Boom-Bust Cycles in Credit Constrained Economies: Facts and Explanation

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Abstract

In this paper we characterize empirically the boom-bust cycle typical of countries that have suffered twin crises. Interestingly, this cycle is associated with co-movements between key macro variables observed in middle income countries more generally. These co-movements indicate that 'balance sheet effects' and 'asymmetric credit constraints' play important roles in middle income countries. In the second part of the paper we consider a model where these co-movements arise along the equilibrium path, and use the restrictions implied by the model to estimate a structural VAR.

1. Introduction

In recent decades many middle income countries have implemented financial liberalization as well as other structural reforms. Typically, the post-liberalization period has seen the development of lending booms. Most of the time the boom has a 'soft landing,' whereby credit growth gradually decelerates. But sometimes the boom ends in 'twin' currency and banking crises, and is followed by a protracted credit crunch. Interestingly, several macroeconomic variables follow patterns which are common across this set of countries: there is a common 'boom-bust cycle.'

In the first part of this paper we empirically characterize the common features of the boom-bust cycle. We also show that these common features are consistent with co-movements of macro variables typically observed in middle income countries. As we shall see, these co-movements are different, in many respects, from the co-movements observed in the US. They indicate that 'balance sheet effects' and 'asymmetric credit constraints' play important roles in middle income countries.

In the second part of the paper we present a model where these co-movements do arise along the equilibrium path, and use the restrictions implied by the model to estimate a structural VAR of key macroeconomic variables.

We characterize the boom-bust cycle by means of an event study on the set of middle income countries over the last two decades. The cycle is centered around twin crises during which a real depreciation coincides with a banking crisis.

Prior to a twin crisis the typical country experiences a real appreciation and a lending boom. Meanwhile, in the aftermath of a crisis there is typically a short-lived recession and a protracted credit crunch that persists long after aggregate growth has resumed.

The puzzling coexistence of a credit crunch and GDP growth can be explained by the fact that the credit crunch hits mainly small and nontradables firms (N). Indeed, for several years after the crisis N-production declines relative to the output of the tradable (T) sector, and the credit-to-deposits ratio falls.

An additional feature of the boom-bus cycle is that investment experiences wide swings over the cycle, while consumption varies very little.

The boom-bust cycle shows up in strong co-movements among key macro variables in middle income countries. In particular, panel regressions indicate that an increase in credit is significantly correlated with a real appreciation, and an increase in the ratio of nontradables-to-tradables output. The first fact indicates that there exist balance sheet effects: in the presence of dollar debt, a real appreciation deflates the debt burden. This leads to an increase in cash flow and a greater ability to borrow. The second fact indicates that there are asymmetric credit constraints: the N-sector is more constrained than the T-sector. Panel regressions also indicate that credit growth co-moves with real investment growth, but not with consumption growth.

Interestingly, there is no evidence that the typical boom-bust cycles differ across exchange rate regimes. We find that the patterns followed by key variables are not significantly different in countries with fixed exchange rates than in other countries.

How can we explain a complete boom-bust cycle? It is well recognized that a real depreciation coincides with a banking crisis because there is 'dollar debt' and because credit is constrained by the capitalization of domestic agents. It is also well known that dollar debt is induced by bailout guarantees, and that credit constraints reflect contract enforceability problems. The question arises as to whether one can construct a consistent framework where bailout guarantees do not neutralize the enforceability problem. Furthermore, can the interaction between these two distortions generate the dynamic patterns that characterize the boom-bust cycle? In the second part of the paper we build upon Schneider and Tornell (2000) to construct a 'boom-bust equilibrium' that exhibits these patterns, and that is consistent with soft landings.

The key point of the model is that if bailout guarantees are *systemic,* then their *interaction* with contract enforceability problems gives rise to binding credit constraints and foreign currency denominated debt. These, in turn, generate balance sheet effects that: (a) deflate the value of debt and introduce a positive feedback between the real appreciation and the lending boom prior to a crisis; (b) cause the meltdown of the banking system and a real depreciation when a crisis hits, and (c) generate a credit crunch in the aftermath of crisis that hits the N-sector especially hard.

The model has clear implications for the contemporaneous linkages among the macroeconomic variables we alluded to above. We use these restrictions to estimate a structural VAR using Mexican and US data. The estimates for Mexico indicate that credit reacts significantly to the real exchange rate and to the ratio of N-to-T output. This is not true for the US.

The paper is structured as follows. In Section 2 we characterize the boom-bust cycle. In Section 3 we use panel regressions to investigate the co-movement between real credit growth and key macro variables. In Section 4 we present a model that rationalizes these co-movements and establishes causal links among them. In Section 5 we use the restrictions implied by the model to estimate a structural VAR. Finally, in Section 6 we present the conclusions.

2. Stylized Facts

The experiences of Mexico around the Tequila crisis and of Thailand around the Asian crisis are prototypical examples of a boom-bust cycle. In this section we will show that several features of such boom-bust cycles are typical of middle income countries that have experienced twin crises. Some of the stylized facts that constitute a boom-bust cycle are widely agreed upon, while others have only recently appeared in the literature or have only been associated with particular episodes.[1] To illustrate these facts we use an event study that includes all middle income countries between 1980 and 1999. We start by describing the facts. Then in Subsection 2.2 we present event windows.

The boom-bust cycle

Many recent BoP crises have differed from their predecessors in that currency crises have coincided with banking crises, and the main villains have not been the traditional suspects such as fiscal deficits or current account deficits. This does not mean, however, that the 'new' crises have been totally delinked from fundamentals. Rather:

(i) *Twin crises are typically preceded by a real exchange rate appreciation and a lending boom along which bank credit grows unusually fast.*

When the crisis hits, a real depreciation takes place. Since many agents, especially those in nontradable sectors, denominate their debts in foreign currency during the boom years, the real depreciation has dramatic 'balance sheet effects': many agents see the value of their debt mushroom, while their revenues remain flat. As a result, their ability to service their debts is reduced and their net worth plummets. There is, therefore, a sharp deterioration of the banks' loan portfolio, and the banking system goes under. Typically, the problems faced by banks are not initiated by a run on banks by depositors. To save the banking system bailouts are granted, frequently with IMF support.[2] Despite this support:

[1] See Demirguc-Kunt (2000), Eichengreen, et. al. (1995), Frankel and Rose (1996), Gourinchas et. al. (2001), Kaminski and Reinhart (1999), Krueger and Tornell (1999), Sachs, Tornell and Velasco, (1996), and Tornell (1999).

[2] See Jeanne and Zettelmeyer (2001).

