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ABSTRACT

This paper proposes a methodology for measuring credit booms and uses it to identify credit booms in emerging and industrial economies over the past four decades. In addition, we use event study methods to identify the key empirical regularities of credit booms in macroeconomic aggregates and micro-level data. Macro data show a systematic relationship between credit booms and economic expansions, rising asset prices, real appreciations, widening external deficits and managed exchange rates. Micro data show a strong association between credit booms and firm-level measures of leverage, firm values, and external financing, and bank-level indicators of banking fragility. Credit booms in industrial and emerging economies show three major differences: (1) credit booms and the macro and micro fluctuations associated with them are larger in emerging economies, particularly in the nontradables sector; (2) not all credit booms end in financial crises, but most emerging markets crises were associated with credit booms; and (3) credit booms in emerging economies are often preceded by large capital inflows but not by financial reforms or productivity gains.

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1. Introduction

Episodes in which credit to the private sector rises significantly above its long-run trend (i.e. "credit booms") are often associated with periods of economic turbulence. To date, however, efforts at developing methodologies for identifying credit booms and characterizing the economic fluctuations that accompany them have produced mixed results. In addition, little is 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.

In this paper, we propose a "*thresholds method"* for identifying credit booms, and implement it to study the microeconomic and macroeconomic characteristics of credit booms in industrial and emerging economies. This method splits real credit per capita in each country into its cyclical and trend components, and identifies a credit boom as an episode in which credit exceeds its long-run trend by more than a given "boom" threshold, with the duration of the boom set by "starting" and "ending" thresholds. A key feature of this method is that boom and duration 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.

We apply our method to data for 48 countries over the 1960-2006 period and find 27 credit booms in industrial countries and 22 in emerging economies. We then take the peak dates of these booms and construct seven-year event windows around them to examine the dynamics of macro aggregates and firm- and bank-level financial indicators during credit booms. 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 build-up phase of the booms, followed by the opposite dynamics in the downswing. Credit booms also feature similar pro-cyclical movements in firm-level indicators of leverage, firm values, and use of external financing, and in bank-level indicators of credit issuance and asset returns. The banks' ratios of capital adequacy and non-performing loans show the opposite pattern (rising in the upswing and falling in the aftermath). Moreover, credit booms tend to be synchronized internationally and centered on "big events" like the 1980s debt crisis, the 1992 ERM crisis, and the 1990s Sudden Stops in emerging economies. In addition, splitting our sample into financial crisis vs. non-crisis cases, we find that booms in the crisis group were larger.

Credit booms in industrial and emerging economies differ in three key respects: First, the fluctuations that macro aggregates and micro indicators display during credit booms are larger, more persistent, and asymmetric in emerging economies, and this pattern is particularly strong in the nontradables sector. Second, not all credit booms end in crisis, but many of the recent emerging market crises were associated with credit booms. Third, the frequency of credit booms in emerging markets is higher when preceded by periods of large capital inflows but not when preceded by domestic financial reforms or gains in total factor productivity (TFP), while industrial countries show the opposite pattern (credit booms are more frequent after periods of high TFP or financial reforms, and less frequent after large capital inflows). In contrast, credit booms in both industrial and emerging economies are far more frequent in the presence of fixed or managed exchange rates, than under floating or dirty floating regimes.

Our work is related to the empirical literature that identifies booms in macro variables using threshold methods and event-study techniques. Montiel's (2000) analysis of

consumption booms was one of the first studies in this vein. Gourinchas, Valdes, and Landerretche (2001), henceforth GVL, introduced threshold methods to the analysis of credit booms, followed by several recent studies including Cottarelli, et. al. (2003), International Monetary Fund (2004), Hilberts, et. al. (2005), and Ottens, et. al. (2005).[1]

The majority of these studies measure credit booms using GVL's method. There are three important differences between their method and the one we propose in this paper: (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 Section 2 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.[2]

These differences have major quantitative implications. An example of both methods applied to Chilean data shows that the GVL method is not robust to the choice of credit measure, and 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, GVL found weak evidence of cycles in output and absorption associated with credit booms. We also find a clear association between credit booms and

[1] Other studies examine linkages between credit and macro variables without measuring credit booms (for example Collyns and Senhadji (2002), Borio, et. al. (2001), and Kraft and Jankov (2005)).
[2] Our study also differs from GVL's in that we examine credit booms in industrial countries, study differences in the dynamics of the tradables v. nontradables sectors, and contrast the macro dynamics of credit booms with evidence from micro-level data.

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).[3] These authors document that twin crises are preceded by rising credit-GDP ratios, increases in output of nontradables 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 v. non-tradables sectors. We also look at sectoral differences in the evolution of output dynamics and firm-level financial indicators, but our approach differs in that we examine these dynamics conditional on credit boom episodes, rather than conditional on being on a twin-crises event. Also, we use actual balance-sheet and cash-flow-statement data to measure firm-level financial indicators for all publicly listed corporations, instead of using the survey data of more limited coverage in the WBES.

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) and Gorton and He (2005)), the underestimation of risks (Borio, et. al. (2001)) and the lowering of lending standards (Dell'Ariccia and Marquez (2006)); the presence of explicit or implicit government guarantees (Corsetti, et. al. (1999)); or limited commitment on the part of

[3] 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).

borrowers (Lorenzoni (2005)). Similarly, our analysis of the connection between credit booms and macroeconomic activity is related to the literature 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) and (2006)).

The rest of the paper is organized as follows: Section 2 describes our method for identifying credit booms, implements it on a sample of 49 countries, and examines the main characteristics of credit booms in industrial and emerging economies. Sections 3 and 4 study the credit-boom dynamics of macro aggregates and micro-level data, respectively. Section 5 concludes.

2. Credit Booms: Methodology and Key Features

2.1 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. We formalize 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.

We used a baseline value of $\phi = 1.75$, and conducted sensitivity analysis for $\phi = 1.5, 2$ (which 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 $|l_{i,t} - \phi^s\sigma(l_i)|$, and the ending date t^e is a date $t^e > \hat{t}$ that yields the smallest difference $|l_{i,t} - \phi^e\sigma(l_i)|$, where ϕ^s and ϕ^e are the start and end thresholds.[4] We use baseline values $\phi^s = \phi^e = 1$, and we also tried other values including 0, ¼, ½ and ¾.[5] Once the starting and ending dates are set, the duration of the credit boom is given by the difference $t^e - t^s$.

2.2 Credit boom episodes and their main features

We use data on credit from the financial sector to the private non-financial sector obtained from the IMF's *International Financial Statistics* for a sample of 49 countries, 21 industrial and 28 emerging economies (see Appendix 1), for the 1960-2006 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). Because credit is a year-end stock variable that we are going to compare with flow variables like output and expenditures, real credit per capita is calculated as the average of two contiguous end-of-year observations of nominal credit per capita deflated by their corresponding

[4] These threshold conditions are set to minimize the absolute values of differences of l_{it} relative to targets because the data are discrete, and hence in general l_{it} does not match the targets with equality.
[5] 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.

end-of-year consumer price index. Data sources for these and all other variables used in the paper are listed in Appendix 2.

We identified 49 credit booms in our data, 27 in industrial countries and 22 in emerging economies.[6] 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 emerging economies are larger than in industrial countries in absolute terms: At the peak of the booms, the average expansion in real credit per capita reached almost 30 percent above trend in emerging economies, twice what is observed in industrial countries. In relative terms (i.e. in multiples of the standard deviation of credit in each country), however, credit booms in industrial countries are similar to those in emerging economies (see Figure 2). This is because the cyclical variability of credit is larger in the latter.

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 duration of about 6-7, years and upswings that last longer than downswings. Using means, however, EMs seem to show longer and more asymmetric booms, but this result is driven largely by the countries that experienced Sudden Stops.

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

[6] There are also four emerging economies (India, South Africa, Turkey, and Venezuela) that were identified as experiencing credit booms in 2006, the end of the sample period, but they were excluded from the event analysis because they have yet to be completed (i.e. the ending thresholds have yet to be crossed).

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—e.g. 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, and the recent Sudden Stops. The Figure also suggests that the frequency of credit booms in industrial countries seems to have declined over time, but this may in fact reflect the pattern of financial deepening away from banks and into non-bank financial intermediaries, rather than an actual reduction in the occurrence of credit booms.[7] A credit boom driven by non-bank financial intermediaries would not be captured in the *IFS* data that we used. [8]

2.3 Differences with the method of Gourinchas, Valdes and Landerretche

As noted in the Introduction, several recent studies of credit booms use the thresholds method proposed by GVL, but their method yields results that differ markedly from ours. Hence, it is important to explain why the two methodologies produce different results. Both methods are threshold methods: They define credit booms by identifying periods in which credit is deemed to have expanded "too much" relative to a long-run trend. However, the two methods differ in three key respects:

(1) *Measure of credit*: We use real credit per capita, while GVL use the ratio of nominal credit to nominal GDP. The latter has three limitations. One is that it does not allow for the possibility that credit and output could have different trends, which is important if countries are undergoing a process of financial

[7] 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.
[8] Indeed, the growing securitization of subprime mortgages in the United States in recent years was accompanied by an increase in the off-balance sheet operations of bank entities.

deepening, or if for other reasons the trend of GDP and that of credit are progressing at different rates. Second, there can be situations when both nominal credit and GDP are falling and yet the ratio increases because GDP falls more rapidly. Lastly, when inflation is high, the fluctuations of the credit to GDP ratio could be misleading because of improper price adjustments.

(2) *Detrending procedure*: We detrend the credit data using a standard application of the HP filter to our full sample period 1960-2006 with the value of the HP smoothing parameter commonly used with annual data (100). In contrast, GVL used an expanding HP trend with a smoothing parameter of 1000. This expanding trend extends the sample over which the trend is computed by one year as each successive year in the sample is added (see Appendix 3 for details).

(3) *Definition of thresholds*: Our thresholds are defined as multiples of the country-specific standard deviation of credit over the business cycle, which changes the threshold level of credit needed to define a boom (i.e. the product $\phi\sigma(l_i)$) with each country's cyclical variability of credit. This ensures that a credit boom is a situation in which the deviation from trend in credit is "unusually large" relative to a country's typical credit cycle. In contrast, GVL use a boom threshold that is invariant across countries, regardless of whether it represents a small or large change relative to a country's historical cyclical variability of credit.

These differences have significant quantitative implications. To illustrate these differences, we apply the two methods to the case of Chile, which is also the case that GVL used to illustrate their method. Figure 4 shows the results of applying our method to Chilean data. Panel 1 shows results using our method exactly as described in *2.1*. It

shows the actual data for the log of real credit per capita, the HP trend, and the boom and start/end thresholds.[9] Panel 2 changes the smoothing parameter from 100 to the value used by GVL (1000). Panel 3 changes the measure of credit from real credit per capita to GVL's ratio of credit to GDP. Panel 4 changes both the smoothing parameter and the definition of credit for the ones used in GVL, but retains our country-specific thresholds.

Our baseline results in Panel 1 indicate that Chile experienced a credit boom that peaked in 1981 and lasted five years (from 1979 to 1983). Panel 3 shows that if we use the credit-GDP ratio as the measure of credit, the boom peaks in 1984 and also lasts five years (from 1981 to 1985). Thus, under our method the choice of credit variable affects the timing of the boom but not its duration. In contrast, Panels 2 and 4 show that increasing the smoothing parameter from 100 to 1000 affects the timing of the boom, and increases both the size of its peak and its duration. This occurs because a larger smoothing parameter produces a smoother trend with larger and more persistent deviations from trend.

Figure 5 conducts a similar experiment as Figure 4 but now starting in Panel 1 with the results produced by applying the GVL method as proposed in their paper. Panel 2 lowers the smoothing parameter to 100. Panel 3 changes the measure of credit from the credit-GDP ratio to real credit per capita. Panel 4 changes both the measure of credit and the smoothing parameter to the ones we used, but retains the country-invariant threshold proposed by GVL.

The results in Panel 1 of Figure 5 are nearly identical to those obtained by GVL (see Figure 2b in their paper), confirming that our implementation of their methodology is accurate. The GVL method indicates that Chile experienced a credit boom that peaked in

[9] We set the start and end thresholds equal to 1.

1982 and lasted *fourteen years* (from 1971 to 1984).[10] Panels 3 and 4 show that if we change the credit measure to real credit per capita, the GVL method cannot identify a credit boom in Chile in the sample period, regardless of the value of the smoothing parameter. This is because deviations from trend in real credit per capita at least as large as 19.5 percent were not observed in Chile, and indeed are extremely large relative to the Chilean history of deviations from trend in real credit per capita. In contrast, our method adjusts the boom threshold to the observed country cyclical variability of credit. As a result, our methodology is robust to the choice of measuring credit in real per capita terms v. as a share of GDP.

Panel 2 of Figure 5 shows that when the expanding HP trend is calculated using a smoothing parameter equal to 100, the GVL method does identify a credit boom in the early 1980s, but one that lasted only three years instead of fourteen—again because a larger smoothing parameter produces a smoother trend with larger and more persistent deviations from trend. Thus, the higher smoothing parameter used in GVL's calculations is the key factor behind the long duration of the credit boom they identified (compare Panels 1 and 2).

One key additional feature that affects the quantitative implications of the two methods is that the expanding trend with high smoothing parameter of the GVL method results in a trend that approximates a smoothed version of the actual time series of credit with some lag (see Figure 6). The standard HP trend used in our method and GVL's expanding HP trend are very similar at the beginning and at the end of the sample, but in most of the "internal" periods (and particularly during the period of fast credit growth)

[10] GVL dated the peak in the same year and found the boom to be of about the same magnitude, but estimated its duration at 10 years. This difference is due to the longer sample in our data (which ends in 2006 instead of 1996), and because of data revisions in the credit-to-GDP data relative to our sample.

the expanding trend resembles a smoothed lagged transformation of the data. Hence, in these periods the expanding trend treats actual observations of high credit-GDP ratios as being largely part of the long-run trend of credit, when in reality they are not.

3. 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.

3.1 Event analysis

We construct seven-year event windows of the cyclical components of macro aggregates centered on the peak of credit booms (i.e. $\hat{t}$ 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 nontradables (*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).[11]

Figures 7-10 illustrate business cycle dynamics around credit boom episodes in emerging and industrial economies. Except for *RER* and *KI*, 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 emerging economies in the right-side of the Figures. *Y*, *C* and *G* rise 2 to 4 percentage points above trend in the build up phase of the

[11] Due to data limitations we exclude Jordan from the event analysis.

credit boom, and drop to between 3 to 4 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 18 percent above trend at t=-1 and drops below trend by a similar amount by t=2. *YN* rises to about 6½ percent above trend by t=0 and then drops to almost 3 percent below trend by t=3. The median *RER* appreciates 9 percent above trend at t=-1, 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 2½ percentage points of GDP in the expanding phase of the boom and then rises to a surplus of 1½ percentage points of GDP in the declining phase. In line with these current account dynamics, *KI* rises by up to 3½ percentage points of GDP by t=-1 and then drops by 2¼ percentage points of GDP by t=3.

