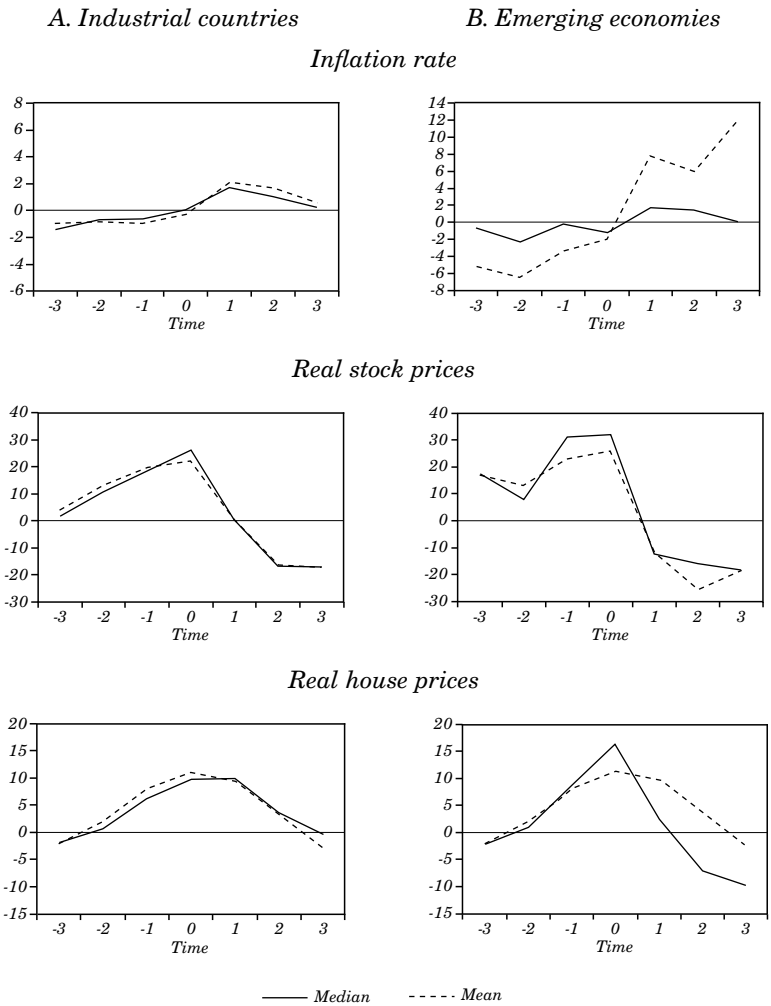


Source: Authors' elaboration.

YN, *C*, *I*, and *G*, and this holds for EMs and ICs separately, and for all the countries together. For output, in particular, close to half of the observed credit booms are associated with output booms, with little difference across EMs and ICs.

The second caveat is that the macro event windows show point estimates of measures of central tendency (means and medians), but do not demonstrate if these moments are statistically significant. To explore this issue, we run cross-section regressions of each macro variable for each date of the event window on a constant. The standard error for the median (mean) is obtained using quintile (OLS) regressions. As table 3 shows, most of the mean and median estimates shown in the event study plots for *Y*, *YN*, *C*, and *I* are statistically significant. For *G*, *RER* and *CA*/*Y*, however, many of the coefficients have large standard errors.

Figure 8. Credit Booms and Prices
Cross-country means and medians of cyclical components



Source: Authors' elaboration.

Table 2. Coincidence of Credit Booms with Output and Demand Booms[a]
Frequency

	Industrial countries	*Emerging market economies*	*All*
Output	0.49	0.46	0.46
Non-tradable output	0.31	0.46	0.40
Consumption	0.49	0.46	0.47
Investment	0.60	0.34	0.47
Government expenditures	0.29	0.34	0.30

Source: Authors' elaboration.
a. The figures reported in this table are fractions of credit booms that coincide with output/demand boom, within the seven-year window of the credit boom.
The output/demand boom has been determined using a similar method to the one employed to determine credit booms, with a boom threshold factor of 1.65.

We now study the behavior of inflation, equity prices and housing prices during credit booms (figure 8). Using medians, there is only a week association between credit booms and inflation in both EMs and ICs, with below-trend inflation in the upswing and above-trend inflation in the downswing.[10] Hence, credit booms are generally *not* associated with sharp changes in inflation. In contrast, housing and equity prices show a clear pattern of rising prices in the upswing and declining prices in the downswing. Equity prices rise to 25-30 percent at the peak of credit booms, and housing prices rise to 10-15 percent in both EMs and ICs. The downswing of credit booms leads to significant equity price collapses of about 20 percent in real terms, in both groups of countries. These movements in asset prices are important because they are consistent with theoretical explanations of credit booms and busts that rely on financial accelerators and balance sheet effects.

Real M2 money balances also expand during the upswing and contract during the downswing of credit booms (figure 7). This

10. The mean inflation in EMs does show a shift from sharply below-trend inflation to sharply above-trend inflation but that reflects outliers driven by a few hyperinflation episodes in Latin America.