(ii) *In the aftermath of a crisis there is a recession, which is typically short-lived.*

Furthermore, a "worsening credit crunch" develops:

(iii) *In the aftermath of a crisis credit falls more sharply than GDP, and the gap widens over time even after economic growth has resumed.*

The puzzling coexistence of a protracted credit crunch and GDP growth several years after the crisis reflects the fact that aggregate GDP performance masks an asymmetric sectorial patterns:

(iv) *In the aftermath of crisis the tradable (T)-sector experiences an acceleration of growth after a mild recession, while the nontradable (N)-sector experiences a sharp fall and a sluggish recuperation. In contrast, prior to a crisis the N-sector grows faster than the T-sector.*

It seems as if the economy is doing well and deposits' growth has resumed. However, banks do not resume lending. Perhaps because the meltdown that occurs during the crisis leads to poor capitalization of both the banks and the agents they lend to. The asymmetric sectorial response indicates that the agents mainly affected are households as well as small and N-sector firms. Large and T-sector firms are not very dependent on bank credit, as they have access to other forms of external finance: trade credit, as well as equity and bond markets. In contrast, in middle income countries N-sector agents are heavily dependent on bank credit, which is primarily determined by collateral values, not investment opportunities. A related fact is that:

(v) *In the aftermath of crisis there is a sustained increase in the spread between lending and deposit rates.*

Facts (iii)-(v) suggest the following transmission mechanism. When the crisis hits, both the interest rate and the spread jump. While large and T-firms are able to shift away from bank credit to other forms of external finance, small and N-firms are not. This results in a deterioration of the banks' credit pool, which in turn feeds back into a higher spread. The outcome is a protracted credit crunch, during which increases in the stock of outstanding bank credit reflect mostly 'evergreening' rather than fresh loans. Along this path the T-sector may initially suffer a mild and short-lived decline, after which it will grow rapidly. The upshot is that the N/T ratio will decline even though aggregate GDP increases.

In order to construct a theoretical explanation it is important to determine which components of GDP drive the typical boom-bust cycle. Is a twin crisis typically preceded by a consumption boom or an investment boom? Is there a big fiscal expansion and/or a current account deterioration before a crisis? We find that

(vi) *Investment is the component of GDP that exhibits by far the largest (and statistically significant) deviations from tranquil times, while consumption deviations are very mild and insignificant.*

To discriminate among models it is also important to know whether crises are self-fulfilling or are generated by a large exogenous shock. It is difficult to determine whether a large exogenous shock was present. We looked after the usual suspects and we find that:

(vii) *There is no significant deterioration in either the terms of trade or the US interest rate in the year prior to the crisis.*

Stylized facts (i)-(vii) complete our description of a boom-bust cycle. The question we address next is whether the properties of the boom-bust cycle vary across exchange rate regimes. In particular, is it true that only counties with fixed exchange rates experience boom-bust cycles? We find that

(viii) *The boom-bust cycle under fixed exchange rates is not significantly different from the cycle under non-fixed regimes.*

It is interesting to note that during the 1980s and 1990s the US does not experience the boom-bust cycle we have described. To make this clear Figure 9 depicts the evolution of key macro variables for Mexico and US. It is evident that the US has experienced neither pronounced asymmetrical sectorial patterns nor dramatic swings in the evolution of credit and the real exchange rate. In contrast, the evolution of Mexico exhibit a dramatic boom-bust cycle. Below we will make more comparisons between Mexico and the US.

Lending Booms

Next, we shift our attention from cycles to lending booms in order to emphasize that although almost every crisis has been preceded by a lending boom, not all lending booms end in crisis. To the contrary:[3]

[3] This fact has been established by Gourinchas et. al. (2001).

(ix) *The typical lending boom does not end in crisis, but with a 'soft landing.'*

In our sample the probability that there is a crisis in a given country-year, conditional on a lending boom, is around 6%. Soft landings suggest that not all lending booms reflect either excessive risk taking or cronism. Instead, they may be a symptom of a less malignant process. The fact that bank credit is the only source of external funds for a big set of agents in the economy implies that many agents are not able to exploit all investment opportunities. Instead, their investment is mainly determined by collateral values. In this world lending booms are episodes during which borrowing constraints are eased.

The question then arises as to what determines the timing of a lending boom. Perhaps these episodes follow structural reforms that improve the long run prospects of a country. To address this issue we consider the financial liberalization date as a proxy for the timing of such reforms. We find that in our set of countries:

(x) *A financial liberalization is typically followed by a lending boom.*

The previous two facts suggest that financial liberalization, and the reforms that typically go with it, make the future look brighter than the present. In anticipation, credit constrained agents try to expand capacity to satisfy that increased future demand for their products and services. The implied deficits are frequently financed by foreign capital inflows from abroad, which are channeled to domestic agents through the domestic banking system. Why aren't these flows taking place through the equity or bond markets? Because there are enforceability problems and domestic banks typically enjoy systemic bailout guarantees (implicit or explicit). Certainly, very large firms and those in the tradables sector can access world capital markets. However, this is not true for the majority of firms operating in the economy.

2.1. Movements in Macro Variables Around Twin Crises - An Event

2.2. Study

The figures below show the average behavior, across a set of countries, of several macroeconomic variables around twin currency and banking crises. We consider all middle income countries with per-capita income between $1,000 and $30,000 over the period 1980-1999.[4] Index t in the figures refers to the year during which a

[4]The patterns in the event windows we present below are basically the same as the patterns that would arise if we were to consider a subset of countries that have experienced well known

twin crisis takes place (we say that there is a crisis at t if a currency and a banking crises occur during year t, or one occurs at t and the other at $t+1$). The graphs below are the visual representations of the point estimates and standard errors from regressions in which the respective variable in the graph is the dependent variable, regressed on time dummies preceding and following a crisis. The panel data estimations account for differences in the mean, by allowing for fixed effects, as well as for differences in the variance, by using a GLS estimator. The heavy line represents the average deviation relative to tranquil times. The thin lines represent the 95% confidence interval.

Figure 1 shows that during the year prior to the crisis the typical economy in our set of countries experiences a 5% appreciation relative to tranquil times, and this is statistically significant.

Figure 2 illustrates the existence of a lending boom in several different ways. Panels (a)-(b) refer to the stock of real credit: during the two years prior to the crisis its growth rate is significantly higher than during tranquil times (around 3%), and its level is significantly above the Hodrik-Prescott trend[5]. Panels (c)-(d) show that the same behavior is exhibited by the credit-to-GDP and the credit-to-deposits ratios.

When twin crises hit there is an average real depreciation of around 16% relative to tranquil times (which is statistically significant). Real credit growth declines back to the growth rates that are observed during tranquil times, after being above the tranquil time mean in $t-1$ and $t-2$. The lending boom thus comes to an end in the year of the crisis.[6]

Let us consider now what happens in the aftermath of crisis. As we can see in Figure 3, both during and the year after the crisis the growth rate of GDP is approximately 5% below its level during tranquil times (panel a). The growth rate starts recovering at $t+2$ and it attains its tranquil time mean growth rate by $t+3$. Adding the average GDP growth during tranquil times of 2.8%, it follows

crises: Argentina, Brazil, Chile, Indonesia, Finland, Korea, Malaysia, Mexico, Phillippines, Sweden and Thailand.

[5] The deviation of the HP-trend is not exactly equal to zero on average for all countries. Therefore, to be more precise, the graph shows the "deviation from the average deviation from the HP-Trend during tranquil times". However the later is close to zero in most countries.

[6] Two comments are in order. While the growth rates are easily comparable across countries, the levels are not due to different long term trends, structural breaks, etc. The HP-trend is therefore a trend corrected proxy for the levels. Second, the fact that the HP deviations are positive at t may reflect the 'evergreening effect.'

that the recession lasts only for 2 years (t and t+1). Looking at deviations from an HP-trend tells the same story (panel b).