The plots for industrial countries in the left-side panels of Figures 7-10 show several similarities with those for 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, and government consumption shows the opposite pattern (slightly below trend in the expanding phase and slightly above trend in the contraction phase).

Two important caveats apply to the event study graphs. First, they illustrate the cyclical dynamics of macro variables, but do not show if these variables themselves are undergoing a boom (i.e. 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 in any year 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*, *YN*, *C*, *I*, and *G*, and this holds for emerging and industrial countries, as well as for all the countries together.

The second caveat of the event study graphs is that they 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, the majority of the mean and median estimates shown in the event study plots for *Y*, *YN*, *C*, and *I* are statistically significant at the 1 percent confidence level for industrial and emerging economies. For *G*, *RER* and *CA/Y*, however, many of the coefficients have large standard errors.

Another potential caveat of the event analysis is that the relationships it captures between credit booms and macro variables may not be particular to credit booms, but may reflect overall business cycle patterns. In particular, one could ask if the results would be any different if instead of identifying credit booms and using them to condition the event analysis, we were to identify output booms and use them as the conditioning variable (defining output booms with the same thresholds method we applied for credit booms). We explored this possibility by constructing seven-year event windows of fluctuations in macro variables (including private sector credit) centered on the peak dates of output booms. In the case of the emerging economies, there is no discernible cyclical pattern in the behavior of credit. Thus, there is an output cycle associated with credit booms, but there is no credit cycle associated with output booms. For industrial countries, we found that there is a cyclical pattern in the behavior of credit during output

booms, but one that is much less pronounced than during credit booms, and some features of the boom-bust dynamics we identified during credit booms are not present during output booms (housing prices, in particular, do not fall in the aftermath of output booms).

We now study the behavior of inflation, equity prices and housing prices during credit booms (see Figure 11). Industrial countries show negligible changes in inflation, and rising (falling) equity and housing prices in the build up (declining) phase of credit booms. In emerging economies, inflation tends to spike after the credit booms peak, but this result is driven by outliers because the mean inflation at t=1 exceeds the median inflation by a large margin. The median inflation rises only 2 percent above trend. Hence, credit booms are generally *not* associated with surges in inflation in either industrial or emerging economies. Stock and housing prices show the same pattern in emerging economies as in industrial countries, but note that the rise in equity prices in the upswing and the decline in housing prices in the downswing are larger in the former.

The event windows for industrial and emerging economies mask important variations across country regions. In industrial countries, the Nordic countries show larger fluctuations in credit and in the 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 the emerging economies (Table 4, Panel B), output and investment fluctuations in Asia and Latin America are similar, but credit expansions and the fluctuations in consumption are much larger in the latter. 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. Beyond these similarities, credit booms in emerging and industrial economies differ in four key respects: (1) the amplitude of the macroeconomic fluctuations is smaller in industrial countries; (2) government consumption in industrial countries fluctuates very little and shows the opposite pattern of that in emerging economies; (3) the current account-output ratio and the (median) capital inflows-output ratio also display smaller changes in industrial countries, and their timing differs sharply (*CAY* does not hit its trough in the build up phase of the credit boom); and (4) fluctuations in the nontradables sector of industrial countries are much smaller, and *RER* actually depreciates slightly, instead of appreciating sharply, in the expansionary phase of credit booms.

These differences in the macro features of credit booms across industrial and emerging economies are consistent with three well-known facts in international business cycle studies: First, the larger amplitude of the fluctuations displayed by emerging economies 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 developing countries (see Kaminski, Reinhart, and Vegh (2005)). Third, the widening current account deficits followed by reversals, and the booms followed by collapses in the price and output of the nontradables sector, are

consistent with observations highlighted in the Sudden Stops literature (e.g. Calvo (1998), Mendoza (2007), Caballero and Krishnamurty (2001)). However, it is important to note that generally these facts have been 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 (i.e. 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 GVL 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.

3.3 Frequency analysis

We conduct next a frequency analysis to examine three issues: (1) the association between credit booms and financial crises; (2) the role of capital inflows, productivity 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 (see 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 emerging economies, industrial countries and all countries

combined. The percent of crises that occurred before, after and at 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 (2006) for banking crises, Eichengreen and Bordo (2002) for currency crises, and Calvo, Izquierdo, and Mejia (2004) for Sudden Stops).

Table 5 yields an important result: Credit booms in emerging economies are often associated with currency crises, banking crises, and Sudden Stops. About 68 percent of the credit booms in emerging economies are associated with currency crises, 55 percent with banking crises, and 32 percent with Sudden Stops. Most of these crises either preceded or coincided with the peak of the credit booms, suggesting that many of the booms ended after a country suffered a crisis. These findings are also at odds with the conclusion in GVL suggesting that there is virtually no association between credit booms and financial crises in emerging economies.

Table 5 also shows that, contrary to what we found in emerging economies, credit booms in industrial countries are only occasionally associated with banking and currency crises, and there is no association with Sudden Stops. Moreover, industrial countries in a credit boom are more likely to experience currency crises than banking crises. The combined frequency of currency crises before, after or at the peak of credit booms is slightly over 50 percent, while that for banking crises is 15 percent. In contrast with the emerging economies, currency crises are more frequent after the peak of credit booms.

We also constructed seven-year event windows that compare the fluctuations in credit and macro aggregates of countries that experienced a crisis (i.e. 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.

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 gross liability flows (i.e. foreign direct investment, portfolio flows, and other investments liabilities) in percent of GDP, using data from *IFS* (see Appendix 2). We define a state of large capital inflows as of date *t* when the *preceding* three-year average of capital inflows ranked on the top quartile of its respective country group (i.e. emerging markets, industrial countries, or both) over the 1975-2006 period.[12] 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 1975-2002 period. Our measure of TFP is based on standard growth accounting methods (see, for instance, Klenow and Rodriguez (1997) and Kose, Prasad, and Terrones (2008)), using labor and investment data from *PWT* 6.2. 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 1975-2006 period.

Table 6 shows the fraction of credit booms preceded by large capital inflows, domestic financial reforms, and large TFP gains. Because these factors are often

[12] We focus on the preceding three-year average because we are interested in the role of capital inflows (as well as TFP and financial reforms) as potential causes of credit booms, so we are interested in studying if credit booms are preceded by these developments as a form of statistical causality.

interconnected and may interact with each other, we compute the frequency of credit booms that coincided with each factor individually as well as jointly with pairs of two factors or with all three factors together. For industrial countries, the results indicate that 40 percent of the credit booms followed large TFP gains and 33 percent followed significant financial reforms. In contrast, in emerging economies we find that over 50 percent of credit booms were preceded by large capital inflows, while TFP gains and financial reforms play a small role. Thus, credit booms in industrial countries are preceded by TFP gains and/or domestic financial reforms and to a much lesser extent by surges in capital inflows, while the opposite is observed in emerging economies.

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 6 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 6 are striking: about ¾ of the credit booms occur in countries with managed or fixed exchange rate regimes, and this holds for industrial countries, emerging economies, and all countries combined.

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 ½ and 1 standard deviations of the cyclical component of our credit measure, and computed the probabilities for industrial countries, emerging

economies and all countries combined. Once a starting threshold of 1 (½) standard deviations is crossed, the probability of a credit boom is 16 (9) percent for emerging economies, 22 (14) percent for industrial countries, and 18 (11) 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 industrial than for emerging economies, indicating that having crossed the starting threshold is a more precise predictor of credit booms in the former than in the latter.

4. Credit Booms and Firm Level Data

Section 3 showed that credit booms are accompanied by a synchronized pattern of economic expansion followed by contraction. This finding raises an important question: Are the credit booms and the macro business cycles that accompany them reflected in the financial conditions of firms and banks at the microeconomic level? To answer this question, we use the credit boom events identified in Section 2 to construct seven-year event windows of the evolution of firm- and bank-level financial indicators centered on the years in which credit booms peaked.

The firm-level data correspond to nonfinancial, publicly-traded firms as reported in *Worldscope* and *Datastream*. The sample period is 1980 to 2005 for the industrial countries and 1991 to 2005 for the emerging markets. This restricts our analysis to credit booms dated after 1991 in the emerging markets. Moreover these data have the drawbacks that the coverage is limited to corporations listed in stock exchanges, and that

they are reported on a fiscal year basis, rather than calendar year. Note, however, that there is no other firm-level, cross-country database with wider coverage available.[13]

The bank-level data was obtained from *Bankscope* and it covers the 1995-2005 period.[14] These data include balance sheet information for commercial banks, saving banks, cooperative banks, mortgage banks, medium- and long-term credit banks, and bank holding companies. The coverage varies from country to country, and since the sample starts in 1995 our analysis of banking behavior around credit booms is limited to the last decade. In the analysis below, we do not report bank indicators for the industrial countries because these countries have experienced only three credit booms since 1995. It is worth noting, however, that the behavior of these indicators is broadly in line with that observed in the emerging market economies.

We construct financial indicators for each firm and bank in each country, and focus on the median firm or bank as country aggregate. Aggregates for emerging and industrial countries are then generated as medians of the country aggregates. For the firm-level data, we also construct the breakdown across tradables and nontradables sectors, and measure sectoral aggregates using the median firm of the corresponding sector.[15]

4.1 Firm-level indicators

We construct seven firm-level financial indicators: (1) two measures of Tobin's Q (the ratio of market to book value of equity, *Q1*, and the ratio of market value plus total

[13] The data are corrected for the presence of multiple listings (firms with multiple country listings are assigned only to the country of primary listing), dead stocks (companies that go out of business are taken out from the sample), and outliers (which can be due to either inadequate accounting, as in the case of firms listed with negative market capitalizations, or statistical outliers, observations that are in excess of two standard deviations from the mean observation).

[14] The data are corrected for the presence of the central bank and government and multilateral institutions as well as for outliers (either because of inadequate accounting or extreme values).

[15] The nontradables sector includes the following industries: construction, printing and publishing, recreation, retailers, transportation, utilities, and miscellaneous. The tradables sector includes aerospace, apparel, automotive, beverages, chemical, electrical, electronics, metals, and all others in the database.

debt to book value, *Q2*); (2) effective interest rate (the ratio of total debt service to total debt obligations, *ER*); (3) profitability (the return on assets in percent, *PR*) ; (4) total leverage (total debt as a percent of book value of assets, *LBV*, or market value of assets, *LMV*); (5) short-term leverage (short-term debt as a percent of market value of assets, *SLMV*); (6) working capital leverage (current liabilities in percent of sales, *LWK*); and (7) the Rajan-Zingales index of dependence on external financing for investment (*RZ*), which is equal to 1 minus the ratio of cash flow from operations to capital expenditures (with the former adjusted for changes in inventories, payables, and receivables).

Figures 12-17 show the event windows for the financial indicators of firms in industrial and emerging economies. Figure 12 shows that all leverage ratios rise in the build up phase of the credit booms and collapse in the declining phase. As in the case of the macro variables, the amplitude of the fluctuations is much larger for emerging economies than for industrial countries. Note, however, that the increases in *LMV* are particularly large because *LMV* includes the effect of equity price declines that coincide with credit boom peaks. Still, the boom-bust cycles in leverage synchronized with credit booms are also evident in *LBV* and *LWK*, which do not use the market value of equity. In emerging economies, *LBV* rises about 20 percentage points from its minimum in the upswing of the boom to the peak (compared with 12 percentage points in industrial countries) and *LWK* rises almost 12 percentage points (compared with 2 percentage points in industrial countries).

The Tobin Q and profitability measures shown in Figure 13 indicate that corporations in both industrial and emerging economies start the expanding phase of credit booms from high ratios of asset valuation and profitability, which decline as the credit boom

peaks and then remain depressed in the aftermath. Again the magnitude of these fluctuations is much larger in emerging economies. In contrast, the dynamics of the effective interest rate are very different in the two groups of countries. In emerging markets, *ER* is low in the expansionary phase of the credit booms, and then jumps about 500 basis points one year after the booms peak. In industrial countries, *ER* is significantly more stable, and in fact drops slightly after the credit booms peak.

Figure 14 shows the evolution of the *RZ* index. Corporations are significantly more dependent on external financing in the build up phase of credit booms than in the downswing. The size of the correction in the downswing is much larger in emerging economies than in industrial countries. This evidence is consistent with the argument of Calvo et al. (2003) suggesting that "creditless recoveries" after Sudden Stops are possible in emerging economies because firms adjust to the loss of credit so as to provide internal financing for operational expenses that were previously financed with outside credit.

Figure 15 illustrates important similarities and differences in the evolution of corporate financial indicators across regions of emerging economies. Firms in Asia are significantly more leveraged than their Latin American counterparts, and their leverage ratios fluctuate more sharply during credit booms. Moreover, Tobin's Q in Asia falls sharply in a continuous decline during the entire seven-year window, while in Latin America it shows an ambiguous pattern and a more modest overall decline. Dependence on external financing falls sharply in both regions in the downswing of credit booms, but the correction is larger in Latin America than in Asia.

Figure 16 shows the evolution of the financial indicators of emerging economies for which the tradables and nontradables sectors behave differently (*LBV*, *LMV* , *LWK* and

RZ).[16] We also include the real exchange rate as a proxy for the relative price of nontradable goods relative to tradables. The cycles in leverage (*LBV*, *LMV* and *LWK*) synchronized with the credit booms are again observable in the sectoral aggregates, but now we can also observe that they are significantly larger for firms in the nontradables sector and that they are synchronized with the sharp boom-bust cycle of the real exchange rate. Moreover, the *RZ* index shows that firms in the tradables sector are slightly more dependent on outside financing in the expansionary phase of credit booms, and that dependence on outside financing falls sharply for firms in both sectors, but significantly more for firms in the nontradables sector. These results are consistent with the Sudden Stops literature that emphasizes the ability of firms in the tradables sector to have more stable access to credit than firms in the nontradables sector (e.g. Caballero and Krishnamurty (1998), Tornell and Westernmann (2005)).

4.2 Bank-level indicators

We constructed four financial indicators using bank data: (1) profitability, measured by the ratio of net income to average assets (*ROA*), where average assets are calculated as the mean of end-of period assets in year t and t-1; (2) non-performing loans, *NPL*, as a measure of asset quality; (3) a measure of lending activity as proxied by the ratio of bank loans to total assets, *LAR*; and (4) a "capital adequacy" measure, *CAR*, that measures a bank's capital as a ratio of its risk-weighted assets.[17] The minimum *CAR* recommended by the Basel Committee in Banking Supervision is 8 percent, however, bank supervisors

[16] The rest of the financial ratios display very similar dynamics across sectors as in the total aggregates shown already in Figures 12-14.