Table 3. Credit Booms: Statistical Significance of Event-Window Coefficients

	Industrial countries						
	t-3	*t-2*	*t-1*	*t*	*t+1*	*t+2*	*t+3*
1. Mean values							
Real credit	-0.031**	0.011	0.079***	0.137***	0.085***	0.031**	0.020
	(0.009)	(0.011)	(0.01)	(0.01)	(0.011)	(0.01)	(0.013)
Output	0.002	0.012***	0.023***	0.036***	0.025***	-0.011*	-0.023***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)
Non-tradable output	0.001	-0.002	0.009	0.026***	-0.01	0.030***	0.042***
	(0.007)	(0.005)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)
Consumption	0.000	0.010**	0.021***	0.029***	0.019***	0.004	-0.015***
	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)
Government consumption	0.001	0.001	0.001	0.005	0.007	0.007	0.001
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.005)
Investment	0.007	0.038***	0.083***	0.130***	0.081***	-0.052**	-0.094***
	(0.01)	(0.009)	(0.013)	(0.014)	(0.013)	(0.018)	(0.018)
REER	0.016	0.007	0.005	0.001	0.011	0.005	0.000
	(0.026)	(0.015)	(0.012)	(0.01)	(0.009)	(0.009)	(0.012)
Current account balance	0.560*	0.249	0.421	-1.582***	-1.741***	0.264	0.571
	(0.259)	(0.334)	(0.376)	(0.385)	(0.398)	(0.285)	(0.33)

Table 3. (continued)

	Emerging market economies						
	t-3	*t-2*	*t-1*	*t*	*t+1*	*t+2*	*t+3*
1. Mean values							
Real credit	0.029	0.071	0.167***	0.332***	0.139***	0.068	-0.164***
	(0.027)	(0.037)	-0.041	-0.03	-0.03	(0.039)	(0.042)
Output	0.009	0.020**	0.037***	0.044***	0.016	-0.025**	-0.030**
	(0.007)	(0.007)	-0.008	-0.011	-0.012	(0.008)	(0.009)
Non-tradable output	0.052***	0.017	-0.021	-0.033**			
	(0.007)	(0.007)	(0.008)	(0.011)	(0.014)	(0.013)	(0.011)
Consumption	0.002	0.005	0.035***	0.033*	0.018	0.016	-0.030**
	(0.007)	(0.013)	(0.009)	(0.013)	(0.012)	(0.009)	(0.01)
Government consumption	0.017	0.022	0.032**	0.022	0.003	0.000	0.013
	(0.012)	(0.012)	(0.01)	(0.016)	(0.011)	(0.013)	(0.011)
Investment	0.050*	0.100**	0.151***	0.164***	0.037	-0.144***	-0.126***
	(0.022)	(0.028)	(0.028)	(0.035)	(0.042)	(0.031)	(0.031)
REER	0.005	0.002	0.021	0.036*	0.011	0.035	0.024
	(0.015)	(0.024)	(0.021)	(0.017)	(0.028)	(0.032)	(0.036)
Current account balance	0.328	0.081	-1.066*	-1.764*	0.333	1.047	1.027
	(0.776)	(0.714)	(0.511)	(0.662)	(0.762)	(0.681)	(0.579)

Table 3. (continued)

	Industrial countries						
	t-3	*t-2*	*t-1*	*t*	*t+1*	*t+2*	*t+3*
2. Median values							
Real credit	-0.02	0.027**	0.078***	0.125***	0.084***	0.037***	-0.004
	(0.01)	(0.009)	(0.013)	(0.015)	(0.008)	(0.009)	(0.011)
Output	0.002	0.010*	0.021***	0.030***	0.024***	-0.009*	-0.019***
	(0.004)	(0.004)	(0.005)	(0.005)	(0.003)	(0.004)	(0.003)
Non-tradable output	0.002	0.007	0.014**	0.021**	0.022***	0.001	0.004
	(0.003)	(0.007)	(0.005)	(0.006)	(0.003)	(0.006)	(0.004)
Consumption	0.000	0.010	0.014**	0.024***	0.013***	0.002	-0.012**
	(0.003)	(0.005)	(0.005)	(0.005)	(0.003)	(0.004)	(0.004)
Government consumption	0.001	0.004	0.001	0.006	0.007***	0.007*	0.001
	(0.003)	(0.004)	(0.004)	(0.005)	(0.002)	(0.003)	(0.003)
Investment	0.006	0.034***	0.070***	0.121***	0.083***	-0.045*	-0.078***
	(0.009)	(0.007)	(0.016)	(0.013)	(0.017)	(0.021)	(0.011)
REER	0.009	0.009	0.000	0.002	0.015	0.005	0.003
	(0.006)	(0.008)	(0.009)	(0.013)	(0.012)	(0.007)	(0.009)
Current account balance	0.354	0.074	0.473	-1.186*	-1.802***	0.228	0.525
	(0.31)	(0.291)	(0.529)	(0.515)	(0.485)	(0.276)	(0.394)

Table 3. (continued)

	Emerging market economies						
	t-3	*t-2*	*t-1*	*t*	*t+1*	*t+2*	*t+3*
2. Median values							
Real credit	0.028	0.044	0.164***	0.289***	0.128***	-0.044	-0.127*
	(0.017)	(0.036)	(0.04)	(0.047)	(0.013)	(0.023)	(0.058)
Output	0.011	0.015	0.032***	0.050***	0.008	-0.023**	0.029
	(0.011)	(0.01)	(0.008)	(0.01)	(0.02)	(0.006)	(0.014)
Non-tradable output	0.018	0.023	0.025	0.044*	0.018	0.021	0.032
	(0.012)	(0.013)	(0.014)	(0.017)	(0.019)	(0.015)	(0.016)
Consumption	0.006	0.019*	0.035**	0.025*	0.011	-0.019*	-0.029*
	(0.013)	(0.008)	(0.012)	(0.011)	(0.012)	(0.009)	(0.013)
Government consumption	0.004	0.019	0.023	0.022**	0.008	0.008	-0.015*
	(0.01)	(0.01)	(0.012)	(0.006)	(0.008)	(0.01)	(0.006)
Investment	0.077*	0.088*	0.096*	0.187***	0.055	-0.144***	-0.129*
	(0.029)	(0.033)	(0.042)	(0.027)	(0.041)	(0.034)	(0.05)
REER	0.007	0.008	0.039	0.066*	0.013	0.031	0.028
	(0.024)	(0.03)	(0.025)	(0.025)	(0.031)	(0.026)	(0.023)
Current account balance	0.380	0.312	0.773	-1.937**	0.342	1.028	1.110
	(0.545)	(0.583)	(0.557)	(0.563)	(0.949)	(0.6)	(0.546)

Source: Authors' elaboration.
Note: Standard errors are in parenthesis. The coefficients are obtained by regressing each macroeconomic aggregate on a constant.
The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% respectively.

suggests that monetary policy may play a role in fueling credit booms, inasmuch as real M2 moves along with credit during credit boom episodes.[11]

The event windows for industrial and emerging economies mask important variations across country regions. In ICs, the Nordic countries show larger fluctuations in credit and macro variables than the G7 (table 4, panel A). In addition, some of the macro variables in the Nordic countries peak earlier than credit. In the case of EMs (table 4, panel B), credit expansions and the associated surge in consumption are much larger in Latin America. In contrast, the current account reversals when the credit booms revert are larger in Asia.