Figure 2 shows that in the year after the onset of the crisis credit falls more severely than aggregate GDP. The puzzling fact is that the 'credit crunch' becomes more severe through time: the credit-to-deposits and credit-to-GDP ratios decline monotonically. Even by $t + 3$ there is no sign of a reversal of the credit crunch. In fact, at $t + 3$ the credit-to-deposits ratio becomes significantly lower than its tranquil time's level! Put another away, from the onset of the crisis until $t + 3$ GDP experiences a cumulative growth rate loss of 13%, while the cumulative loss in real credit is about 30%. It is interesting, though, that not all of the financial deepening gains made during the boom are lost during the bust, as suggested by the behavior of the credit-to-GDP ratio.

Figure 4 looks at the ratio of N-goods to T-goods production. As we can see, prior to the crisis the N/T ratio is significantly above its tranquil times level, while in the aftermath of the crisis the N/T ratio follows a declining path, and it becomes significantly lower than its tranquil times level by t+3. Interestingly, this path is quite similar to that followed by the credit-to-deposits ratio in Figure 2.

We proxy N-sector and T-sector production with data for construction, manufactures and services. Since the price of N-goods tracks international prices less closely than that of T-goods, for each country we classify as N(T) sectors in which the sectorial real exchange rate varies the most(the least). Construction is never classified as a T-sector, while for services and manufacturing the choice between N and T varies across countries.[7]

Figure 5 exhibits the behavior of the spread for a set of 11 countries for which we have good data[8]. The figure shows that when the crisis hits, there is an upward jump in the spread between lending and deposits rates. Moreover, the spread remains significantly higher 3 years after the onset of the crisis.

Figure 6 looks at the behavior of GDP's components relative to tranquil times. Investment exhibits a significantly higher growth rate of 2-3% during the three

[7] The N-sector is proxied by construction in 17 countries, by services in 22 countries and by manufacturing in 5 countries. The T-sector is manufacturing in 39 cases and services in 5 cases. We consider that the criterion we use captures better the concept we want to measure than the exports-to-production ratio. In any case the results are robust to changes in the definition of non-tradables, as for most countries both indicators coincide.

[8] Argentina, Brazil, Chile, Indonesia, Finland, Korea, Malaysia, Mexico, Phillippines, Sweden and Thailand.

years prior to a crisis and a lower growth rate of 1-2% during $t+1$, $t+2$ and $t+3$. For consumption, there is neither an increase before the crisis, nor a decrease after the crisis. Government expenditure is not significantly different, except for the year of the crisis and in $t+2$, when it is significantly higher. Lastly, exports are not significantly different from tranquil times in the build up, but clearly are above in the aftermath of a crisis. This pattern is consistent with our previous observation that the T-sector suffers less after the crisis than the N-sector.

Figure 7 addresses the question of whether crises are caused by 'big exogenous shocks.' It shows that both at t and at $t-1$ the terms of trade and the US interest rate are not significantly different than their tranquil times means. Of course, there might be other exogenous shocks that rock the boat. The point is that neither the terms of trade nor the US interest rate can be invoked to explain the occurrence of crises. Furthermore, to the best of our knowledge, no one has yet identified any exogenous shock as the cause of well know crises, such as the Tequila or Asian ones.

In order to investigate whether the boom-bust cycles are dependent on whether the exchange rate regime is fixed, we break our set of countries into two groups: fixed and non-fixed. There are two ways to make this classification: de jure and de facto. Figure 8 shows the event windows corresponding to the de facto classification by Levy-Yeyati and Sturzenegger (2000).[9] Although there are differences in the details, all of the variables display patterns that are broadly similar between the two groups of countries, both before and after the crisis.

Figure 9 present the evolution of key variables for Mexico and the US. Here we choose the period 1989 to 1999 for Mexico and 1986 to 1996 for the United States, as the early 1990s are often argued to have been characterized by a credit crunch in the US. We find that the behavior of the main variables around the 1994 crisis in Mexico and the 1991 recession in the US are fundamentally different. In particular, asymmetric sectorial patterns are evident in Mexico, while not in the US.[10] A common feature is that real GDP recovered quickly in both countries.

To see whether lending booms typically end with a 'soft landing,' not in a crash, we cannot center the analysis around a crisis as we have done so far. Instead, we need to consider all country/years and define what we mean by the beginning of

[9] If we used instead a de jure clasification, the graphs would be qualitatively the same as those in Figure 8. In fact, for most countries in our sample de jure and de facto indicators coincide. A notable exception is Mexico 1994, which was fixed de facto, but not fixed de jure.

[10] In these graphs, tradable output in both countries is proxied by manufacturing and non-tradable output is proxied by construction.

a lending boom. There are several ways in which this can be done. We will say that a lending boom starts at t if real credit grows by more than 10% per year during t and $t+1$. Figure 10 depicts the typical lending boom. Panel (a) shows that if a boom starts at t, credit growth will be significantly above the HP trend for 6 years. Furthermore, after an initial buildup phase, credit growth starts to gradually decelerate at $t+4$ and it lands softly to its trend by $t+6$. Panel (b) shows that the same pattern arises if we look at real credit growth rates. In this case the duration of the boom is somewhat shorter but also fades out gradually.

Another way of investigating whether there is a soft landing is to look at conditional probabilities of crises and booms as we do in Table 1. Take the case in which a lending boom is a pair of country-years in which credit grows by 20% or more. Table 1 shows that crises tend to be preceded by booms: $p(lb|cr) = 82\%$. However, the converse is not true: if a boom starts at t, the probability of a crisis in either $t+2$ or $t+3$ is approximately $p(cr|lb) = 6\%$. This is a rather small number, although relatively much bigger than the probability of a crisis in tranquil times, which is 3.7%.

To see whether financial liberalization is typically followed by a lending boom we use the liberalization dates of Bekaert et. al. (2001), and follow a similar procedure as in Figure 10. Panel (a) in Figure 11 shows that the growth rate of credit is significantly above its tranquil time mean for 5 years after liberalization. Panel (b) shows that starting the third year after liberalization the deviation of real credit from its HP trend becomes significantly positive.[11]

3. Co-movements

The event windows clearly show that around twin crises key macro variables behave significantly different from tranquil times. Together they characterize the boom-bust cycle. Here we ask whether these patterns have been reflected in statistically significant co-movements among some variables during the last two decades. For instance, does credit growth commove with the real exchange rate and the N/T ratio? Does it commove with investment and GDP? We address this question by regressing real credit growth on several variables. The panel data es-

[11] Since financial liberalization constitutes a structural break in the series, the interpretation of tranquil times is less clear. However for our purposes the dynamic pattern is relevant and the increase of credit after liberalization is clear regardless of the mean credit growth that exisits in the years not covered by the dummies in the regression.

timation is implemented allowing for fixed effects and a GLS estimator.[12] Again, we have our set of 44 countries in the cross section dimension and the period 1980-1999 in the time series dimension.