[17] This measure combines "Tier I capital," which includes stock issues and disclosed reserves, and "Tier II capital," which includes subordinated debt, perpetual securities, expressed as a percentage of risk-weighted assets and off-balance-sheet risks (see Dewatripont and Tirole (1993)).

in the more vulnerable economies, such as EMs, are encouraged to set higher minimum *CARs* (often in the 8-12 percent range).

Figure 17 shows the event study window for the financial indicators of banks in emerging economies. Lending activity is high in the expanding phase of the credit boom, but at the same time the quality of the banks' assets deteriorates sharply as non-performing loans rise from 2.5 percent a year before the peak to 10 percent two years after the peak of the boom. This evidence is consistent with Dell' Ariccia and Marquez's (2006) argument that the banks' lowering of lending standards in a boom increases lending to more risky clients, and hence leads to a subsequent weakening of the quality of bank's assets.

The profitability measure indicates that banks yield high profits in the expanding phase of credit booms. *ROA* reaches its highest level at 1.5 percent a year before the peak of the boom, followed by a collapse in the ending phase of the boom. Finally, bank capital adequacy shows v-shaped dynamics—it drops sharply late in the expanding phase of credit booms and then rebounds early in the ending phase of the boom, ending at higher levels than when the booms start. Interestingly, *CAR* at its trough was just below 12 percent which points to vulnerabilities in the banking system of these economies.

5. Conclusions

This paper proposed a new thresholds method for measuring credit booms, used this method to identify credit booms in industrial and emerging economies, and conducted an event study analysis of the dynamics of macro aggregates and micro-level financial indicators during credit booms. We identified 27 credit booms in industrial countries and 22 in emerging economies during the 1960-2006 period. The build up phase 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. Similar dynamics are observed in firm-level indicators of leverage, firm values, and dependence on external financing, and in bank-level indicators of asset quality, profitability and lending activity. Moreover, credit booms tend to be synchronized internationally and centered on "big events" like the 1980s debt crisis, the 1992 ERM crisis, and Sudden Stops in emerging economies.

Despite the similarities in the features of credit booms across industrial and emerging economies, there are also three major differences: (1) Fluctuations in macroeconomic aggregates and micro-level indicators during credit booms are larger, more persistent, and asymmetric in the emerging economies, and this pattern is particularly strong in the nontradables sector; (2) not all credit booms end in crisis, but many of the recent emerging markets crises were associated with credit booms; (3) credit booms in emerging economies tend to be preceded by large capital inflows and not by domestic financial reforms or TFP gains, while credit booms in industrial countries tend to be preceded by high TFP or financial reforms. In contrast, the frequency of credit booms in both emerging and industrial economies is much higher in economies with fixed or managed 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 et al. (2001)).

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 nontradables sector, large inflows of foreign capital (in EMs) and fast TFP growth or domestic financial reforms (in ICs), as well as increases in the leverage and profitability ratios of corporations and weakening in the quality of banks' assets. 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 can be subsumed into two sets of stylized facts: First, the strong association of credit booms with booms in output and expenditures, rising asset prices, widening external deficits and sharp real appreciations. Second, the close relationship between these macro features of credit booms and a similar cyclical pattern in the financial indicators of corporations and banks.

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Appendix 1

SAMPLE OF COUNTRIES

The sample of countries we studied includes the 21 industrial countries and 28 emerging economies listed below. The dates of the peaks of credit booms identified for each country are shown in parenthesis.

Industrial countries

Australia (AUS, 1989), Austria (AUT, 1972 and 1980), Belgium (BEL, 1980 and 1990), Canada (CAN, 1967), Denmark (DNK, 1987 and 1991), Finland (FIN, 1991), France (FRA, 1991), Germany (DEU, 1973), Greece (GRC, 1972), Ireland (IRL, 1979 and 2000), Italy (ITA, 1973 and 1992), Japan (JPN, 1973), Netherlands (NLD, 1979), New Zealand (NZL, 1974), Norway (NOR, 1988), Portugal (PRT, 1973 and 2001), Spain (ESP), Sweden (SWE, 1990), Switzerland (CHE, 1990), United Kingdom (GBR, 1974 and 1990), and United States (USA, 1999).

Emerging Market Economies

Algeria (DZA), Argentina (ARG, 1982), Brazil (BRA), Chile (CHL, 1981), Colombia (COL, 1997), Costa Rica (CRI, 1979), Côte d'Ivoire (CIV, 1978), Ecuador (ECU), Egypt (EGY,1982), Hong Kong (HKG, 1998), India (IND,*), Indonesia (IDN, 1997), Israel (ISR, 1979), Jordan (JOR, 1970), Korea (KOR, 1998), Malaysia (MYS, 1997), Mexico (MEX, 1994), Morocco (MAR, 1977), Nigeria (NGA, 1982), Pakistan (PAK, 1986), Peru (PER), Philippines (PHL, 1983 and 1997), Singapore (SGP, 1984), South Africa (ZAF, *), Thailand (THA, 1997), Turkey (TUR, 1997 and *), Uruguay (URY, 1981), and Venezuela, Rep. Bol. (VEN, *).

(*) Ongoing credit booms.

Appendix 2: Data Definitions and Sources

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).	*IFS*. For some industrial countries data were completed using the OECD *Analytic Database. Datastream* and *Heaver Analytics*.
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 6.2*
Private consumption	Real private consumption per-capita, in international prices	*PWT 6.2*
Government consumption	Real government consumption per-captia, in international prices	*PWT 6.2*
Investment	Real investment per-capita, in international prices	*PWT 6.2*
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)*
Capital inflows	Capital inflows (proxied as the flow of total external liabilities) as percent of GDP.	*IFS*
Real stock prices	Equity price indices deflated using consumer price indeces.	Authors' calculation with data from *IFS*.
Real house prices	House price indices deflated using consumer price indeces.	Authors' calculation with data from several country sources, *Haever Analytics* and *Bloomberg*.
Total factor productivity	Total factor productivity calculated using the PWT6.2 dataset	Kose, Prasad, and Terrones (2008).
B. Microeconomic and financial data.		
Tobin's Q	Measured by:	
	(1) The ratio of the market value of a firm's equity to the current replacement cost of assets.	Author's calculations with data from *Worldscope*.
	(2) The ratio of the market value of a firm's equity and debt to the current replacement cost of assets.	Author's calculations with data from *Worldscope*.
Leverage	Measured by:	
	(1) The ratio of total debt to book value of equity of the firm.	Author's calculations with data from *Worldscope*.
	(2) The ratio of total debt to market value of equity of the firm.	Author's calculations with data from *Worldscope*.
	(3) The ratio of short term debt to market value of equity of the firm.	Author's calculations with data from *Worldscope*.
	(4) The ratio of current liabilities to sales of the firm.	Author's calculations with data from *Worldscope*.
Effective interest rate		Author's calculations with data from *Worldscope*.
Return on assets	The ratio of net income to total assets.	Author's calculations with data from *Worldscope*.
Rajan-Zingales index	The ratio of a firm's capital expenditures minus cash flow from operations to capital expenditures. This ratio measures a firm's dependence on extenal finance.	Author's calculations with data from *Worldscope*.
Non-performing loans to gross loans ratio	The ratio of non-performing loans to gross loans. This is a measure of asset quality.	Author's calculations with data from *Bankscope*.
Loan to asset ratio	The ratio of bank loans to total assets. Proxies the percentage of assets assigned to loans.	Author's calculations with data from *Bankscope*.
Return on average assets	Ratio of net income to average assets. This ratio measures the efficiency and operational performance of a bank.	Author's calculations with data from *Bankscope*.
Capital adequacy ratio	Total capital adequacy ratio under the Basle rules. This ratio measures a bank's capital as a ratio of its risk weighted assets.	*Bankscope*.
C. 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 (2006)
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 rae 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.	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 Mejia (2004)
D. 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)

Key to sources: IFS=International Financial Statistics, IMF. WDI=World Development Indicators, World Bank, PWT=Penn World Tables, Center for International Comparisons, Univ. of Pennsylvania, INS=Information Notice System, IMF

Appendix 3
THE GOURINCHAS-VALDES-LANDERRETCHE THRESHOLDS METHOD

The thresholds method proposed by GVL uses the ratio of nominal credit to the private sector to nominal GDP $(L/Y)_{i,t}$ as the measure of credit.[18] They define the long-run trend of credit using an "expanding trend" by applying the HP filter as follows: Given a sample of data for dates t=1,…,T, denote $(L/Y)_{i,t}^{EHP}$ as the expanding HP trend of the credit-GDP ratio in country i at date t, for $1 \leq t \leq T$. This expanding trend is the trend component of the HP filter applied to the sequence of data $\left[(L/Y)_{i,j}\right]_{j=-k}^{j=t}$, where k is a positive integer that defines the length of a sample of "initial data." In particular, GVL used a sample for 1960-1996 and set k=5, so their expanding trend starts in 1965 with $(L/Y)_{i,1965}^{EHP}$ as the 1965 value of the HP trend computed using data from 1960 to 1965, $(L/Y)_{i,1966}^{HP}$ is the 1966 value of the HP trend computed using data from 1960 to 1966, and so on. Thus, the sample over which the trend is computed expands by one year as each successive year in the sample is added. GVL compute all these trends setting the HP smoothing parameter to 1000. [19]

GVL identify a country to have experienced a credit boom when one or more contiguous dates satisfy the following condition: $\left[(L/Y)_{i,t} - (L/Y)_{i,t}^{EHP}\right] \Big/ (L/Y)_{i,t}^{EHP} \geq \tilde{\phi}$. That is, the deviation from the expanding trend in the credit-GDP ratio must be at least as large as a boom threshold $\tilde{\phi}$.[20] The peak of the credit boom occurs on the date within the set included in the credit boom that shows the largest deviation from the expanding HP trend, and the starting (ending) date is the date earlier (later) than the peak date at which the credit-GDP ratio is higher (lower) than a "limit threshold."[21] GVL conduct their event analysis using $\tilde{\phi}$=19.5 percent and a limit threshold of 5 percent.

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[18] Since credit is a stock variable, GVL proxy Y_{it} as the geometric average of nominal GDP in t and t+1.

[19] GVL justify the expanding trend by arguing that it reflects the credit information available to policymakers at a given time. As our comparison of the two methods showed, however, the expanding trend yields a trend process that is close to a smoothed, one-period lagged transformation of the original credit series, suggesting that the policymaker would tend to misinterpret the most recent credit observations as part of a trend rather than a boom. Moreover, the credit data themselves are frequently revised, making the expanding trend difficult to justify on the basis of representing the information available to policymakers.

[20] GVL refer to this threshold as the "relative deviation threshold." They also measured credit booms using an "absolute deviation threshold," which measures credit booms relative to the size of the economy instead of the relative size of the banking sector. Their macro event analysis is based on the relative threshold.

[21] Notice that this limit threshold does not correct for the discrete nature of the data, as we did in our method by defining the starting and ending thresholds using an absolute-value metric.

Figure 1. Credit Booms: Seven-Year Event Windows
(Deviations from HP-trend in Real Credit Per-Capita)