In summary, the macro event study shows that credit booms across emerging and industrial economies are associated with a well-defined pattern of economic expansion in the build-up phase of the booms, followed by contraction in the declining phase. Output, expenditures, stock prices, housing prices, and the real exchange rate move above trend in the first phase, and drop below trend in the second phase, and the current account falls first and then rises. All of this happens without major changes in inflation in most countries.

There are interesting differences in the dynamics around credit boom events across EMs and ICs in terms of the amplitude of macro fluctuations in levels (that is, without some form of normalization) and in the dynamics of government expenditures. These differences are consistent with three well-known facts in international business cycle studies: First, as noted earlier, the larger amplitude of the fluctuations displayed by EMs is in line with well-established evidence showing that business cycles are larger in developing countries (see Mendoza, 1995, Kose, Prasad, and Terrones, 2003, Neumeyer and Perri, 2005). Second, the striking difference in the behavior of government purchases is consistent with the evidence produced in the literature on the procyclicality of fiscal policy in EMs (see Kaminski, Reinhart, and Vègh, 2005). Third, the widening current account deficits followed by reversals, and the larger booms followed by collapses in the price and output of the non-tradables sector, are consistent with observations highlighted in the Sudden

11. There is the impression that central banks in developing countries often loosen (tighten) monetary policy in good (bad) times. However, a systemic characterization of this regularity has been elusive because of lack of good indicators of the monetary policy stance (see, for instance, Kaminsky, Reinhart and Vègh, 2005).

Table 4. Credit Booms: Regional Features
Cross-country median of cyclical components

		Date						
Variable	*Region*	*t-3*	*t-2*	*t-1*	*t*	*t+1*	*t+2*	*t+3*
1. Industrial countries: G7 vs nordic countries								
Real credit	G7	0.132	2.827	7.029	8.421	6.515	1.750	0.163
	Nordic	-4.839	1.185	12.221	19.280	12.035	10.358	4.603
Output (Y)	G7	0.028	1.177	1.846	2.886	1.799	-0.435	-1.773
	Nordic	0.044	2.086	3.850	3.679	1.289	-1.739	-2.227
Non-tradable output (YN)	G7	0.194	0.662	1.436	2.011	1.882	0.626	-0.723
	Nordic	0.792	1.293	1.885	2.533	1.128	-1.362	-1.070
Consumption (C)	G7	0.393	1.402	1.430	2.380	1.756	0.253	-1.069
	Nordic	0.033	2.034	4.479	3.306	0.828	-1.362	-1.765
Investment (I)	G7	1.750	4.125	7.695	9.988	5.743	-7.319	-6.516
	Nordic	0.159	5.174	15.572	16.522	10.458	-3.644	-8.669
Real exchange rate (RER)	G7	0.420	1.281	0.004	-3.049	-3.314	-0.190	-1.292
	Nordic	0.639	0.944	0.736	3.600	1.933	-0.315	1.327
Current account-GDP ratio (CAY)	G7	0.138	-0.314	-0.871	-1.161	-0.655	0.310	0.053
	Nordic	0.477	0.665	-0.730	-0.598	-0.642	-0.829	-1.729

Table 4. (continued)

Variable	*Region*	*Date*						
		t-3	*t-2*	*t-1*	*t*	*t+1*	*t+2*	*t+3*
2. Emerging economies: Latin America (LA) vs Asia vs transition								
Real credit	LA	15.741	22.270	36.815	51.891	27.723	-6.820	-21.593
	Asia	3.705	5.789	14.747	24.175	12.379	-3.907	-4.425
	Transition	-4.764	-1.356	5.570	23.218	10.393	-6.697	-25.947
Output (Y)	LA	0.430	2.906	5.841	7.729	5.892	-2.737	-6.010
	Asia	3.839	4.092	4.088	5.727	-3.547	-3.108	-0.945
	Transition	2.126	4.807	3.224	7.081	4.672	-5.464	-6.303
Non-tradable output (YN)	LA	1.027	2.320	5.650	10.031	2.702	-5.020	-5.144
	Asia	3.780	4.897	4.714	4.387	0.444	-2.741	-1.487
	Transition	3.210	4.016	1.982	4.632	5.668	-4.388	-5.755
Consumption (C)	LA	-1.876	0.974	4.398	8.541	5.862	-2.292	-6.391
	Asia	3.596	2.904	2.780	2.230	-2.214	-2.821	-2.065
	Transition	0.543	3.080	2.227	2.381	2.713	-2.306	-6.604
Investment (I)	LA	8.836	8.773	13.374	20.947	15.871	-18.896	-18.177
	Asia	10.040	14.465	9.830	18.064	-7.154	-11.401	-3.363
	Transition	1.254	1.581	15.281	20.471	18.703	-16.581	-23.255
Real exchange rate (RER)	LA	0.519	-1.900	1.855	9.238	8.883	2.437	-5.766
	Asia	4.774	6.040	8.654	6.725	-3.976	-0.348	-4.624
	Transition	-1.997	-0.567	-1.168	6.582	1.270	1.248	-1.469
Current account-GDP ratio (CAY)	LA	-0.889	-0.253	0.211	-2.299	-0.585	0.631	1.159
	Asia	-1.497	-3.338	-3.316	-2.233	1.566	1.367	0.065
	Transition	-0.293	0.619	-0.464	-1.789	-0.832	1.605	1.611

Source: Authors' elaboration.