The first regression in Table 2 shows that an increase in credit is associated with (i) a real appreciation and (ii) an increase in the ratio of nontradables-to-tradables output. It is remarkable that these partial correlations are significant at the 1% level. Correlation (i) indicates that there exist 'balance sheet effects': in the presence of a currency mismatch, a real appreciation deflates the debt burden. This increases cash flow and the ability to borrow. Correlation (ii) indicates that the N-sector is more 'credit-constrained' than the T-sector.

We also find that investment growth is statistically significant, but GDP growth is not. Interestingly, GDP enters the regression with a negative sign. This reflects the puzzle we have noted earlier: in the aftermath of crisis a credit crunch coexists with a recovery of aggregate GDP. To investigate this further we define the interaction term $GDP * Dummy$, where the dummy is equal to one in the period of the crisis, and the following three periods, while it is equal to zero otherwise. Regression 4 shows that $GDP * Dummy$ enters with a negative sign and is statistically significant, while GDP enters positive, but remains insignificant. As the sum of the two coefficients is clearly negative, credit and GDP are negatively correlated in the aftermath of crisis, while there exists no statistical relationship that adds to the information provided by investment, the real exchange rate and N/T, otherwise. Regression 5 shows that if GDP and $GDP * Dummy$ are included without investment, the coefficient on GDP is positive and the one on the interaction dummy is negative. Both are significant.

It is likely that the some of the explanatory variables are endogenous. In order to test for the robustness against the simultaneity problem, we estimated the model with two stage least squares, rather than OLS, using lagged variables as instruments. This yielded qualitatively similar results. Also, in the appendix we report a number of alternative specifications, where the key variables (N/T and p) prove to be very robust.[13]

The fact that a simple regression reveals the co-movements we have alluded to above is noteworthy. These correlations, of course, cannot be interpreted as

[12] All variables are in first differences in oder to avoid the issues associated with non-stationarity.

[13] A further issue is the apparent presence of serial correlation in the error terms as reflected in the low value of the Durbin Watson test statistics. We will deal with this issue in the VAR section.

causal relations. In order to provide a structural interpretation it is necessary to have a model. In the next section we will present such a model. Then we will use the identifying restrictions implied by the model to estimate a structural VAR Model for Mexico and the US.

4. Model

To account for the stylized facts described in Section 2 we will build on Schneider and Tornell (2000) to construct a 'boom-bust equilibrium.'[14] We consider a two-sector finite horizon economy. There are two goods: an internationally tradable (T) good, which is the numeraire, and a nontradable (N) good. We will denote the inverse of the real exchange rate by $p_t = \frac{p_{N,t}}{p_{T,t}}$.

The only source of uncertainty is endogenous real exchange rate risk. In equilibrium p_{t+1} might equal $\overline{p}_{t+1}$ with probability α or $\underline{p}_{t+1}$ with probability $1-\alpha$. The absence of fundamental uncertainty is consistent with the the fact that large exogenous shocks have typically not preceded twin crises.

There is no money in this economy, as it is not necessary for any of the mechanisms we described earlier. Furthermore, the fact that the boom-bust cycle does not differ across exchange rate regimes indicates that a real model is appropriate. We will refer to 'twin crises' as a situation where a banking crisis coincides with a drastic real depreciation.

In the model only N-sector agents may be subject to credit constraints. This captures the fact that in middle income countries T-sector firms have easy access to external finance because they can either pledge export receivables as collateral, or can get guarantees from closely linked firms. In contrast, collateralized bank credit is practically the only source of external finance for small and N-sector firms.

4.1. The N-Sector

We consider nontradables producing firms that face credit constraints and their creditors enjoy bailout guarantees.[15] It is a common theme in the literature that

[14] There is a large literature that analyzes several aspects of the boom-bust cycle. See for instance, Aghion, Bacchetta and Banerjee (2000), Burnside, Eichenbaum and Rebelo (2000), Caballero and Krishnamurthy (1999), Calvo (1998), Corsetti, Pesenti and Roubini (1999), Krugman (1999) and Mckinnon and Pill (1998).

[15] One can interpret these firms as banks that specialize in lending to the N-sector.

financing constraints arise if firms are run by insiders whose interests conflict with those of other claimholders.[16] Here we follow Schneider and Tornell (2000) and think of a firm as being run by overlapping generations of myopic managers, who can divert funds to their own benefit, and default strategically.

There is a continuum of managers of measure one. The representative manager begins period t with internal funds w_t, and raises an amount $B_t = b_t + b_t^n$ by issuing one-period bonds that pay off in T-goods and N-goods, respectively. The promised repayment is

$$L_{t+1} + p_{t+1} L_{t+1}^n = (1+\rho_t) b_t + p_{t+1}(1+\rho_t^n) b_t^n \tag{4.1}$$

We allow the firm to choose between debt denominated in either T-goods or N-goods in order to address the question of when it is that agents will issue risky 'foreign currency' debt.[17]

A manager can use his investable funds to buy a riskless international bond (s_t) with a return $1+r$, or he can buy an ammount I_t of N-goods to produce N-goods according to a linear production technology[18]

$$q_{t+1} = \theta I_t \tag{4.2}$$

Since b_t and b_t^n are measured in T-goods, the budget constraint is

$$p_t I_t + s_t = w_t + b_t + b_t^n \tag{4.3}$$

At time $t+1$ a firm's cash flow in terms of T-goods is

$$\hat{\pi}(p_{t+1}) := p_{t+1}\theta I_t + (1+r)s_t - L_{t+1} - p_{t+1} L_{t+1}^n \tag{4.4}$$

We introduce bankruptcy costs by assuming that if a firm is insolvent (i.e., $\hat{\pi}(p_{t+1}) < 0$), all returns are dissipated in the bankruptcy procedure.

Credit Constraints

[16] See Bernanke, Gertler and Gilchrist (2000).

[17] In several middle income countries banks borrow from abroad to finance N-sector firms. Furthermore, they typically *over-expose themselves to the N-sector and do not hedge the implied real exchange rate risk.* Even when banks denominate loans in foreign currency, they face the risk that domestic firms will not be able to repay in the event of a real depreciation.

[18] The fact that N-goods are produced using N-goods will be key in generating self-fulfilling twin crises.

In order to generate a credit constraint we assume that a manager can set up a diversion scheme by incurring a cost proportional to investable funds: $h[w_t + b_t + b_t^n]$, and that lenders only finance plans that do not lead to diversion. Since the goal of every manager is to maximize next period's expected profits net of diversion costs, the plans that are financed are those where the expected debt repayment is no greater than the diversion cost. Thus, the *credit constraint* is

$$L_t E_t\left[\zeta_{t+1}\right] + L_{t+1}^n E_t\left[\zeta_{t+1} p_{t+1}\right] \leq h[w_t + b_t + b_t^n], \tag{4.5}$$

where $\zeta_{t+1} = 1$ indicates that the firm is solvent (i.e., $\hat{\pi}(p_{t+1}) \geq 0$). The parameter h can be interpreted as a measure of the severity of the contract enforceability problem, with a low h representing lax contract enforcement. Notice that if h were smaller than $1 + r := \beta^{-1}$, there would be no enforceability problem because it would always be cheaper to repay debt rather than to divert. Since we are interested in firms that face financing constraints, we assume:

$$\beta h < 1 \tag{4.6}$$

Bailout Guarantees

Typically, countries have two types of bailout guarantees in place: 'unconditional' and 'systemic'. With the former, bailouts are granted whenever there is an individual default, like a deposit insurance scheme. In contrast, with the latter, bailouts are granted only if a critical mass of agents defaults, as during a systemic crisis. Note that if all debt were covered by unconditional guarantees, credit constraints could not arise in equilibrium. It would not make sense for lenders to care about (4.5) because they would be bailed out in all states of the world. Thus, some portion of debt must only be covered by systemic bailout guarantees.