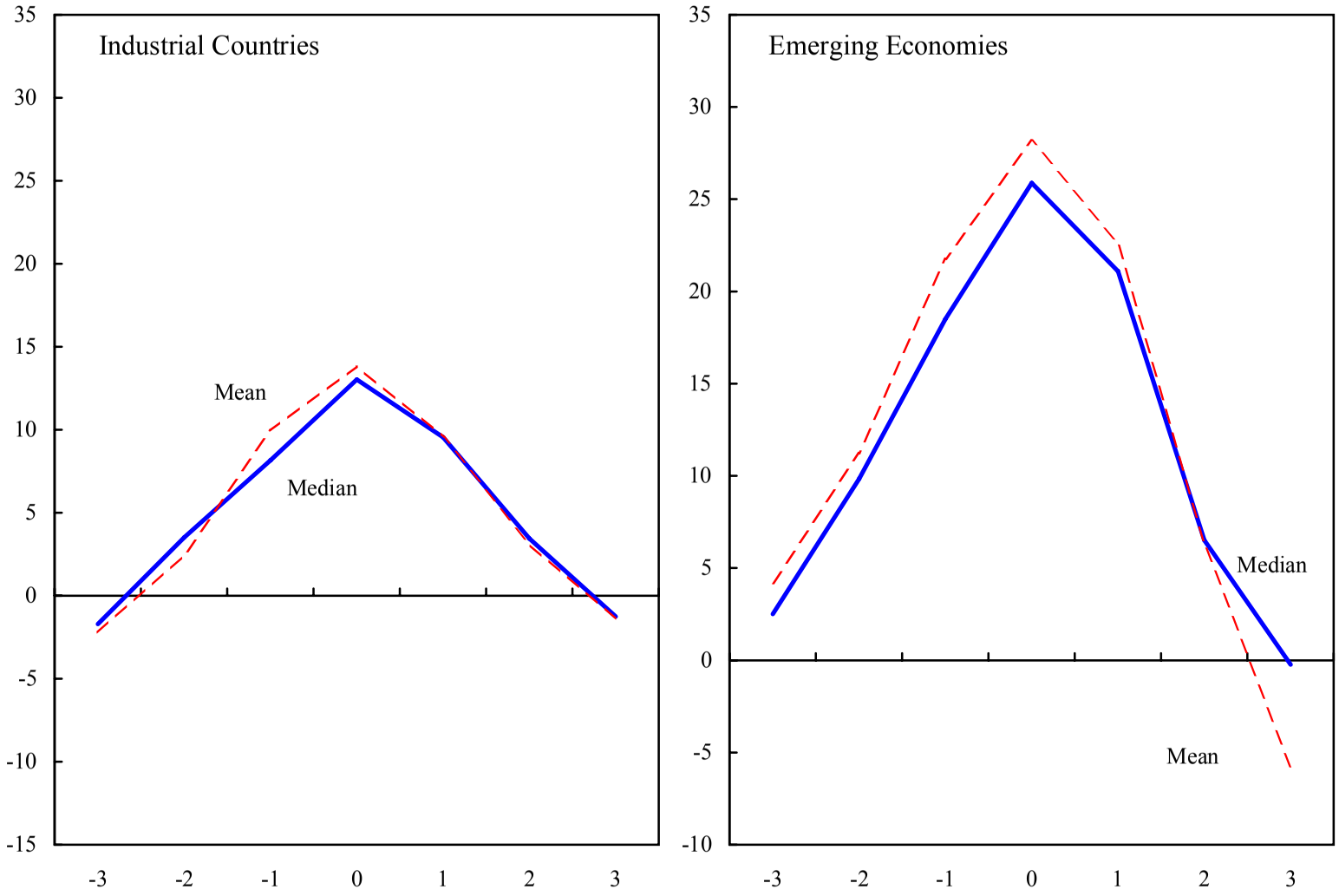
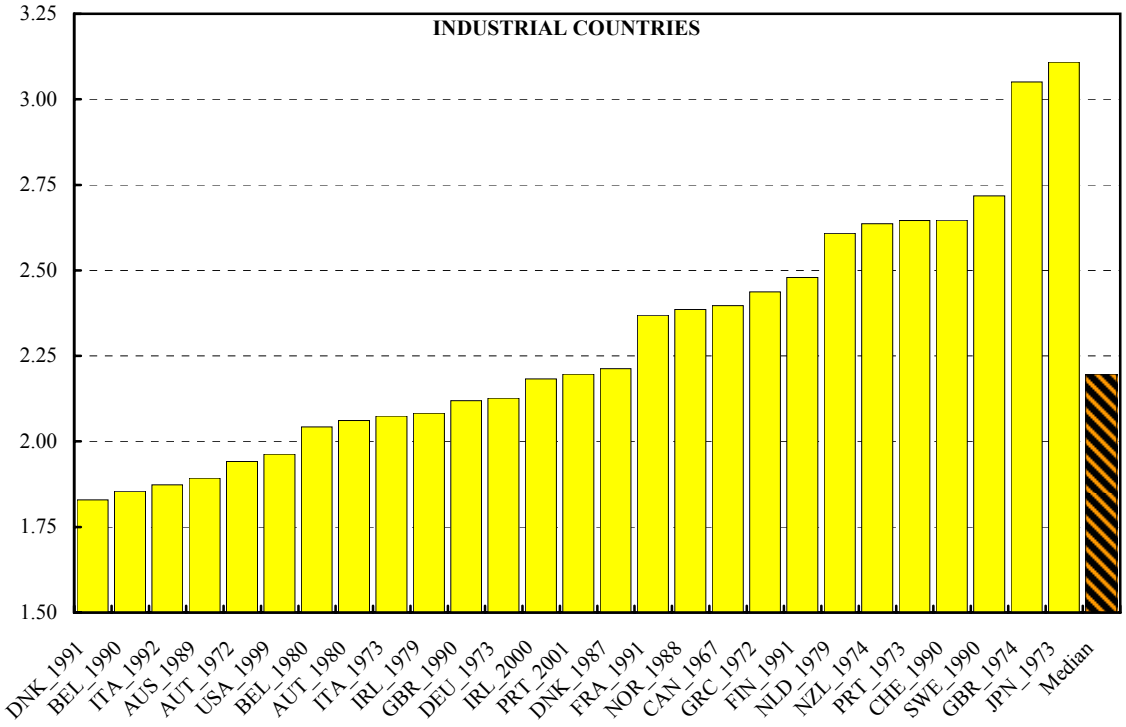
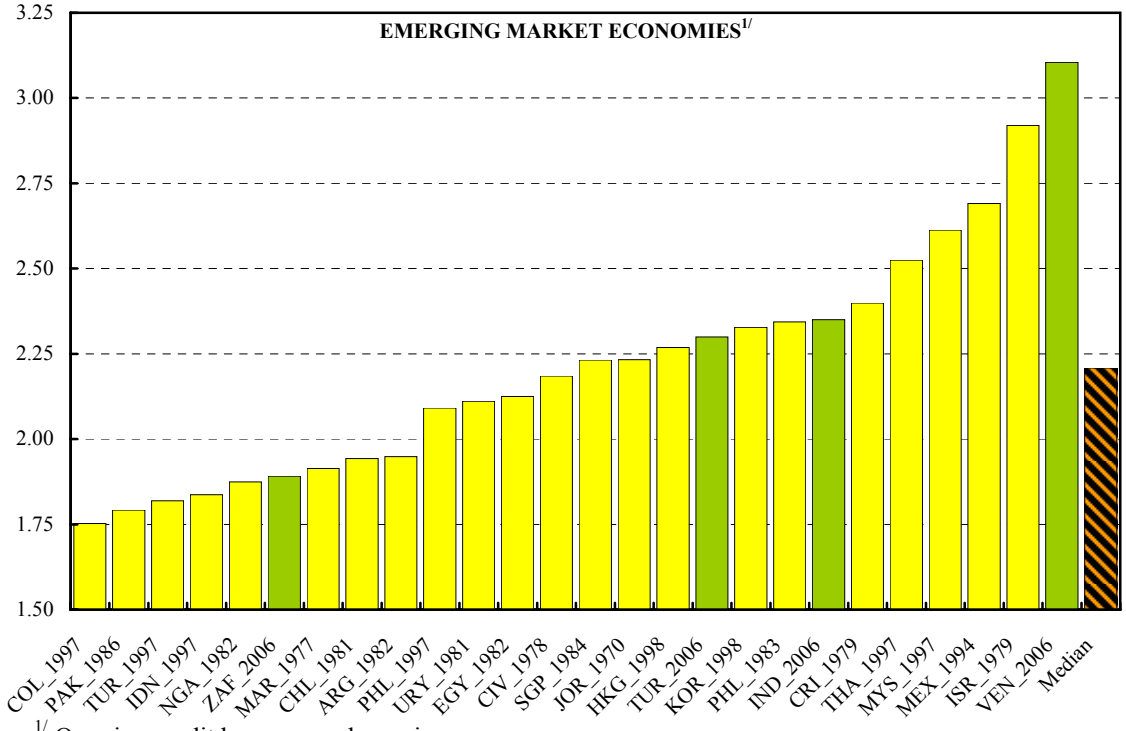


Figure 2. Relative Credit Booms

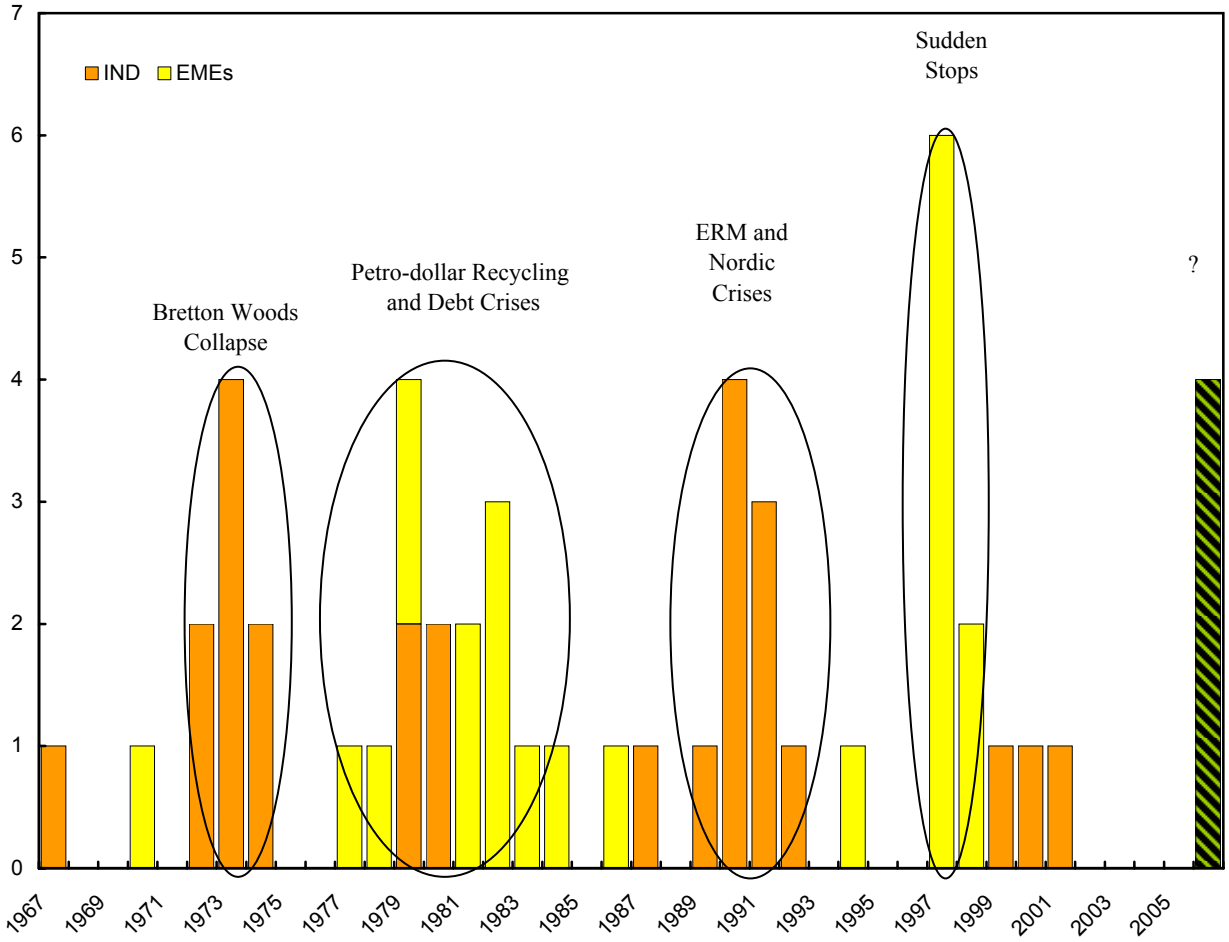
(Deviation from trend at peak of credit boom as a ratio of the std deviation of credit)





1/ Ongoing credit booms are shown in green.

Figure 3. Frequency of Credit Booms[1/]



[1/] Ongoing credit booms are shown in green.

Figure 4. Credit Booms in Chile: the Mendoza-Terrones Method

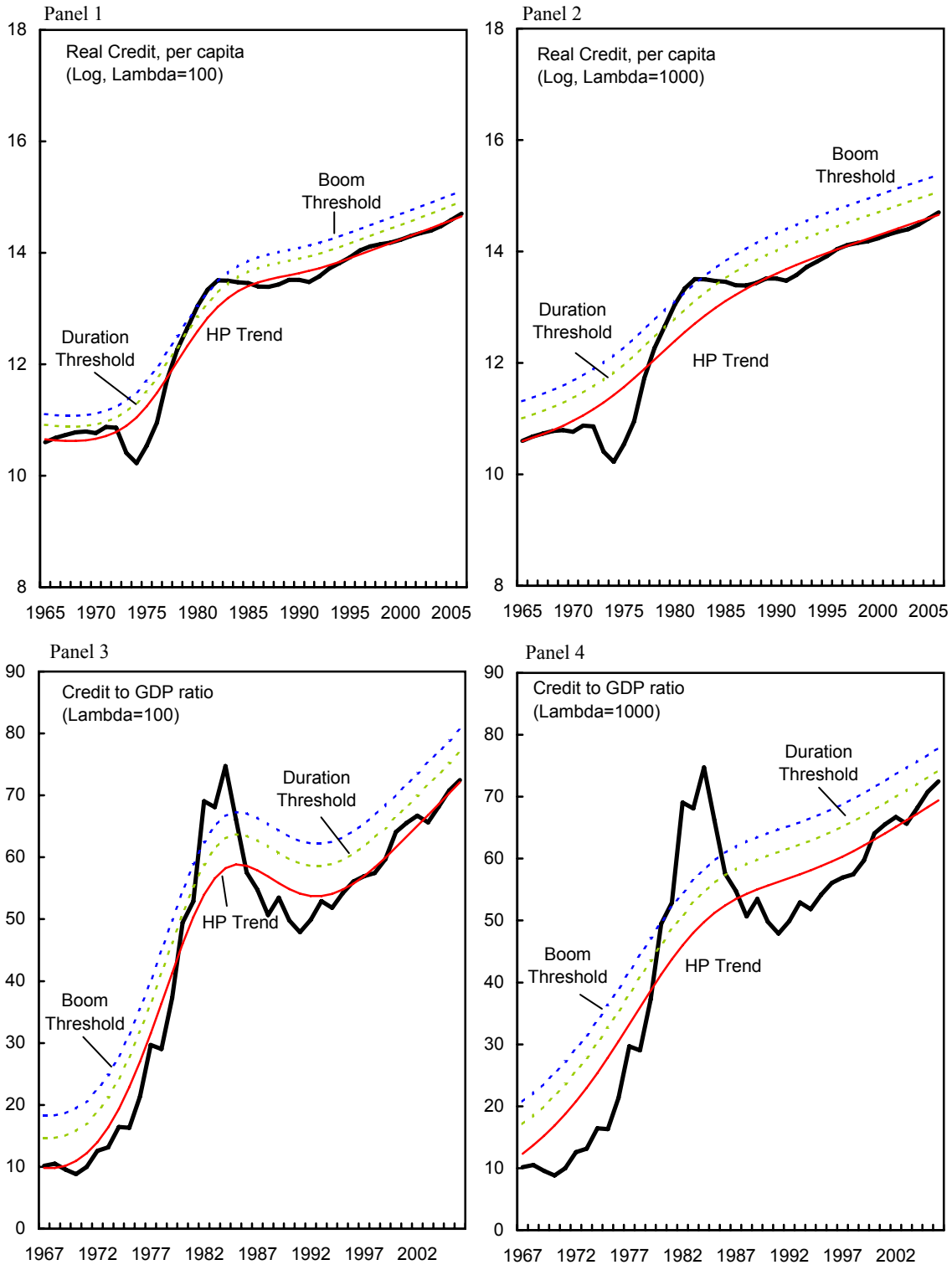


Figure 5. Credit Booms in Chile: the Gourinchas, Valdes, and Landerretche (GVL) Method