Stops literature (for example, Calvo, 1998, Mendoza, 2005, Caballero and Krishnamurty, 1998). However, it is important to note that these facts have been generally documented by examining macroeconomic data *without* conditioning for credit booms. In contrast, our results apply specifically to fluctuations associated with credit boom episodes. This is particularly relevant for the Sudden Stop facts (that is, the reversals in *CAY* and the boom-bust cycles in *RER* and *YN*), because most of the Sudden Stops literature emphasizes the role of credit transmission mechanisms in explaining Sudden Stops.

Our finding that credit booms are associated with a well-defined cyclical pattern in output and expenditures contrasts sharply with the findings of Gourinchas, Valdés, and Landerretche (2001), showing only ambiguous evidence of this association. Figure 6 in their paper shows a small cycle in GDP, a decline in GDP growth below trend for the entire duration of credit booms, and no cycle in consumption.

2.2 Frequency analysis

Next, we conduct a frequency analysis to examine three issues: (1) the association between credit booms and financial crises; (2) the role of capital inflows, TFP gains, financial reforms and exchange rate regimes as preconditions of credit booms; and (3) the probability of experiencing a credit boom once the starting threshold is crossed.

Credit booms are often cited as the culprit behind financial crises, particularly in emerging economies (Eichengreen and Arteta, 2002). If this is the case, credit booms should be closely associated with financial crises. Table 5 shows the percent of banking crises, currency crises and Sudden Stops that occurred during the seven-year window of the credit boom events in EMs, ICs and all countries combined. The percent of crises that occurred before, at, and after the peak of the credit booms are listed in separate columns. The dates identifying the occurrence of these crises were obtained from sources in the empirical literature (Demirguic-Kunt and Detragiache, 2005, for banking crises, Eichengreen and Bordo, 2002, for currency crises, and Calvo, Izquierdo, and Mejía, 2004, for Sudden Stops).

Table 5 yields an important result: Credit booms in both EMs and ICs are often associated with currency crises, banking crises, and Sudden Stops, although the first two are observed more often than the third. Banking crises are observed in 44 percent of all credit booms, in about a third of IC credit booms, and half of EM credit booms. Currency crises are observed in 54 percent of all credit booms,

Table 5. Credit Booms and Crises[a]
Frequency

	Banking crises[b]				*Currency crises*[c]				*Sudden stops*[d]			
	Before	*Peak boom*	*After*	*Total*	*Before*	*Peak boom*	*After*	*Total*	*Before*	*Peak boom*	*After*	*Total*
All countries	0.11	0.08	0.24	0.44	0.23	0.08	0.23	0.54	0.04	0.06	0.14	0.24
Industrial countries	0.06	0.06	0.25	0.36	0.17	0.03	0.25	0.44	0.00	0.00	0.14	0.14
Emerging market economies	0.17	0.11	0.23	0.51	0.29	0.14	0.20	0.63	0.09	0.11	0.14	0.34

Source: Authors' elaboration.
a. Coincidence of credit booms and financial crises in the seven-year window around the boom.
b. A banking crisis is defined by Demirguic-Kunt and Detragiache (2006) as a situation in which at least one of the following conditions holds: (1) the ratio of nonperforming assets to total assets of the banking system exceeds 10 percent; (2) the cost of banking system bailouts exceeds 2 percent of GDP; (3) there is large scale bank nationalization as result of banking sector problems; or (4) there are bank runs or new important depositor protection measures.
c. A currency crisis is defined by Eichengreen and Bordo (2002) as a period in which a country experiences a forced change in parity, abandons a currency peg or receives a bailout from an international organization, and at the same time an index of exchange rate market pressure (a weighted average of the depreciation rate, change in short-term interest rate, and percentage change in reserves) rises 1.5 standard deviations above its mean.
d. A sudden stop is defined by Calvo, Izquierdo and Mejía (2004) as a year-on-year fall in capital flows that exceeds 2 standard deviations relative to the mean.

in 44 percent of IC credit booms, and two-thirds of EM credit booms. Sudden Stops are observed in about one-quarter of all credit booms, in 14 percent of IC credit booms and third of EM credit booms.

It is also worth noting that, within the seven-year window of credit boom events, the incidence of the three types of crises is at its highest after credit booms peak, and this holds true again for EMs, ICs and all countries combined. Moreover, the frequency with which each type of crisis is observed after the peak of credit booms is also very similar across EMs and ICs (23 versus 25 percent for banking crises, 20 versus 25 percent for currency crises, and a common 14 percent for Sudden Stops). Thus, clearly not all credit booms end in crisis; but odds are about 1 out of 4 that once a country enters a credit boom it will end with a currency or a banking crisis, and a little less that it will end in a Sudden Stop.

These findings are broadly consistent with those reported in Schularick and Taylor (2012). They examined whether credit growth is a significant predictor of banking crises for a sample of fourteen developed countries over the 1870 to 2008 period, and found that indeed credit growth helps predict these crises. However, their analysis only provides indirect evidence of the credit boom-bust cycle because using credit growth, per-se, as an explanatory variable, does not identify whether this credit growth is the result of financial deepening or a credit boom.

Our findings are at odds with the conclusion in Gourinchas, Valdés, and Landerretche (2001), which noted that there is virtually no association between credit booms and financial crises in EMs. They are also sharply different from the findings in Mendoza and Terrones (2008), where lacking the data from 2007-2010 we found that credit booms in ICs were rarely associated with banking and currency crises, and there was no association with Sudden Stops.