In the model we assume that all guarantees are systemic. In particular, a bailout occurs if and only if more than 50% of firms are insolvent ($\hat{\pi}(p_{t+1}) < 0$) in a given period. During a *bailout* an international organization pays lenders a fraction $F \in \{0, 1\}$ of the outstanding debts of all defaulting managers, regardless of debt-denomination (N- or T-goods).

Sequence of Actions

At the beginning of period t every new manager starts with internal funds w_t in terms of T-goods. All managers simultaneously announce a plan $(I_t, s_t, b_t, b_t^n, \rho_t, \rho_t^n)$ that satisfies budget constraint (4.3). All lenders then simultaneously decide whether to fund the plan proposed to them. During $t + 1$ lenders receive the debt repayments of solvent non-diverting managers. In the case that more than half of the managers default, a bailout occurs. The lenders then receive a fraction F of the outstanding debt. Each (now old) manager pays out a fixed fraction c of profits as dividends to himself and passes on the remainder to the next manager. We assume that whenever there is bankruptcy, the new cohort of managers receive an 'aid payment' e to jump start their firms. Thus, internal funds evolve according to $w_0 = e_0$, and for $t \geq 1$:

$$w_t = \begin{cases} [1-c]\hat{\pi}(p_t) & \text{if } \hat{\pi}(p_t) > 0 \\ e & \text{otherwise} \end{cases} \tag{4.7}$$

We assume that in period 0 there is both a cohort of initial incumbent managers who have an amount q_0 of nontradables to sell and a cohort of new managers who have an endowment e_0 in terms of tradables.

4.2. The T-sector

The N-sector will take center stage in the model. For our purposes it is sufficient to think of the T-sector as a group of agents that demands N-goods (D_t) and produces tradable goods (q_t^{tr}). What is important for the argument is that the demand function for N-goods be downward-sloping and that it be expected to increase at some point in the future. We assume that $D_t(p_t) = \frac{d_t}{p_t}$. Thus, the market clearing condition for non-tradables is

$$\frac{d_t}{p_t} + I_t = q_t^n. \tag{4.8}$$

where I_t is the investment demand from the new cohort of managers. The supply of T-goods q_t^{tr} will play no role in the model. In fact q_t^{tr} will only appear in Section 5 when we refer to the gross domestic product: $GDP_t = q_t^{tr} + p_t q_t^{nt}$. In particular, it is not necessary that q_t^{tr} be decreasing in p_t to link the model to the facts in Section 5. We thus assume that q_t^{tr} follows a linear trend: $q_t^{tr} = \varepsilon q_{t-1}^{tr}$, where ε is an arbitrary constant.

4.3. Road Map

In order to rationalize the stylized facts it is essential that binding borrowing constraints and risky debt denomination emerge in equilibrium. There must also be a time interval during which the real exchange rate can take on one of two possible values: one that leads to widespread defaults, and another under which firms are solvent. Third, prior to a crisis the lending boom must coincide with a real appreciation and fast growth of the N-sector, while in the aftermath of a crisis a worsening credit crunch must coincide with a declining N/T ratio. Lastly, the typical lending boom must end with a soft landing: the likelihood of crisis must be small or zero.

We derive symmetric equilibria in two steps. First, we take current prices (p_t) and expected future prices (${}_t\bar{p}_{t+1}$, ${}_t\underline{p}_{t+1}$) as given and characterize equilibria within a given period. In subsection 4.4 we show that if there is enough price risk then credit constraints will bind and managers will choose T-debt. In subsection 4.5 we take as given the existence of T-debt and ask whether p_t can take on two values, so that twin crises can occur.

In the second step we ask whether there is a self-validating price process that supports these mechanisms. We show that if the future looks brighter than the present and if there are strong balance sheet effects, there can be 'boom-bust equilibria.'

4.4. Risky Debt Denomination

In order to determine how a cohort of managers will denominate debt, we consider first the problem of an individual manager who takes current prices (p) and expected future prices ($\bar{p}, \underline{p}$) as given, and who expects that a bailout will be granted next period in the bad state (i.e., $p' = \underline{p}$), but not in the good state (i.e., $p' = \bar{p}$). We will temporarily assume that there is 'enough' expected real exchange rate risk:

$$\frac{\theta p^e}{p} \geq 1 + r \ > h > \frac{\alpha \theta \underline{p}}{p} \tag{4.9}$$

where p^e denotes the expected future price of N-goods: $p^e_{t+1} := \alpha_t \bar{p}_{t+1} + (1-\alpha)_t \underline{p}_{t+1}$. In subsection 4.6 we will determine the conditions under which (4.9) is satisfied.

First of all, the manager will choose to invest if and only if the production of N-goods is a positive NPV activity: $\frac{\theta p^e}{p} \geq 1 + r$. Otherwise, the manager will simply buy default-free bonds and the credit constraint will not bind.

Let us consider now the optimal debt denomination: will the manager choose T-debt or N-debt? The incentives to choose risky T-debt derive from the fact that in the bad state the bailout agency will pay part of the debt obligations of those firms that go bust. Since lenders must break even, switching from N to T debt reduces the expected debt repayment. This is a subsidy!

Since there are no exogenous shocks, the only way to go bust at $t + 1$ is to adopt a '*risky*' plan by issuing enough T-debt at t. Clearly, this requires that the bad state price be low enough so that $\hat{\pi}(\underline{p}) < 0$.This is ensured by the third inequality in (4.9).

The manager then has to choose between a '*safe*' plan that never leads to insolvency ($\hat{\pi}(\bar{p}) \geq 0$, $\hat{\pi}(\underline{p}) \geq 0$), and a '*risky*' plan that leads to bankruptcy in the bad state ($\hat{\pi}(\bar{p}) \geq 0 > \hat{\pi}(\underline{p})$). To see which plan is preferable let us determine the cost of capital and the investment level that can be attained under each plan. If the manager were to choose a safe plan, he would never go bust. Since lenders must break even, the interest rates that he would have to offer are

$$1 + \rho = 1 + r \qquad \text{and} \qquad 1 + \rho^n = \frac{1 + r}{p^e} \tag{4.10}$$

If $\frac{\theta p^e}{p} \geq 1 + r$, it is optimal to denominate all debt in N-goods ($b = 0$) and to invest as much as possible: $pI = w + b^n$. In this case credit constraint (4.5) will bind: $p^e(1 + \rho^n)b^n = h(w + b^n)$. Hence, we obtain the well known result that investment of a credit constrained firm depends not only on the rate of return, but also on cash flow (with our linear structure, the rate of return enters only through the positive NPV condition):

$$pI^s = m^s w := \frac{1}{1 - \beta h} w \quad \text{iff} \quad \frac{\theta p^e}{p} \geq 1 + r \tag{4.11}$$