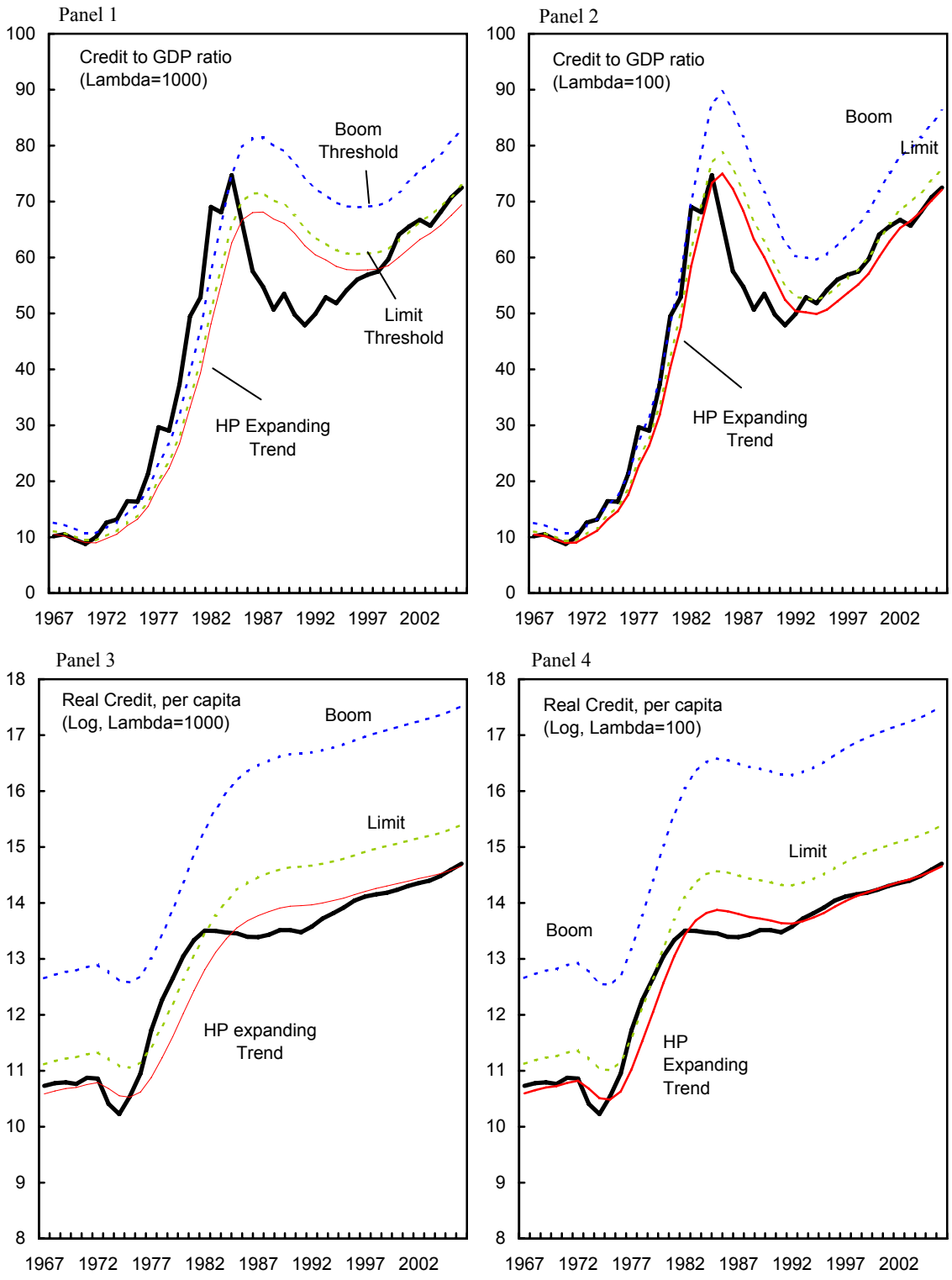


Figure 6. Credit Booms in Chile: Expanding vs. Conventional Trend

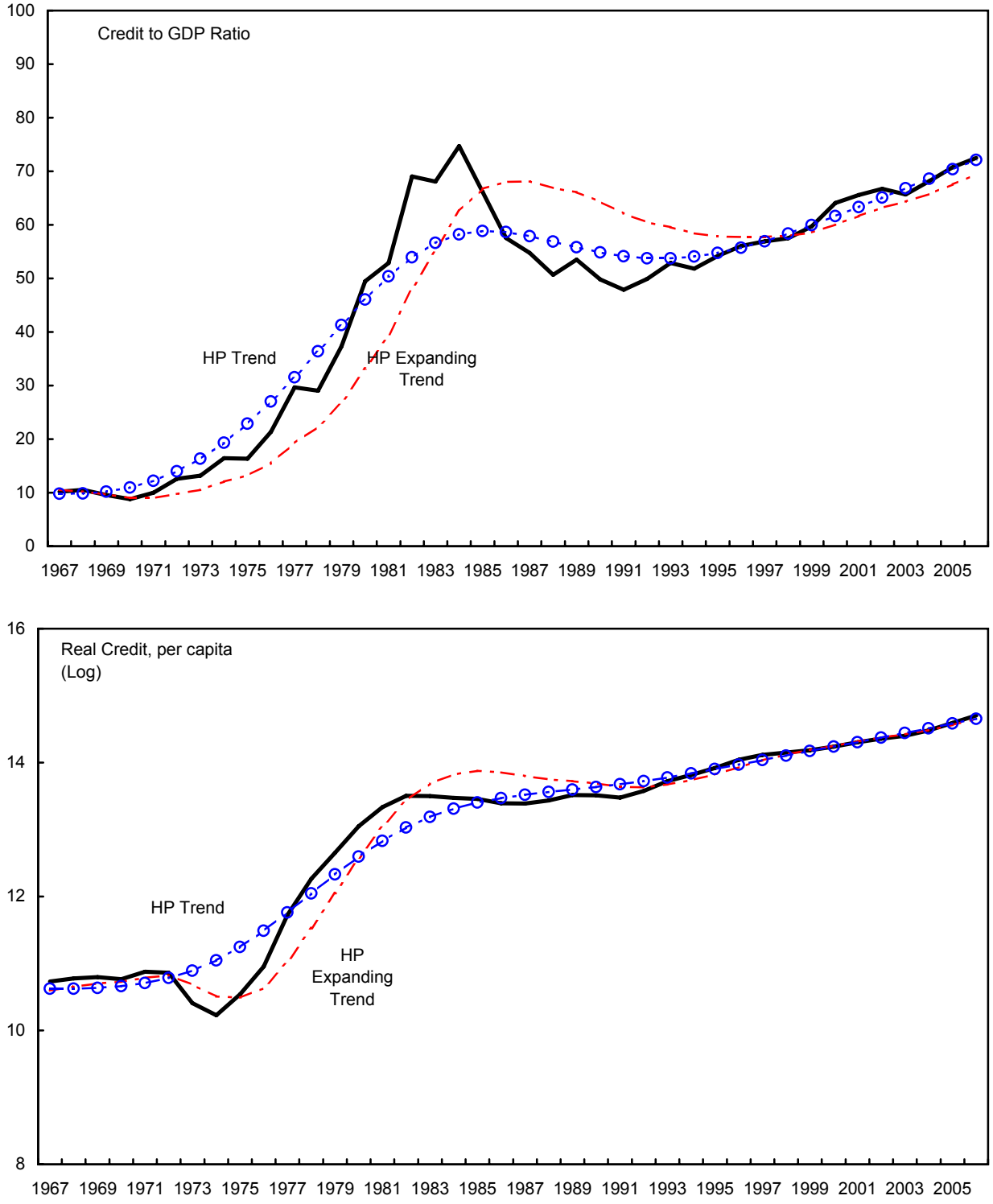


Figure 7. Credit Booms and Economic Activity
(Cross-country means and medians of cyclical component of real GDP)

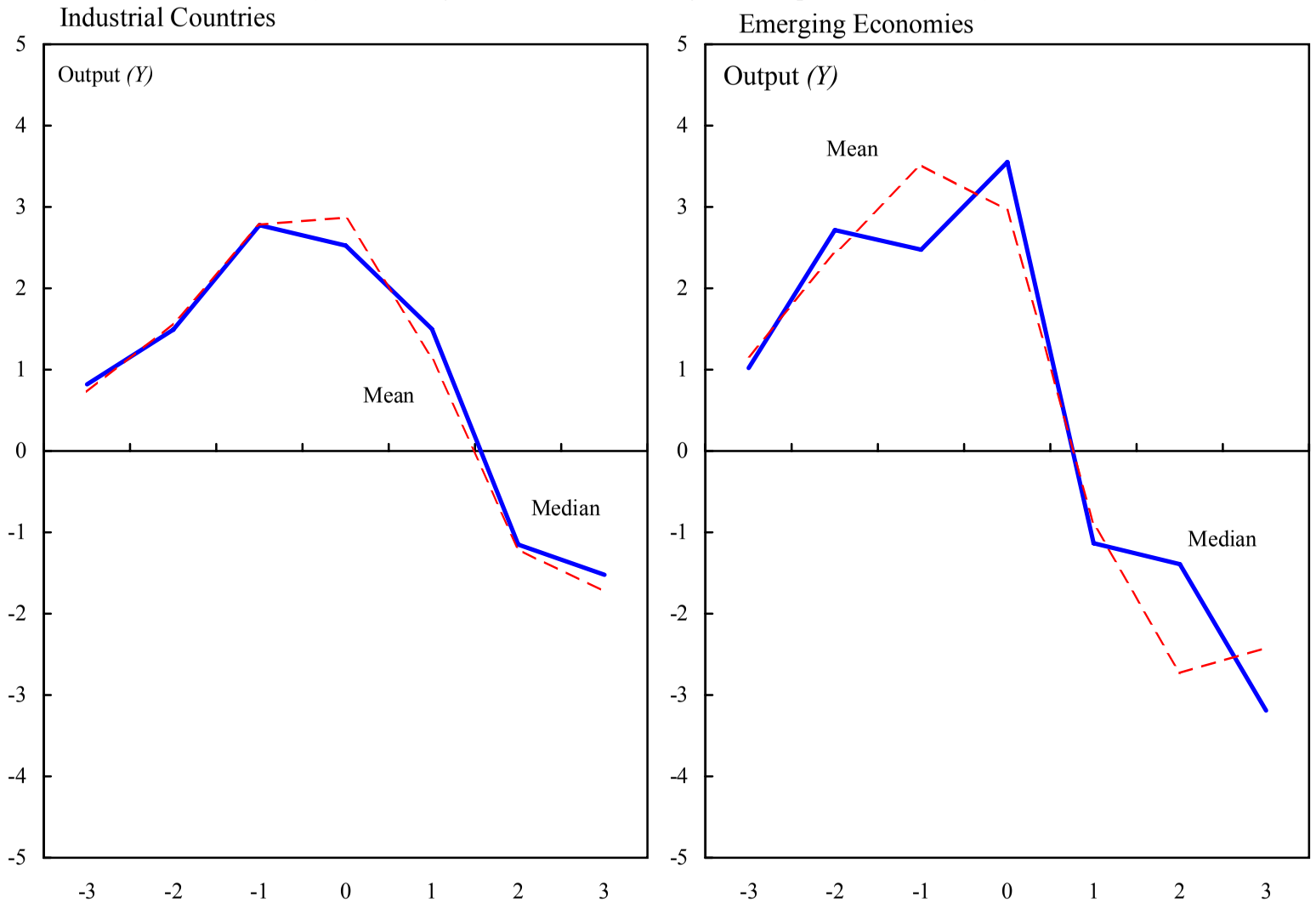


Figure 8. Credit Booms and Domestic Demand

(Cross-country means and medians of cyclical components)

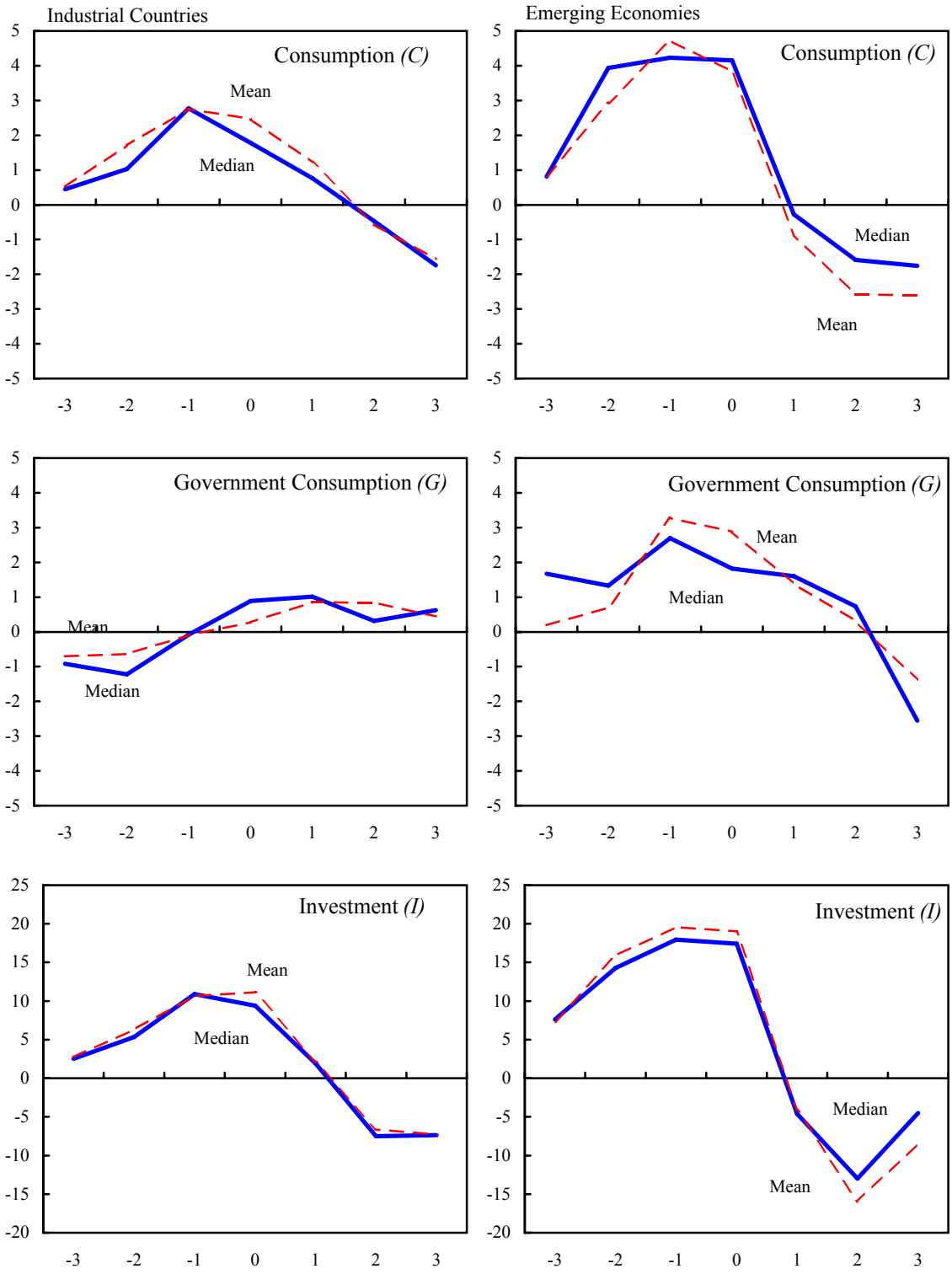


Figure 9. Credit Booms and the Non-tradables Sector

(Cross-country means and medians of cyclical components)