We also constructed seven-year event windows that compare the fluctuations in credit and macro aggregates of countries that experienced a crisis (that is, banking crisis, currency crisis, or Sudden Stop) with those that did not. The results (available from the authors on request) show clearly that the macro fluctuations in the countries that experienced crisis are larger and display more abrupt declines than those of the non-crisis countries. In particular, the dynamics of credit are more pronounced, and with more drastic downswings in the case of the crisis countries, than in the non-crisis countries. In addition, the behavior of capital inflows is different across the two groups of countries. While capital inflows rise in the upswing of the

crisis episodes and fall abruptly in the downswing, they seem more stable in the case of the non-crisis episodes.

Consider now the frequency analysis of the association between credit booms and large capital inflows, financial reforms, and TFP gains. Capital inflows are measured as the total net inflows (that is, net foreign direct investment, net portfolio flows, and other net investments liabilities) in percent of GDP, using data from IFS (appendix 2). We define a state of large capital inflows as of date t when the preceding three-year average of net capital inflows ranked on the top quartile of its respective country group (that is, EMs, ICs, or both) over the 1975-2010 period. Domestic financial reforms are measured using the index produced by Abiad, Detragiache, and Tressel (2007). This index takes values between 0 and 21, and includes information on reserve requirements and credit controls, interest rate controls, barriers to entry, state ownership, policies on securities markets, banking regulation, and capital account restrictions. We identify a country undertaking significant financial reforms as of date t if the preceding three-year change in this index ranks on the top quartile of its respective country group over the 1975-2005 period. Our measure of TFP is based on standard growth accounting methods (see, for instance, Klenow and Rodríguez-Clare, 1997, and Kose, Prasad, and Terrones, 2009), using labor and investment data from PWT 7.0, and educational attainment levels from Barro and Lee (2010). A country is identified to have experienced high TFP growth as of date t if the preceding three-year average of TFP growth ranked on the top quartile of its respective group over the 1975-2010 period.

Table 6 shows the fraction of credit booms preceded by large capital inflows, large TFP gains and domestic financial reforms. In the case of ICs, 42 percent of the credit booms followed large TFP gains, 33 percent followed large capital inflows, and 22 percent followed significant financial reforms. In contrast, in EMs we find that almost 1/2 of credit booms were preceded by large capital inflows and 30 percent by financial reforms, while TFP gains play a smaller role than in ICs, with a frequency of 20 percent. These results indicate that surges in capital inflows are a good predictor of credit booms in both ICs and EMs,[12] while in ICs large TFP gains are also a good predictor

12. In terms of the composition of the inflows, net portfolio and debt inflows stand out as the most important for ICs, while net foreign direct investment and net bank flows are the most significant for EMs.

Table 6. Credit Booms: Potential Triggering Factors[a]
Frequency distribution

	Industrial countries	*Emerging market economies*	*All*
Large capital inflows (A)[b]	0.33	0.47	0.36
Significant productivity gains (B)[c]	0.42	0.20	0.18
Large financial sector changes (C)[d]	0.22	0.30	0.27
Memo items:			
(A) and (B)	0.17	0.10	0.07
(A) and (C)	0.06	0.15	0.09
(B) and (C)	0.17	0.04	0.04

Source: Authors' elaboration.
a. Because of data availability we have used the 1975-2010 period only. Frequencies have been adjusted for non-available data.
b. The three-year average of net capital inflow before the peak of the boom ranks in the top quartile of their corresponding country group.
c. The three-year average of the annual growth rate of TFP before the peak of the boom ranks in the top quartile of their corresponding country group.
d. The three-year change before the peak of the boom in the financial reform index ranks in the top quartile of their corresponding country group. The financial reform index is available till 2005.

Table 7. Credit Booms and Exchange Rate Regimes
Frequency distribution

	Industrial countries	*Emerging market economies*	*All*
Fixed and managed[a]	0.71	0.62	0.67
Dirty floating[b]	0.11	0.21	0.16
Floating[c]	0.06	0.03	0.06
Mixed	0.11	0.15	0.12

Source: Authors' elaboration.
a. Fixed and managed includes the following regimes from the Reinhart and Rogoff (2004) classification: no separate legal tender, pre-announced peg or currency board arrangement, pre-announced horizontal band that is narrower than or equal to +/- 2%, de facto peg, pre-announced crawling peg, pre-announced crawling band that is narrower than or equal to +/-2%, de facto crawling peg, and de facto crawling band that is narrower than or equal to +/-2%.
b. Dirty floating includes the following regimes from the Reinhart and Rogoff (2004) classification: pre-announced.
c. Freely floating regimes from the Reinhart and Rogoff (2004) classification.

but financial reforms less so, and the opposite holds true for EMs.

Table 7 shows the results of a similar frequency analysis, but now, aimed at examining the association between the peak of credit booms and the exchange rate regimes in place the preceding three years. We use Reinhart and Rogoff's (2004) classification of exchange rate regimes to create the following four regime groupings: fixed and managed, dirty floating, floating, and mixed (see the footnote to table 7 for details). The mixed regime includes countries that switched across the other regimes in any of the three years prior to the peak of the credit boom. The results shown in table 7 are striking: about 70 percent of the credit booms occur in countries with managed or fixed exchange rate regimes, and this holds true for ICs, EMs, and all countries combined.[13]

Finally, we use frequency analysis to determine the probability that a country will experience a credit boom once it has crossed the starting threshold. This probability can be a useful "early warning" indicator for surveillance of credit market conditions. We considered starting thresholds of one-half, and one standard deviation of the cyclical component of our credit measure, and computed the probabilities for ICs, EMs and all countries combined. Once a starting threshold of one (one-half) standard deviation of the cyclical position of credit is crossed, the probability of a credit boom is 13 (8) percent for EMs, 23 (14) percent for ICs, and 17 (10) percent for all countries combined. Naturally, these probabilities are lower with the lower starting threshold, as it is less likely that the cyclical expansion of credit turns into a credit boom. The probabilities are higher for ICs than for EMs, indicating that having crossed the starting threshold is a more precise predictor of credit booms in the former, than in the latter.