Under a risky plan the firm goes bust in the bad state. However, since there are systemic bailout guarantees, the interest rates he has to offer are still given by (4.10). If (4.9) holds, the manager finds it optimal to denominate all debt in T-goods ($b^n = 0$), and to invest as much as possible: $pI = w + b$. As a result the borrowing constraint binds: $\alpha(1 + \rho)b = h(w + b)$, and investment expenditure is given by

$$pI^r = m^r w =: \frac{1}{1 - \beta h \alpha^{-1}} w \quad \text{iff} \quad (4.9) \text{ holds} \tag{4.12}$$

We can now see that in the presence of generous bailout guarantees the manager might select a risky plan and denominate all debt in T-goods. By doing so, he reduces the cost of capital from $1 + r$ in a safe plan to $\alpha(1 + r)$. Furthermore, since expected debt repayment falls, the borrowing constraint is eased and investment increases relative to a safe plan ($I^r > I^s$). The downside of a risky plan is that it entails a probability $1 - \alpha$ of bankruptcy. Clearly, if crises are rare events ($\alpha > \underline{\alpha}$), the benefits outweigh the bankruptcy costs, and risky plans are preferred to safe ones.[19] In contrast, in the absence of bailouts (i.e., $F = 0$ or $\alpha = 1$), the manager will select a safe plan because the two benefits associated with risky debt disappear.

In order to determine the equilibrium plans recall that bailouts are granted only during a 'systemic' crisis. Thus, as long as nobody expects a bailout, everybody hedges, and a crisis – and hence a bailout – cannot occur. In other words, a safe symmetric equilibrium always exists. This is independent of whether the real exchange rate is variable or not. However, in a world with bailout guarantees there is also a risky symmetric equilibrium. Indeed, suppose that a manager believes that all other managers will undertake risky plans. He will conclude that a bailout will occur in the bad state. Thus, he will take on real exchange rate risk and go bankrupt in the bad state, along with all other managers, triggering a bailout.

4.5. Twin Crises

Here we determine the conditions under which a risky debt structure can generate real exchange rate risk. We assume that (4.9) holds, that incumbent managers enter the current period with a supply of nontradables q_t, no bond holdings ($s = 0$) and a debt burden $L_t + p_t L_t^n$. The new cohort chooses its plans taking as given the value of the internal funds they get from incumbents and future prices.

As long as incumbents are solvent, internal funds are $w_t = (1 - c)\hat{\pi}_t$, where $\hat{\pi}_t = p_t \theta I_t - L_t - p_t L_t^n$. In contrast, if the bad state is realized and firms become insolvent, the new cohort starts out with an endowment e of T goods. Investment expenditure is thus

$$p_t I_t = \begin{cases} \eta_t [p_t q_t - L_t - p_t L_t^n] & \text{if } p_t q_t \geq L_t + p_t L_t^n \\ m_t e & \text{otherwise} \end{cases} \tag{4.13}$$

where the *cash flow multiplier* η_t is defined by $\eta_t := (1 - c) m_t$. In a temporary equilibrium the real exchange rate equalizes total demand and the (predetermined) supply of nontradables: $D(p_t) = q_t$. Since the T-sector's demand for non-tradables

[19] Expected profits under risky and safe plans are $\Pi^r = \frac{\alpha \overline{p} \theta p^{-1} - h}{1 - \beta h (1 + \frac{1-\alpha}{\alpha} F)} w$ and $\Pi^s = \frac{p^e \theta p^{-1} - h}{1 - \beta h} w$, respectively.

is equal to d_t/p_t,

$$D(p_t) = \begin{cases} \frac{d_t}{p_t} + \eta_t \left[q_t - \frac{L_t}{p_t} - L_t^n \right] & \text{if } p_t q_t \geq L_t + p_t L_t^n \\ \frac{d_t + m_t e}{p_t} & \text{otherwise} \end{cases} \tag{4.14}$$

Since supply is given ($q_t = \theta I_{t-1}$), the key to having multiple equilibria is a backward bending aggregate demand curve, as in Graph 1. This is impossible if incumbent managers have only N debt ($L_t = 0$). However, multiple equilibria are possible if incumbents have T-debt on the books (and $L_t^n = 0$). In this case price movements affect revenues, but keep the debt burden unchanged. It thus becomes important to distinguish between insolvent and solvent firms. For prices below the cutoff price $p_t^c = \frac{L_t}{q_t}$, all N-firms go bankrupt. Total demand in this range is downward sloping. In contrast, for prices above p_t^c, investment demand is *increasing* in price. This will make total demand 'bend backward' and cross the supply schedule twice (as in Graph 1) if and only if

$$L_t > d_t + m_t e \qquad \text{and} \qquad \eta_t > 1 \tag{4.15}$$

A 'strong balance sheet effect' ($\eta_t > 1$) means that an increase in N-sector's cash flow induces a more than proportional increase in the N-sector's expenditure on its own goods. As we shall see, $\eta_t > 1$ is not only necessary for self-fulfilling crises, but it is also key for the existence of lending booms. To ensure that $\eta_t > 1$ for all t we assume

$$c < \beta h \tag{4.16}$$

With identical fundamentals, in terms of supply and debt, the market may clear in one of two equilibria. In a 'solvent' equilibrium (point B in Graph 1), the price is high, inflating away enough of firms' debt (measured in nontradables) to allow them to bid away a large share of output from the T-sector. In contrast, in the 'crisis' equilibrium of point A, the price is low to allow the T-sector and bankrupt N-firms with little internal funds to absorb the supply of nontradables. Which of these two points is reached depends on expectations. Fundamentals determine only whether the environment is fragile enough to allow two equilibria.

4.6. Equilibrium Dynamics

We have seen that *anticipated* endogenous price risk can induce managers to take on enough T-debt for such risk to *actually* arise, provided there is a strong balance sheet effect and internal funds are high enough. In order for this self-feeding mechanism to be part of an equilibrium along which self-fulfilling crisis are rationally anticipated, we need to construct *a set of beliefs about future market clearing prices* such that the resulting distribution of returns encourages firms to issue enough T-debt to validate the price process.

In this subsection we will construct a boom-bust equilibrium (BBE) along which a crisis can occur with probability $1-\alpha$ during any period. Along this BBE managers select risky plans from time 0 until a crisis occurs at some time τ. If a crisis occurs, internal funds become too small to sustain another risky path, so managers choose safe plans from time τ on. If a crisis does not occur along the risky path, managers shift to a safe path at $T-1$. This is because there cannot be a crisis in the final period as firms do not reinvest at T.

First of all, in order to have a lending boom it is necessary that N firms will be able to repay their debts at time T in case a crisis, and hence a bailout, does not take place. This requires that the N-sector's future looks sufficiently bright relative to the present. We capture this by assuming that at time T there will be an outward shift in the demand for N-goods by the T-sector (d_t/p_t), and this is known by all agents as of time 0 :

$$d_t = \begin{cases} d & \text{if } t < T \\ \hat{d} \; > d & \text{if } t = T \end{cases} \tag{4.17}$$

This future shift in d_t can represent a T-sector expansion after a transition period following a trade reform or the discovery of a natural resource.