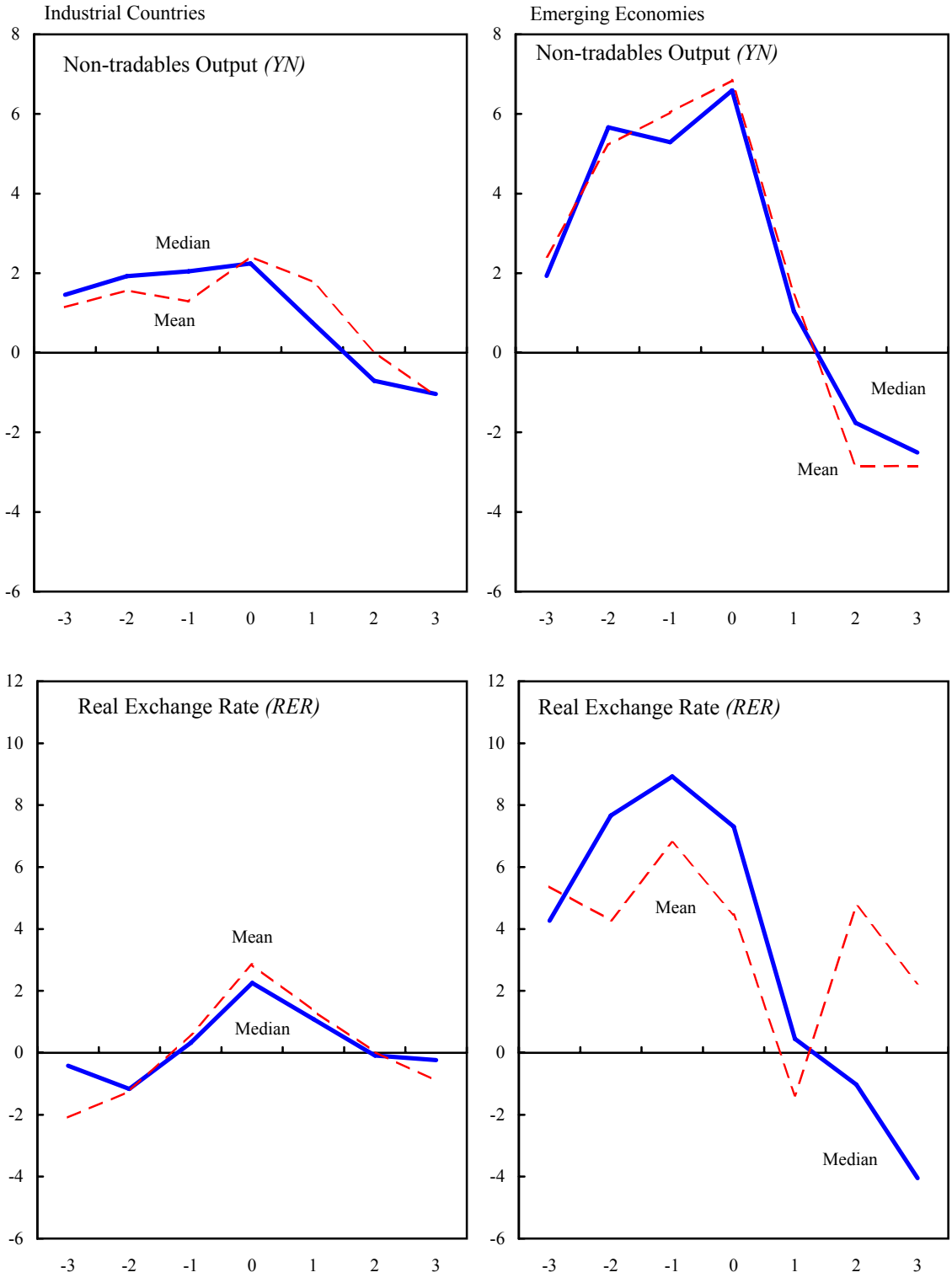


Figure 10. Credit Booms, Current Account, and Capital Inflows

(Cross-country means and medians of cyclical component)

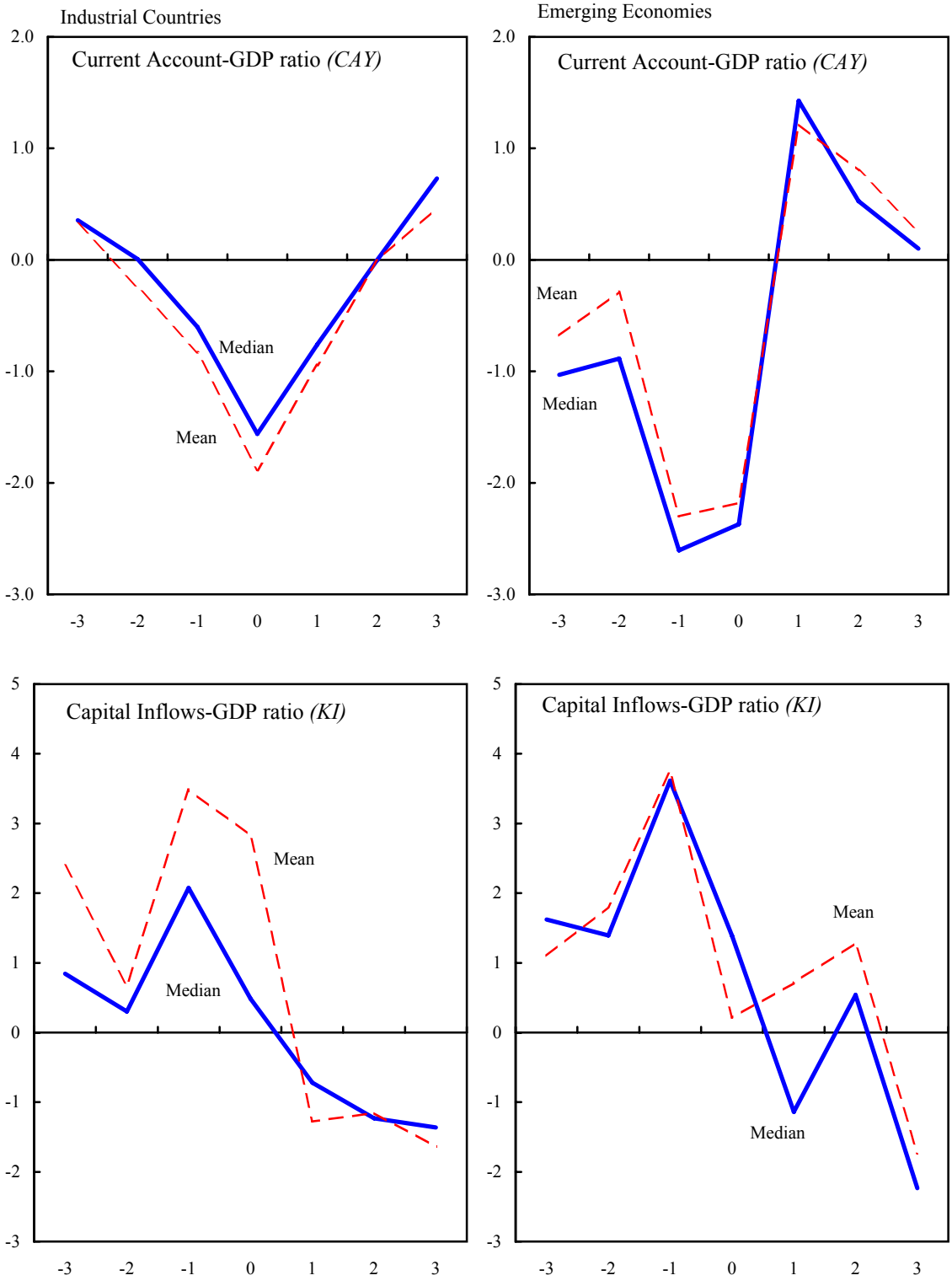


Figure 11. Credit Booms and Prices

(Cross-country means and medians of cyclical components)