3. Conclusions

This paper used a thresholds method to identify and measure credit booms in industrial and emerging economies, and conducted an event study analysis of the dynamics of macro aggregates during

13. In a related paper, Magud, Reinhart, and Vesperoni (2011), study the effects of exchange rate flexibility on credit expansions during episodes of large capital inflows in the emerging economies. They report evidence suggesting that countries with less flexible exchange rates often experience significant credit expansions during surges in capital inflows; thus, becoming more vulnerable to capital flow reversals.

credit booms. We identified 70 credit booms in a sample of 61 countries with data for the 1960-2010 period, with half of the credit booms in industrial countries and half in emerging economies. The upswing of these booms is associated with economic expansions, rising equity and housing prices, real currency appreciation, and widening external deficits, followed by the opposite dynamics in the downswing. Moreover, credit booms tend to be synchronized internationally and centered on "big events" like the 1980s debt crisis, Sudden Stops in emerging economies, and the 2008 Global Financial Crisis.

Credit booms display three striking similarities across industrial and emerging economies: (1) credit booms normalized by the cyclical variability of credit are similar in magnitude across both groups of countries; (2) banking crises, currency crises or Sudden Stops often follow credit booms, and the frequencies with which they do are similar across industrial and emerging economies; and (3) credit booms often follow surges in capital inflows, TFP gains, and financial reforms, and are far more common with managed, rather than flexible, exchange rates. These results differ significantly from previous findings in the literature on credit booms, suggesting an ambiguous relationship between credit booms and economic expansions, and little or no association between financial crises and credit booms (see Gourinchas, Valdés, and Landerretche, 2001). They are also different from the findings of our previous work (Mendoza and Terrones, 2008), which used data until 2006 and reported differences across industrial and emerging economy booms in the above three characteristics that we now find similar.

The results of our study have important implications for the analysis of macro-finance linkages, and for surveillance of financial systems and their macroeconomic effects. From the policy perspective, the thresholds method we proposed provides a tractable framework for measuring and identifying credit booms that are closely associated with cyclical fluctuations in macro aggregates and key financial indicators of corporations and banks. Our results show that credit booms can be identified by the size of a credit expansion relative to trend, and that this information can be supplemented with other indicators of excessive credit growth: such as, booms in output and expenditures, excessive real appreciation and/or expansion of the non-tradables sector, large inflows of foreign capital and fast TFP growth or domestic financial reforms. Moreover, our results also highlight the importance of using corrective policy actions to prevent credit booms, because the declining phase of credit booms is

associated with recessions and a higher incidence of financial crises.

From the perspective of research on macro-finance linkages, our results provide a set of robust empirical regularities that can guide research on models of "credit transmission" by providing the set of facts that these models should aim to explain. These empirical regularities are reflected in a strong association of credit booms, with booms in: output and expenditures, rising asset prices, widening external deficits and sharp real appreciations.

Appendix 1

Sample of Countries

The sample of countries we studied includes the 21 industrial countries and 40 emerging economies listed below. The dates of the peaks of credit booms identified for each country are shown in parenthesis.

Industrial countries

Australia (AUS, 1973 and 1988), Austria (AUT, 1972 and 1979), Belgium (BEL, 1979, 1989, and 2007), Canada (CAN), Denmark (DNK, 1987), Finland (FIN, 1990), France (FRA, 1990), Germany (DEU, 1972 and 2000), Greece (GRC, 1972 and 2007), Ireland (IRL, 1979 and 2007), Italy (ITA, 1973 and 1992), Japan (JPN, 1972 and 1990), Netherlands (NLD, 1979), New Zealand (NZL, 1974), Norway (NOR, 1987 and 2007), Portugal (PRT, 1973 and 2000), Spain (ESP, 2007), Sweden (SWE, 1989 and 2007), Switzerland (CHE, 1989 and 2007), United Kingdom (GBR, 1973 and 1989), and United States (USA,1988 and 2007).

Emerging market economies

Algeria (DZA), Argentina (ARG), Brazil (BRA, 1989), Bulgaria (BGR), Chile (CHL, 1980), China (CHN), Colombia (COL, 1998), Costa Rica (CRI, 1979), Côte d'Ivoire (CIV, 1977), Czech Republic (CZE), Ecuador (ECU, 1997), Egypt (EGY,1981), Estonia (EST, 2007), Hong Kong (HKG, 1997 and *), Hungary (HUN), India (IND,1989), Indonesia (IDN, 1997), Israel (ISR, 1978), Jordan (JOR), Korea (KOR, 1998), Latvia (LVA), Lithuania (LTU), Malaysia (MYS, 1997), Mexico (MEX, 1994), Morocco (MAR), Nigeria (NGA, 1982 and 2008), Pakistan (PAK, 1986), Peru (PER, 1987), Philippines (PHL, 1983 and 1997), Poland (POL, 2008), Romania (ROM, 1998), Russia (RUS, 2007), Singapore (SGP, 1983), Slovak Republic (SVK), Slovenia (SVN, 2007), South Africa (ZAF, 2007), Thailand (THA, 1978 and 1997), Turkey (TUR, 1976 and 1997), Uruguay (URY, 2002), and Venezuela (VEN, 2007).

(*) Ongoing credit booms.