Given that (4.17) holds, consider a typical period $0 < t < T-1$ during which all inherited debt is denominated in T goods and agents believe that at $t+1$ there will be a crisis with probability $1-\alpha$. Since in the good state in period t firms are solvent, internal funds are given by $\overline{w}_t = (1-c)\left(\overline{p}_t q_t - L_t\right)$. Since the debt burden equals $(1+r)b_{t-1} = \alpha^{-1} h m^r w_{t-1}$ and output is $q_t = \theta I_{t-1} = \frac{\theta m^r w_{t-1}}{p_{t-1}}$, it follows that any equilibrium path of N-output and internal funds (q_t, w_t) must be a solution to

$$q_t = \theta \frac{m^r w_{t-1}}{m^r w_{t-1} + d} q_{t-1} \qquad t \leq T \tag{4.18}$$

$$w_t = \frac{\eta^r h \alpha^{-1}}{\eta^r - 1} w_{t-1} - \frac{(1-c)d}{\eta^r - 1}, \qquad t < T \tag{4.19}$$

with initial conditions q_0 and $w_0 = e_0$, and where $\eta^r = (1-c)m^r = \frac{1-c}{1-\alpha^{-1}h\beta} > 1$ is the risky cash flow multiplier. The solution to (4.18)-(4.19) determines the 'lucky path,' along which no crisis occurs. The paths of high and low prices associated with the lucky path are:

$$\bar{p}_{t+1} = \frac{d + m^r w_{t+1}}{q_{t+1}} \quad \text{and} \quad \underline{p}_{t+1} = \frac{d + m^s e}{q_{t+1}} \qquad 1 \leq t < T \tag{4.20}$$

The lucky path is part of a BBE provided that along this path agents expect: (i) a sufficiently low price during a crisis, so that it is possible to claim the bailout subsidy by defaulting ($\hat{\pi}(\underline{p}_{t+1}) < 0$); (ii) a sufficiently high return on investment in the absence of a crisis ($\theta \bar{p}_{t+1}/p_t > 1 + r$), and (iii) a sufficiently low probability of a crisis ($\alpha > \underline{\alpha}$), which ensures that the ex-ante expected return is high enough and credit constraints bind ($\theta p^e_{t+1} > (1+r)p_t$).

Since during a crisis, internal funds of the new cohort are $\underline{w}_{t+1} = e$, $\hat{\pi}(\underline{p}_{t+1}) < 0$ is equivalent to

$$\underline{p}_{t+1} q_{t+1} - L_{t+1} = d + m^r e - (1+r)w_t < 0 \tag{4.21}$$

Clearly, $\theta \bar{p}_{t+1}/p_t$ is high enough provided investment demand grows sufficiently fast relative to supply. Since tomorrow's supply is determined by today's investment, tomorrow's investment must grow fast enough. But, since borrowing constraints bind, this can only happen if internal funds grow fast enough. How can we ensure this will happen? It is apparent from (4.19) that if w_t is increasing over time, it will do so at an increasing rate. Thus, if initial internal funds e_0 are above a certain threshold and α is large enough, investment will have a positive NPV for all $t < T - 1$ provided, of course, that investment is profitable at $T - 1$.[20]

Since at terminal time there is no investment, the T-sector must absorb all N-

[20] Algebraically, $\theta p_{t+1}/p_t = [d + m^r w_{t+1}]/p_t I_t$. Thus, investment is profitable when $[d + m^r w_{t+1}]/m^r w_t > 1 + r$. This holds for all $t < T - 1$ if $w_0 = e_0$ is above a certain threshold because w_{t+1}/w_t is increasing in w_t (by (4.19)).

production. Thus, $p_T = \hat{d}/q_T$. This means that investment at $T-1$ is profitable only if the T-sector's demand shift at terminal time (from d to $\hat{d}$) is large enough. Since managers choose safe plans at $T-1$, the positive NPV condition is equivalent to $\hat{d} > m^s(1+r)w_{T-1}$. Clearly, if $\hat{d}$ were not high enough, there would be no investment at $T-1$, and by backward induction there would be no investment throughout.

Suppose that a crisis hits at some time $\tau < T-1$. At the time of crisis internal funds collapse to e. Thereafter, managers will not find it optimal to choose risky plans, as the amount of debt that firms can issue in the aftermath of crisis is 'too small' for multiple market clearing prices to arise (i.e., fragility condition (4.15) is violated). Managers will choose safe plans and will invest in N-production if the return is high enough. Along the post-crisis path all debt will be denominated in N-goods, so the debt burden will be $p_t(1+\rho^n_{t-1})b^n_{t-1} = hm^s w_{t-1}$. Thus, N-output and internal funds evolve according to

$$\begin{array}{ll} q_t = \theta \frac{m^s w_{t-1}}{m^s w_{t-1}+d} q_{t-1} & \tau < t \\ w_t = \frac{\eta^s h}{\eta^s - 1} w_{t-1} - \frac{(1-c)d}{\eta^s-1} & \tau < t < T \\ w_T = \hat{d} - hm^s w_{T-1} & t = T \end{array} \tag{4.22}$$

with initial conditions $q_\tau = \theta I_{\tau-1}$ and $w_\tau = e$. A solution to (4.22) belongs to a BBE if the implied price path given by

$$p_t = \begin{cases} \frac{d+m^s w_t}{q_t} & t < T \\ \frac{\hat{d}}{q_T} & t = T \end{cases} \tag{4.23}$$

is steep enough to make N-production a positive NPV undertaking (i.e., $p_{t+1}\theta > (1+r)p_t$ for all $t < T$).

For the same reasons as in the risky phase, since $\eta^s > 1$, the positive NPV condition holds on $t < T-1$ and w_t follows an increasing path provided e is greater than a certain threshold.[21] Clearly, at $T-1$ the positive NPV condition holds if $\hat{d}$ is sufficiently large.

It follows that if initial internal funds are high enough ($e_0 > \underline{e_0}(d,e)$), there is a range of crisis probabilities, $(1-\alpha) \in (0, 1-\underline{\alpha}(e_0))$, for which internal funds increase over time, agents choose a risky debt structure and a crisis can occur

[21] The threshold is $\underline{e} = \max\{\hat{e}_1, \hat{e}_2\}$ where $\hat{e}_1 := \beta d/cm^s$ and $\hat{e}_2 := \left[\frac{1}{1-c} - \frac{1-h}{1-\beta h}\right]^{-1} d$.

during the next period with conditional probability $1 - \alpha$. Along the lucky path the N-sector expands, running a deficit in anticipation of strong T-sector demand in the future. Debt and investment expenditure rise over time as the N-sector issues new debt to cover the sequence of deficits. A large shift in the T-sector demand in the final period ($\hat{d} > \underline{d}(e_0, \alpha, T)$) ensures that the accumulated debt can be repaid in case no crisis had occurred by $T - 1$. In case a crisis occurs at some time τ, the economy follows a safe path thereafter. If internal funds in the aftermath of crisis are high enough ($e > \underline{e}(\tau)$), N-production will take place along the safe phase. We conclude that there is a parameter region for which a BBE exists.