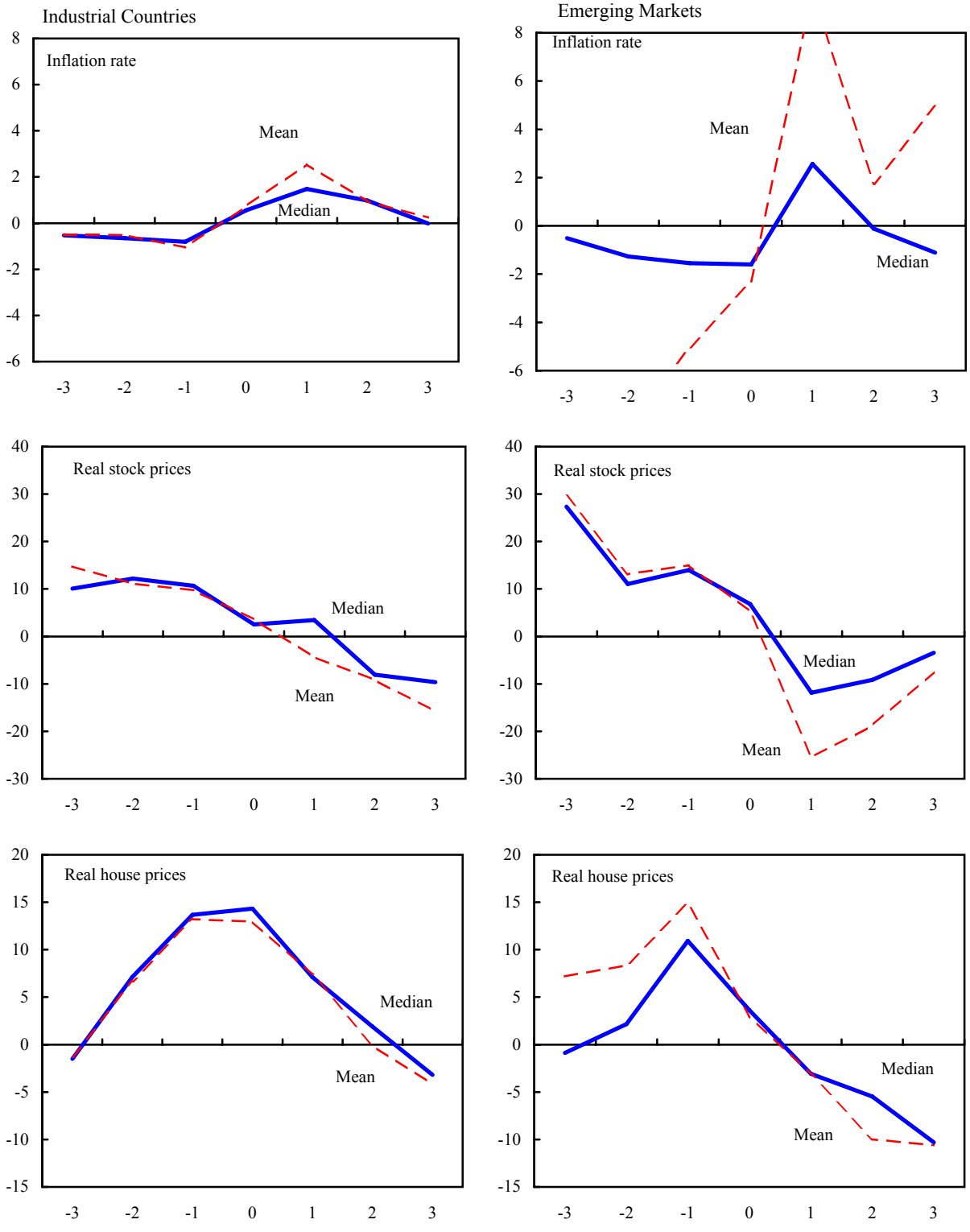


Figure 12. Credit Booms: Corporate Leverage

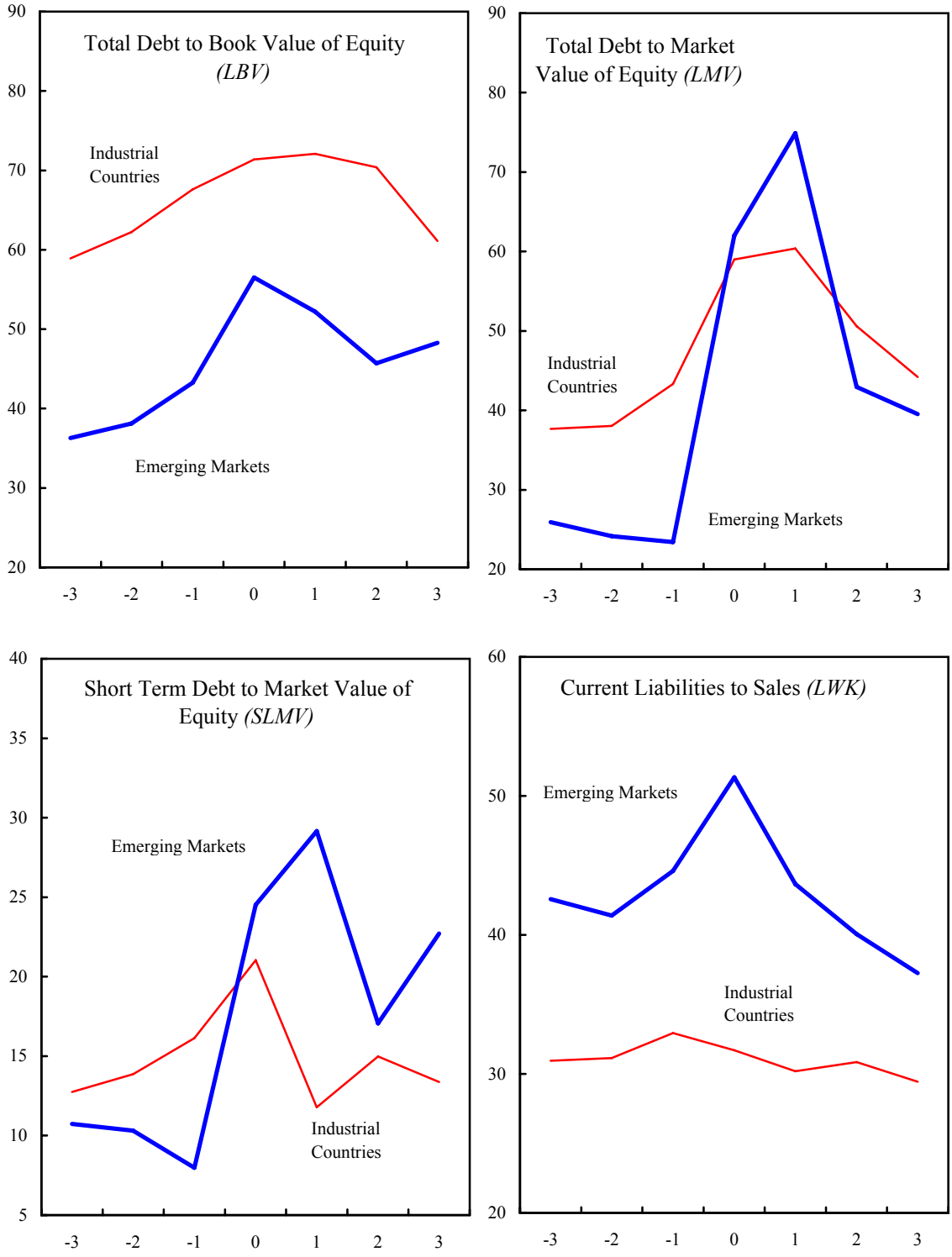


Figure 13. Credit Booms: Tobin's Q, Interest Rate, and Profitability

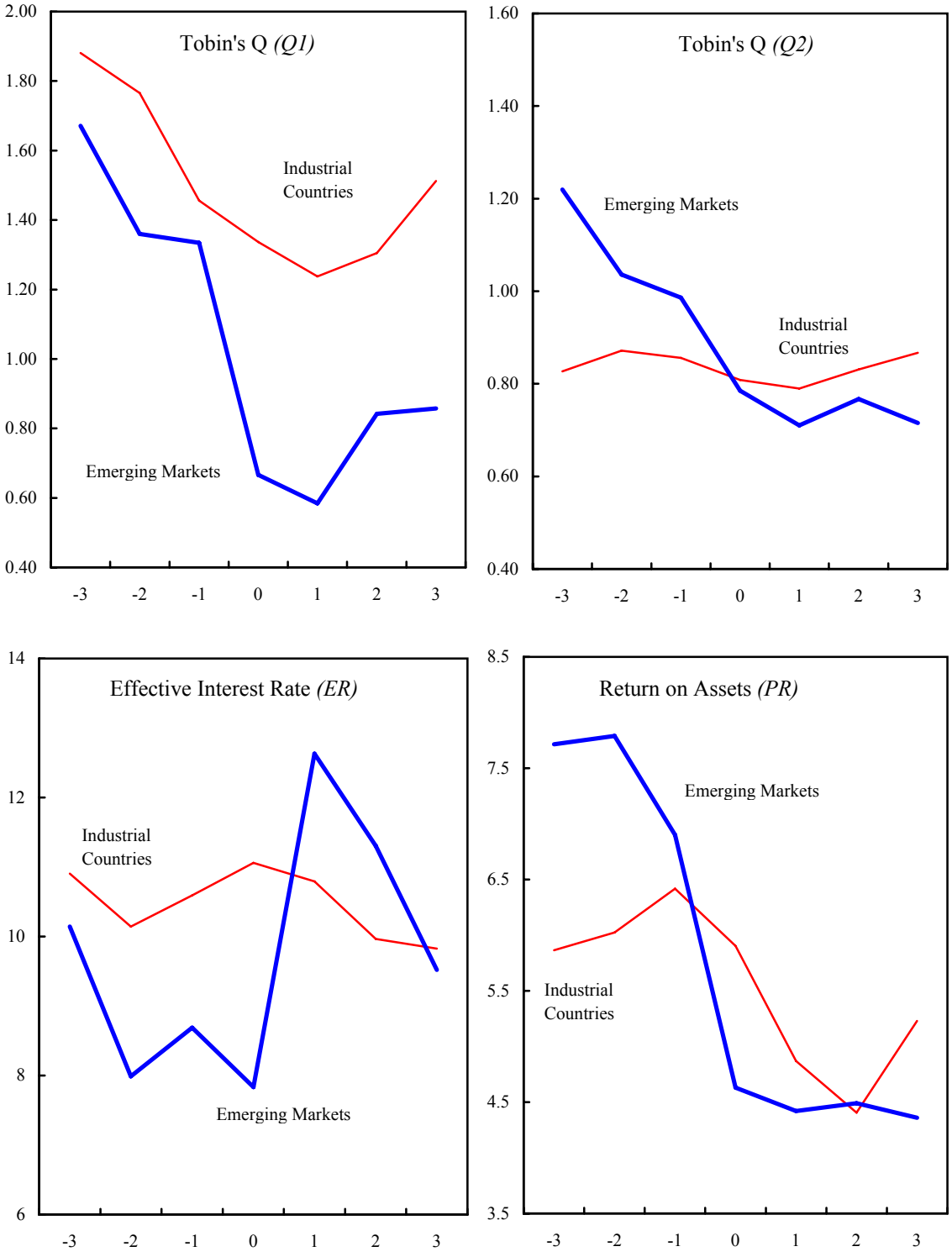


Figure 14. Credit Booms: Corporate External Financing

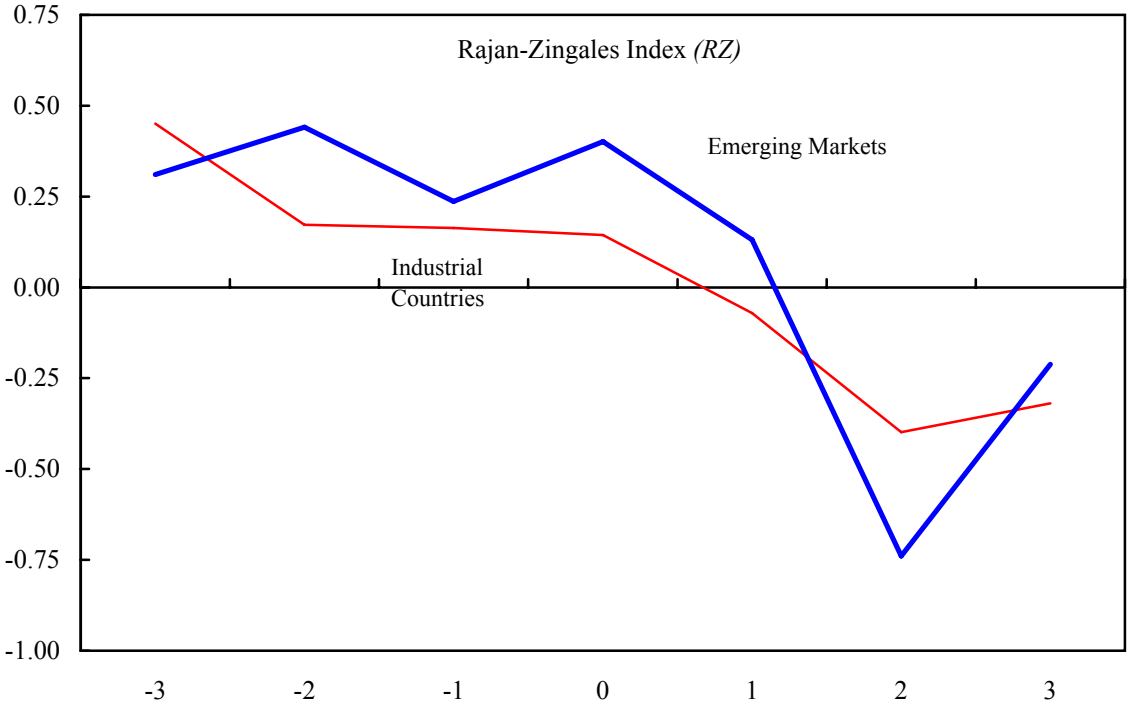


Figure 15. Credit Booms: Financial Indicators

Regional Differences

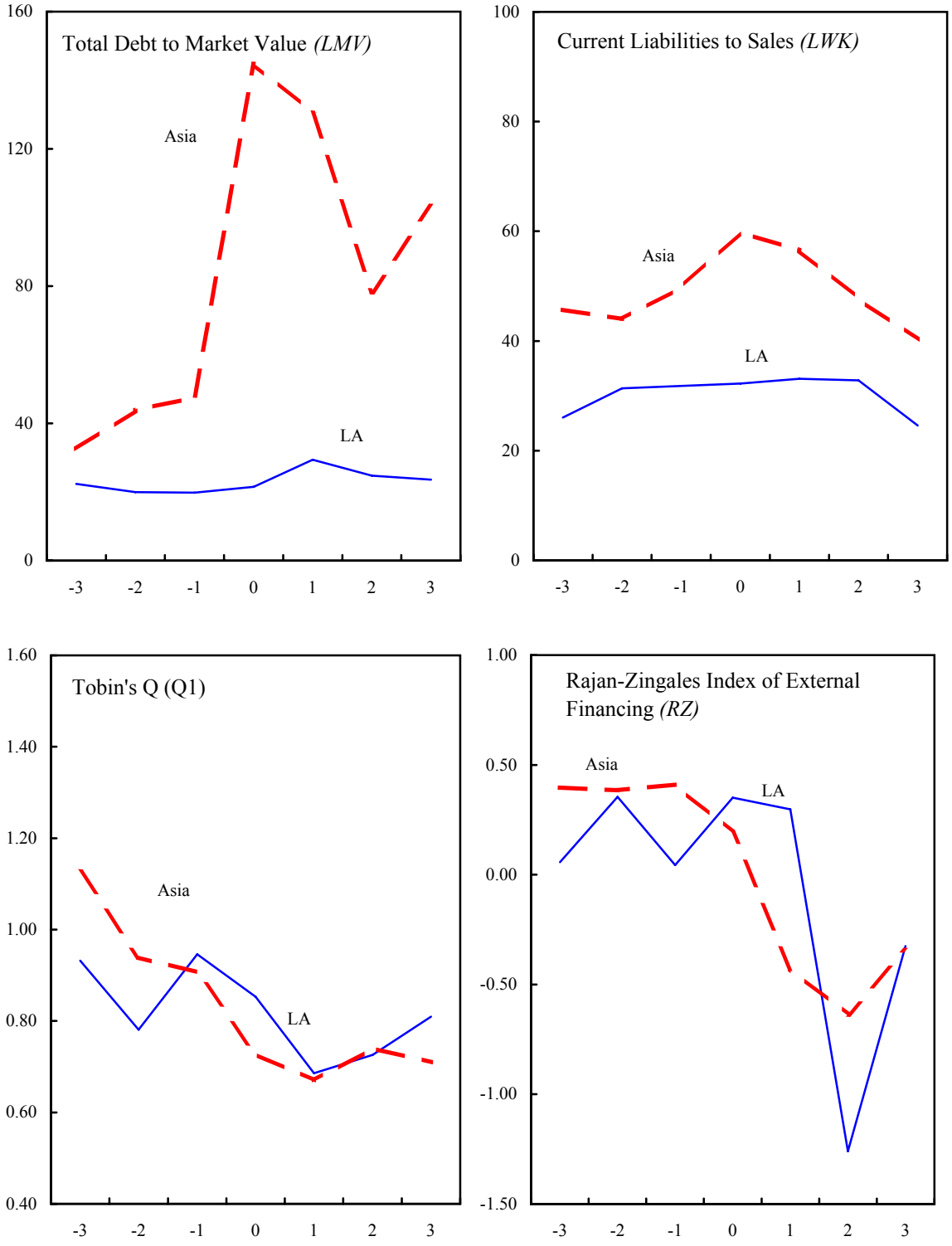


Figure 16. Credit Booms: Corporate Leverage and External Financing in Emerging Market Countries