Appendix 2

Description and definition of main variables

Variable	*Variable definition*	*Source*
A. Macroeconomic and financial data.		
Credit to the non-financial private sector	Sum of claims on the private sector by deposit money banks (IFS line 22d) plus, whenever available for the entire sample period by other financial institutions (IFS line 42d and sub-items).	IFS. In some industrial country cases data were completed using data from the OECD, Datastream, and Heaver.
M2	Sum of money and quasimoney.	WDI and IFS.
Consumer price index	Consumer price index (both average and end-of-period).	IFS
Nominal GDP	GDP in current prices, local currency.	WDI
Population	Population	WDI
Real GDP	Real GDP per-capita, in international prices	PWT 7.0
Private consumption	Real private consumption per-capita, in international prices	PWT 7.0
Government consumption	Real government consumption per-capita, in international prices	PWT 7.0
Investment	Real investment per-capita, in international prices	PWT 7.0
Non-tradable GDP	Sum of the value added in services plus the value added in industry minus manufacture.	WDI
Current account balance	Current account balance as percent of GDP	WDI
Real exchange rate	Real effective exchange rate, index	INS (IMF)
Net capital inflows	Net capital inflows (proxied as the difference between the flow of total external liabilities and external assets) as percent of GDP.	IFS
Real stock prices	Equity price indices deflated using consumer price indices.	Authors' calculation with data from IFS.
Real house prices	House price indices deflated using consumer price indices.	Authors' calculation with data from several country sources, Haever Analytics, and OECD.
Total factor productivity	Total factor productivity calculated using the PWT 7 dataset and the new dataset on Educational Attainment (Barro and Lee, 2010).	Authors calculations following Kose, Prasad, and Terrones (2009).

Variable	*Variable definition*	*Source*
B. Crises definitions		
Banking crises	A situation in which at least one of the following conditions holds: (1) the ratio of non-performing assets to total asses of the banking sector exceeds 10 percent; (2) the cost of banking system bailouts exceeds 2 percent of GDP; (3) there is a large scale bank nationalization as result of banking sector problems; and (4) there are bank runs or new important depositor protection measures.	Demirguic-Kunt and Detragiache (2005). Data for 2007 on has been taken from Laeven and Valencia (2011).
Currency crises	A situation in which a country experiences a forced change in parity, abandons a currency peg or receives a bailout from an international organization, and at the same time an index of exchange market pressure (a weighted average of the depreciation rate, change in short-term interest rate, and percentage change in reserves) rises 1.5 standard deviation above its mean.	Eichengreen and Bordo (2002).
Sudden stops	A situation in which a country experiences a year-on-year fall in capital flows that exceeds 2 standard deviations relative to the mean.	Calvo, Izquierdo, and Mejía (2004) Data for 2005 on has been calculated by the authors.
C. Other variables		
Financial reform index	The index captures changes in seven financial policy dimensions: (1) credit controls and reserve requirements; (2) Interest rate controls; (3) Entry barriers; (4) State ownership in the banking sector; (5) Capital account restrictions; (6) Prudential regulations and supervision of the banking sector; and (7) Securities market policy. The index is just the sum of these seven dimensions (each of wich can take values between 0 and 3) and takes values between 0 (the lowest) and 21 (the highest).	Abiad, Detragiache, and Tressel (2007).

References

Abiad, A., E. Detragiache, and T. Tressel. 2007. "A New Database of Financial Reforms." Research Department. Washington: International Monetary Fund.

Barro, R. and J.-W. Lee. 2010. "A New Data Set of Educational Attainment in the World, 1950–2010," Working Paper 15902. Cambridge, Mass.: National Bureau of Economic Research.

Bernanke, B. and M. Gertler. 1989. "Agency Costs, Net Worth, and Business Fluctuations." *American Economic Review* 79(1): 14–31.

————. and S. Gilchrist. 1999. "The Financial Accelerator in a Quantitative Business Cycle Framework." In *Handbook of Macroeconomics*, Vol. 1C, edited by J.B. Taylor and M. Woodford, pp. 1531–1614. Amsterdam: North-Holland.

Borio, C., C. Furfine, and P. Lowe. 2001. "Procyclicality of Financial Systems and Financial Stability." BIS Papers 1, Basel: Bank for International Settlements.

Boz, E. and E.G. Mendoza. 2010. "Financial Innovation, the Discovery of Risk and the US Credit Crisis." Working Paper 16020. Cambridge, Mass.: National Bureau of Economic Research.

Caballero, R. and A. Krishnamurthy. 1998. "Emerging Market Crises: An Asset Markets Perspective." Working Paper 6843. Cambridge, Mass.: National Bureau of Economic Research.

Calvo, G.A., 1998, "Capital Flows and Capital-market Crises: The Simple Economics of Sudden Stops." *Journal of Applied Economics* 1: 35–54.

Calvo, G.A., A. Izquierdo, and L. Mejía. 2004. "On the Empirics of Sudden Stops: The Relevance of Balance-Sheet Effects." Working Paper 10520. Cambridge, Mass.: National Bureau of Economic Research.

Collyns, C. and A. Senhadji. 2002. "Lending Booms, Real Estate Bubbles, and the Asian Financial Crisis." IMF Working Paper 20. Washington: International Monetary Fund.

Corsetti G., P. Pesenti, and N. Roubini. 1999. "What Caused the Asian Currency and Financial Crisis?" *Japan and the World Economy* 11(3): 305–373.

Cottarelli, C., G. Dell'Ariccia, and I. Vladkova-Hollar. 2003. "Early Birds, Late Risers, and Sleeping Beauties: Bank Credit Growth to the Private Sector in Central and Eastern Europe and the Balkans." IMF Working Paper 213. Washington: International Monetary Fund.

Dell'Ariccia, G. and R. Márquez. 2006. "Lending Booms and Lending Standards." *Journal of Finance* 51(5): 2511–2546.

Demirguc-Kunt, A. and E. Detragiache. 2005. "Cross-Country Empirical Studies of Systemic Bank Distress: A Survey." IMF Working Paper 96. Washington: International Monetary Fund.