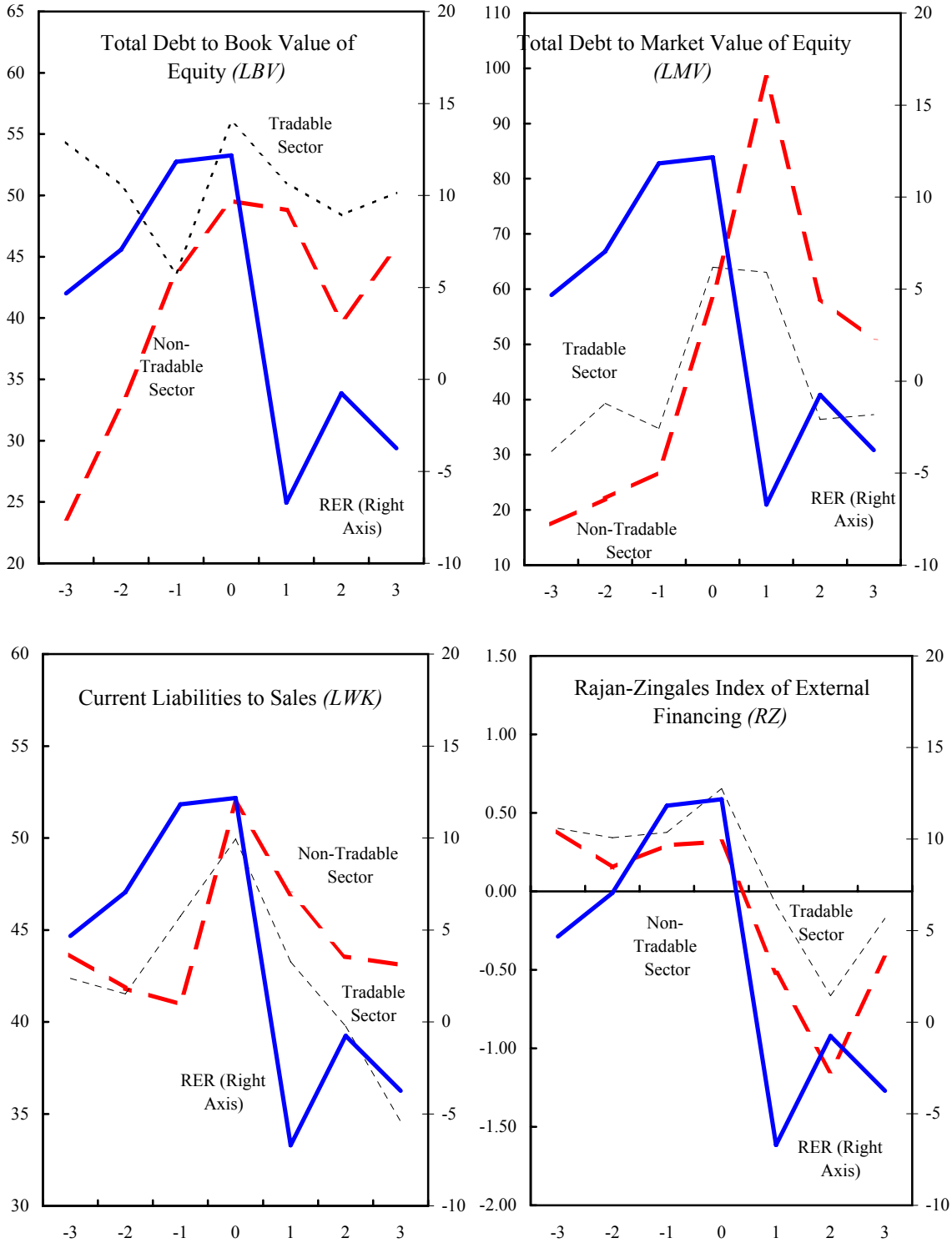


Figure 17. Credit Booms: Bank Level Data
Emerging Market Economies

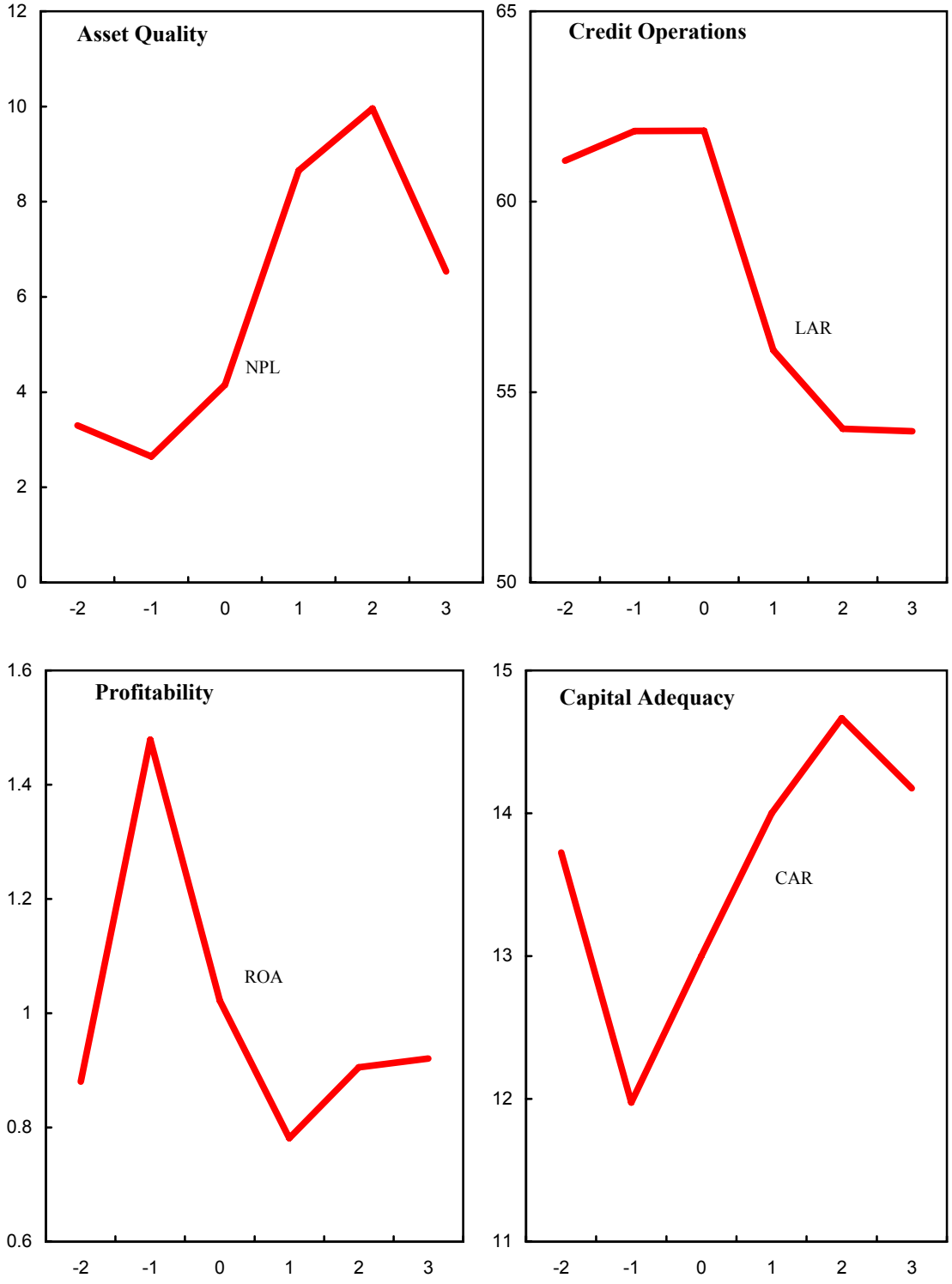


Table 1. Credit Booms: Duration

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	7.76	0.47	0.40	6.93	0.41	0.45
0.25	7.00	0.47	0.39	6.30	0.41	0.44
0.50	6.05	0.46	0.38	5.63	0.39	0.43
0.75	5.24	0.43	0.38	5.00	0.40	0.40
1.00	4.62	0.41	0.37	4.67	0.39	0.40
B. Median						
0.00	7.00	0.57	0.43	7.00	0.43	0.43
0.25	7.00	0.43	0.29	6.00	0.50	0.33
0.50	6.00	0.50	0.33	6.00	0.33	0.33
0.75	5.00	0.40	0.40	5.00	0.40	0.40
1.00	5.00	0.40	0.40	4.00	0.50	0.50

Table 2. Coincidence of Credit Booms with Output and Demand Booms[1/]

(Frequency)

	Industrial Countries	Emerging Market Economies	All
Output	0.56	0.32	0.45
Non-tradable Output	0.33	0.55	0.43
Consumption	0.56	0.36	0.47
Investment	0.59	0.55	0.57
Government Expenditures	0.33	0.41	0.37

[1/] 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 1.75.

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

	Industrial Countries							Emerging Market Economies						
	t-3	t-2	t-1	t-0	t+1	t+2	t+3	t-3	t-2	t-1	t-0	t+1	t+2	t+3
1. Mean Values														
Real credit	-0.027**	0.026**	0.103***	0.141***	0.098***	0.032**	-0.012	0.004	0.081**	0.202***	0.283***	0.224***	0.058	-0.064*
	(0.013)	(0.013)	(0.012)	(0.012)	(0.012)	(0.013)	(0.013)	(0.034)	(0.034)	(0.033)	(0.032)	(0.035)	(0.036)	(0.036)
Output	0.007	0.016***	0.030***	0.031***	0.012***	-0.012**	-0.019***	0.007	0.022**	0.037***	0.032***	-0.011	-0.026***	-0.025***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.009)	(0.009)	(0.009)	(0.009)	(0.01)	(0.01)	(0.01)
Non-tradable Output	0.008	0.012	0.018**	0.029***	0.022***	0.003	-0.011	0.011	0.044***	0.057***	0.069***	0.016	-0.028**	-0.028**
	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)	(0.011)	(0.011)
Consumption	0.005	0.018***	0.030***	0.027***	0.013***	-0.005	-0.018***	0.003	0.024**	0.046***	0.041***	-0.011	-0.027**	-0.032***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.011)	(0.011)	(0.011)	(0.011)	(0.012)	(0.012)	(0.012)
Government Consumption	-0.007*	-0.002	0.004	0.007*	0.009**	0.009**	0.002	-0.001	0.012	0.036***	0.031**	0.010	0.002	-0.014
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.013)	(0.013)	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)
Investment	0.026	0.063***	0.112***	0.121***	0.024	-0.064***	-0.075***	0.015	0.129***	0.191***	0.177***	-0.039	-0.153***	-0.095**
	(0.017)	(0.017)	(0.017)	(0.016)	(0.017)	(0.017)	(0.017)	(0.034)	(0.034)	(0.034)	(0.034)	(0.037)	(0.037)	(0.037)
REER	-0.024*	-0.013	0.004	0.031**	0.015	0.002	-0.005	0.035	0.033	0.060**	0.039	0.005	0.039	0.013
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.013)	(0.012)	(0.031)	(0.029)	(0.027)	(0.027)	(0.03)	(0.029)	(0.028)
Current Account Balance	0.003	-0.003	-0.009***	-0.021***	-0.011***	-0.001	0.005	-0.003	-0.003	-0.019***	-0.021***	0.012	0.007	0.003
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)
2. Median Values														
Real credit	-0.015	-0.015	-0.015	-0.015	-0.015	-0.015	-0.015	0.010	0.048**	0.157***	0.260***	0.212***	0.052**	-0.019
	(0.015)	(0.015)	(0.013)	(0.013)	(0.013)	(0.014)	(0.015)	(0.022)	(0.023)	(0.023)	(0.023)	(0.025)	(0.024)	(0.024)
Output	0.009	0.017***	0.031***	0.028***	0.016***	-0.010*	-0.015***	0.004	0.023**	0.027***	0.036***	-0.011	-0.014*	-0.032***
	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)	(0.006)	(0.006)	(0.009)	(0.009)	(0.009)	(0.009)	(0.01)	(0.008)	(0.008)
Non-tradable Output	0.007	0.013	0.023***	0.029***	0.011	-0.004	-0.009	0.010	0.054***	0.052***	0.066***	0.013	-0.016*	-0.025***
	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.01)
Consumption	0.005	0.011**	0.031***	0.022***	0.009*	-0.004	-0.017***	0.003	0.035***	0.042***	0.041***	-0.009	-0.023**	-0.026***
	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.006)	(0.005)	(0.009)	(0.009)	(0.009)	(0.009)	(0.01)	(0.01)	(0.01)
Government Consumption	-0.010**	-0.012***	0.003	0.009**	0.010**	0.005	0.006	0.015	0.015	0.029**	0.031***	0.017	0.009	-0.022*
	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Investment	0.025*	0.045***	0.111***	0.101***	0.027*	-0.067***	-0.076***	0.035	0.128***	0.173***	0.169***	-0.046*	-0.134***	-0.051*
	(0.014)	(0.014)	(0.016)	(0.016)	(0.015)	(0.013)	(0.014)	(0.027)	(0.025)	(0.027)	(0.026)	(0.028)	(0.029)	(0.029)
REER	-0.006	-0.015	0.001	0.026*	0.014	-0.011	-0.006	0.028	0.056**	0.067***	0.020	0.022	-0.008	-0.038
	(0.012)	(0.013)	(0.012)	(0.014)	(0.012)	(0.01)	(0.01)	(0.028)	(0.026)	(0.025)	(0.025)	(0.026)	(0.026)	(0.025)
Current Account Balance	0.003	-0.001	-0.009**	-0.018***	-0.009***	-0.001	0.003	-0.007	-0.007	-0.024***	-0.022***	0.015**	0.006	0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)	(0.004)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)

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

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

Variable	Region	Date						
		t-3	t-2	t-1	t-0	t+1	t+2	t+3
A. Industrial Countries: G7 vs Nordic Countries								
Real credit	*G7*	-0.76	3.89	7.76	10.82	9.09	3.26	-1.26
	Nordic	-1.05	7.68	13.54	17.77	14.67	7.77	1.29
Output (Y)	*G7*	0.88	1.84	2.78	1.87	-0.33	-1.98	-1.35
	Nordic	2.07	3.55	3.89	-0.49	-1.48	-2.64	-2.34
Non-tradables Output (YN)	*G7*	1.46	1.70	1.80	1.55	-0.05	-1.64	-0.45
	Nordic	3.11	4.83	5.78	3.75	0.63	0.79	-2.74
Consumption (C)	*G7*	1.04	2.08	2.77	1.77	0.26	-1.06	-1.76
	Nordic	4.22	5.22	4.92	2.06	-0.81	-2.81	-2.54
Investment (I)	*G7*	3.62	7.67	9.48	7.08	-2.07	-7.50	-5.14
	Nordic	4.35	9.20	19.64	6.46	-0.58	-7.61	-12.31
Real Exchange Rate (RER)	*G7*	-2.89	-0.63	2.87	3.87	2.48	3.75	-1.99
	Nordic	-0.77	-2.46	0.18	3.60	1.44	0.77	-0.18
Current Account-GDP ratio (CAY)	*G7*	0.09	-0.31	-0.88	-1.09	0.05	0.05	0.06
	Nordic	0.08	-2.10	-2.71	-1.42	-0.78	-0.31	0.82
B. Emerging Economies: Latin America (LA) vs Asia								
Real credit	*LA*	13.22	29.52	43.14	48.14	39.64	12.61	-6.30
	Asia	1.09	4.90	12.22	24.68	21.10	1.34	-3.97
Output (Y)	*LA*	1.10	5.50	4.64	5.73	1.06	-2.32	-5.19
	Asia	3.78	3.38	4.41	3.55	-3.89	-1.48	-3.19
Non-tradables Output (YN)	*LA*	0.98	6.35	6.02	6.90	1.81	0.28	-2.90
	Asia	4.15	5.39	6.77	6.51	-0.36	-3.08	-2.00
Consumption (C)	*LA*	0.88	5.50	7.21	8.78	2.10	-4.65	-5.41
	Asia	2.99	3.93	6.18	1.12	-5.23	-2.22	-1.56
Investment (I)	*LA*	8.95	23.02	17.84	20.62	3.26	-17.89	-22.12
	Asia	12.08	14.29	20.70	17.00	-11.58	-11.13	-4.76
Real Exchange Rate (RER)	*LA*	10.40	16.50	13.71	16.85	12.83	-2.36	-3.74
	Asia	4.22	7.05	10.97	8.96	-6.71	-1.30	-6.88
Current Account-GDP ratio (CAY)	*LA*	-0.84	-1.68	-2.41	-2.96	-0.86	1.46	0.24
	Asia	-2.50	-3.24	-3.22	-2.37	3.40	0.40	0.66

Table 5. Credit Booms and Crises[1/]

(Frequency)

	Banking crises[2/]				Currency crises[3/]				Sudden Stops[4/]			
	Before	Peak Boom	After	Total	Before	Peak Boom	After	Total	Before	Peak Boom	After	Total
All countries	0.15	0.15	0.04	0.33	0.23	0.15	0.23	0.60	0.06	0.06	0.04	0.17
Industrial Countries	0.08	0.08	0.00	0.15	0.15	0.08	0.31	0.54	0.00	0.00	0.04	0.04
Emerging Market Economies	0.23	0.23	0.09	0.55	0.32	0.23	0.14	0.68	0.14	0.14	0.05	0.32

[1/] Coincidence of credit booms and financial crises in the seven-year window around the boom.
[2/] Banking crises as defined by Demirguic-Kunt and Detragiache (2006). See Appendix 2 for details.
[3/] Currency crises as defined by Eichengreen and Bordo (2002). See Appendix 2 for details.
[4/] Sudden Stops as defined by Calvo, Izquierdo and Mejia (2004). See Appendix 2 for details.

Table 6. Credit Booms: Potential Triggering Factors[1/].

(Frequency distribution)

	Industrial Countries	Emerging Market Economies	All
Large Capital Inflows (A) [2/]	0.27	0.50	0.52
Significant Productivity Gains (B) [3/]	0.40	0.17	0.33
Large Financial Sector Changes (C) [4/]	0.33	0.22	0.27
Other	0.27	0.39	0.30
Memo items:			
(A) & (B)	0.07	0.00	0.09
(A) & (C)	0.00	0.06	0.12
(B) & (C)	0.07	0.11	0.09
(A) & (B) & (C)	0.07	0.06	0.06

[1/] Because of data availability we have used the 1975-2005 period only.

[2/] The three-year average of capital inflow before the peak of the boom ranks in the top quartile of their corresponding country group.

[3/] 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.

[4/] 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.

Table 7. Credit Booms and exchange rate regimes

(Frequency distribution)

	Industrial Countries	Emerging Market Economies	All
Fixed and managed[1/]	77.78	73.91	76.00
Dirty Floating[2/]	7.41	17.39	12.00
Floating[3/]	7.41	0.00	4.00
Mixed	7.41	8.70	8.00

[1/] Fixed and managed includes the following regimes from the Reinhart-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%.

[2/] Dirty floating includes the following regimes from the Reinhart-Rogoff (2004) classification: pre-announced crawling band wider than or equal to +/-2%, de facto crawling band narrower than or equal to +/-5%, moving band that is narrower than or equal to +/- 2%, and managed floating.

[3/] Freely floating regimes from the Reinhart-Rogoff (2004) classification.