Eichengreen, B. and M.D. Bordo. 2002. "Crises Now and Then: What Lessons from the Last Era of Financial Globalization?" Working Paper 8716. Cambridge, Mass: National Bureau of Economic Research.

Eichengreen, B. and C. Arteta. 2002. "Banking Crises in Emerging Markets: Presumptions and Evidence." In *Financial Policies in Emerging Markets*, edited by M. Blejer and M. Skreb. Cambridge, Mass.: The MIT Press.

Fisher, I. 1933. "The Debt-Deflation Theory of the Great Depressions." *Econometrica* 1(4): 337–357.

Gourinchas, P.O., R. Valdés, and O. Landerretche. 2001. "Lending Booms: Latin America and the World." *Economia* (Spring): 47–99.

Gorton, G. and P. He. 2008. "Bank Credit Cycles." *Review of Economic Studies* 75(4): 1181–1214.

Hilbers, P., I. Otker-Robe, C. Pazarbasioglu, and G. Johnsen. 2005. "Assessing and Managing Rapid Credit Growth and the Role of Supervisory and Prudential Policies." IMF Working Paper 05/151. Washington: International Monetary Fund.

International Monetary Fund. 2004. "Are Credit Booms in Emerging Markets a Concern?" *World Economic Outlook*, pp. 148–166.

Kaminsky, G., C. Reinhart, and C. Vègh. 2005. "When it Rains it Pours: Procyclical Capital Flows and Macroeconomic Policies." In *NBER Macroeconomic Annual*, edited by M. Gertler and K. Rogoff, pp. 11–53, Cambridge, Mass.: National Bureau of Economic Research.

Kindleberger, C. 2000. *Manias, Panics, and Crashes: A History of Financial Crises*. New York: Harcourt, Brace and Company.

Kiyotaki, N. and J. Moore. 1997. "Credit Cycles." *Journal of Political Economy* 105(2): 211–248.

Klenow, P. and A. Rodríguez-Clare. 1997. "The Neoclassical Revival in Growth Economics: Has It Gone Too Far?." In *NBER Macroeconomics Annual*, edited by B. Bernanke and J. Rotemberg, pp. 73–102. Cambridge, MA: National Bureau of Economic Research.

Kose, A., E. Prasad, and M. Terrones. 2003. "Financial Integration and Macroeconomic Volatility." *IMF Staff Papers* 50: 119–143.

————. 2009. "Does Opennes to International Financial Flows Raise Productivity Growth?" *Journal of International Money and Finance* 28(4): 554–580.

Kraft, E. and L. Jankov. 2005. "Does Speed Kill? Lending Booms and their Consequences in Croatia." *Journal of Banking and Finance* 29(1): 105–121.

Laeven, L. and F. Valencia. 2011. "The Real Effects of Financial Sector Interventions During Crises," IMF Working Paper 45. Washington: International Monetary Fund.

Lorenzoni, G. 2008. "Inefficient Credit Booms." *Review of Economic Studies* 75(3): 809–833.

Magud, N.E., C.M. Reinhart, and E. Vesperoni. 2011. "Capital Inflows, Exchange Rate Flexibility, and Credit Booms." Working Paper 17670. Cambridge, Mass.: National Bureau of Economic Research.

Mendoza, E.G. 1995. "The Terms of Trade, the Real Exchange Rate, and Economic Fluctuations." *International Economic Review* 36(1): 101–137.

————. 2005. "Real Exchange Volatility and the Price of Non-Tradables in Sudden-Stop Prone Economies." *Economia* (Fall): 103–148.

————. and M.E. Terrones. 2008. "An Anatomy of Credit Booms: Evidence from Macro Aggregates and Micro Data." Working Paper 14049. Cambridge, Mass.: National Bureau of Economic Research.

————. 2010. "Sudden Stops, Financial Crises and Leverage." *American Economic Review* 100(5): 1941–1966.

Montiel, P. 2001. "What Drives Consumption Booms?" *The World Bank Review* 14(3): 457–480.

Neumeyer, P. and F. Perri. 2005. "Business Cycles in Emerging Economies: The Role of Interest Rate." *Journal of Monetary Economics* 52: 345–380.

Ottens, D., E. Lambregts, and S. Poelhekke. 2005. "Credit Booms in Emerging Market Economies: A Recipe for Banking Crises?" De Nederlandsche Bank.

Rajan, R.G. 1994. "Why Bank Credit Policies Fluctuate: A Theory and Some Evidence." *Quarterly Journal of Economics* 109(2): 399–441.

————. 2005. "Has Financial Development Made the World Riskier?" In *The Greenspan Era: Lessons for the Future*, pp. 313–369. Kansas: Federal Reserve Bank of Kansas City.

Reinhart, C.M. and K.S. Rogoff. 2004. "The Modern History of Exchange Rate Arrangements: A Reinterpretation." *Quarterly Journal of Economics* 119(1): 1–48.

Reinhart, C.M. and V. Reinhart. 2009. "Capital Flow Bonanzas: An Encompassing View of the Past and Present." In *NBER International Seminar on Macroeconomics 2008*, edited by

J. Frankel and C. Pissarides. Chicago, Illinois: University of Chicago Press.

Scheneider, M. and A. Tornell. 2004. "Bailout Guarantees, Balance Sheet Effects and Financial Crises." *Review of Economic Studies* 71(4): 883–913.

Schularick, M. and A.M. Taylor. 2012. "Credit Booms Gone Bust: Monetary Policy, Leverage Cycles, and Financial Crises, 1870–2008." *American Economic Review* 102(2): 1029–1061.

Tornell, A. and F. Westermann. 2005. *Boom-Bust Cycles and Financial Liberalization.* Cambridge, Mass.: The MIT Press.