5. Linking the Model to the Stylized Facts

In this section we relate the model to the stylized facts. First, we show that the evolution of our model economy along the equilibrium path resembles the typical boom-bust cycle described in Section 2. Then we estimate a structural VAR model using the restrictions implied by the model.

5.1. The Model Boom-Bust Cycle

In order to match the stylized facts it is necessary that both p_t and q_t rise along the lucky path. Although the *value* of output ($p_t q_t$) grows, p_t and q_t need not rise simultaneously. The technology parameter θ in (4.2) determines how the rise in value translates into changes in prices and quantities. If θ were very high, supply would outpace demand. As a result the price would fall over time, while investment would rise. At the other extreme, if θ were small, we could have an equilibrium along which nontradables become increasingly scarce while firms chase the returns offered by rising prices but can afford to invest less and less. To match the fact that N-sector growth coincides with a real *appreciation*, we fix θ at an intermediate value.

$$\theta \in \left(1,\ \frac{\eta^s h}{\eta^s - 1}\right) \tag{5.1}$$

Graph 2 depicts an equilibrium path followed by a model economy that satisfies (5.1). Prior to a crisis the N-sector experiences accelerating growth, while the real exchange rate appreciates. During the crisis there is a real depreciation and a meltdown of the banking system. In the aftermath of a crisis there is a deepening credit crunch alongside GDP expansion. Lastly, we can observe an asymmetric sectorial pattern: during the boom the N-sector outpaces the T-sector, while during the bust the opposite is true.

Since along the equilibrium path credit constraints bind, credit is determined by N-sector's internal funds: $b_t = (m_t - 1)w_t$.Therefore, credit follows the same path as w_t. Initially credit grows slowly, but it accelerates over time because there is a strong balance sheet effect ($\eta_t > 1$). This generates a lending boom.

A strong balance sheet effect also implies that prior to a crisis a real appreciation coincides with a lending boom. This is because an increase in p_t deflates the real value of the debt burden and increases internal funds. This in turn increases future investment demand, which leads to a higher p_{t+1} and so on. Note, however, that a strong balance sheet effect also implies that a self-fulfilling real depreciation can lead to widespread bankruptcies in the N-sector and a protracted credit crunch. If a crisis occurs at τ, the real exchange rate depreciates from $\bar{p}_{\tau-1} = \frac{d+m^r w_{\tau-1}}{q_{\tau-1}}$ to $\underline{p}_\tau = \frac{d+m^s e}{q_\tau}$, N-sector firms become insolvent and internal funds collapse to a level e. This generates a drop in investment that validates the real depreciation.

Let us define a 'credit-crunch' as a declining path of the credit-to-GDP ratio. In equilibrium GDP ($q_t^{tr} + p_t q_t^{nt}$) evolves according to $GDP_t = \varepsilon q_{t-1}^{tr} + d + m_t w_t$, and credit is given by $B_t = (m_t - 1)w_t$. Since in the aftermath of a crisis internal funds collapse ($w_\tau = e$), the growth rate of credit falls (because a strong balance sheet effect implies that w_t/w_{t-1} is increasing in w_t). On the other hand, the growth rate of tradables production remains unchanged. As a result, in the aftermath of crisis the credit-to-GDP ratio follows a declining path for a while until internal funds recover.

Note that if e is below a critical level, GDP declines at the time of the crisis. Thereafter, the recession might continue for a few more periods. However, since the T-sector continues to grow in the aftermath of a crisis, a resumption of GDP growth can coexist with a deepening credit crunch.

Two comments are in order. On the one hand, if T-production were decreasing in p_t, the severity of the credit crunch would be greater. On the other hand, if we allowed for 'evergreening,' the credit-to-GDP ratio would decline less in the aftermath of crisis.

Now consider the asymmetric sectorial pattern: the N-sector outperforms the T-sector during the boom, while the opposite is true during the bust. In the model T-output grows at a rate: $g^{tr} = \varepsilon - 1$,while the growth rate of N-output

($g_t^{nt} = \frac{q_t}{q_{t-1}} - 1$) is given by (4.18). Thus the growth differential is given by

$$g_t^{nt} - g^{tr} = \frac{\theta m_t w_{t-1}}{m_t w_{t-1} + d} - \varepsilon$$

This equation states that the fraction of N-production that is invested by the N-sector depends on the financial strength of the N-sector. If internal funds are low, N-firms can borrow very little. Holding supply fixed, weak investment demand implies that the price is low and the T-sector absorbs a large fraction of N-output. Thus, there can be an initial period during which the T-sector outpaces the N-sector. However, along the lucky path internal funds grow gradually. Thus, the N-sector is able to borrow more over time, and is able to bid a greater share of N-supply away from the T-sector. In other words, both w_t and g_t^{nt} accelerate over time. Therefore, if the boom lasts long enough, there is a time when the N-sector will start to grow faster than the T-sector.

During the crisis internal funds collapse to e. If e is below $\frac{d}{(\theta-1)m^s}$, N-output falls between τ and $\tau+1$ and $g_{\tau+1}^{nt} < 0$. Thereafter, if ε is relatively high, g_t^{nt} will remain below g^{tr} for a while until internal funds have grown sufficiently. We thus have a simple version of the asymmetric sectorial pattern that actually takes place during boom-bust cycles. Clearly, in a more complicated model, in which T-production is decreasing in p_t, the amplitude of the cycles experienced by the N/T ratio would be greater.

Finally, we would like to emphasize that the typical lending boom along a BBE ends with a soft landing. In fact the *likelihood of self-fulfilling crises is not a free parameter*. BBE exist only if the probability of crisis during a given period is small. If crises were not rare events, low ex ante returns would discourage managers from investing in the first place.

5.2. Structural VAR

In this subsection we estimate a VAR including three key macroeconomic variables of the model: bank credit (B_t), the real exchange rate (p_t^{-1}) and the ratio of nontradables-to-tradables output ($q_t^n/q_t^{tr} := N_t/T_t$).

The key point of the model is that N-sector financing is subject to contract enforceability problems and bailout guarantees. The *interaction* of these two distortions gives rise to binding credit constraints and foreign currency denominated debt. These in turn generate balance sheet effects that: (a) deflate the value of N-sector's debt during a lending boom prior to a crisis; (b) cause the meltdown of the banking system and a drastic real depreciation when a crisis hits, and (c) generate a credit crunch that especially affects the N-sector in the aftermath of a crisis. Investment in the T-sector mainly reflects investment opportunities, while investment in the N-sector is mostly determined by cash-flow (as there are credit-constraints). Thus, the N/T ratio will experience large swings over the cycle as balance sheet effects will affect N-sector cash flow.

We start by deriving a linear representation of the evolution of the variables along the equilibrium path, as well as to determining how each variable is contemporaneously affected by the others. First, N-production (q_t^n) is determined by past investment (I_{t-1}). The latter depends on B_{t-1} and p_{t-1} because in equilibrium credit constraints bind and debt is denominated in T-goods. It follows from the equilibrium output equation (4.18) that $\frac{q_t^n}{q_t^{tr}} = \frac{1}{\varepsilon}\frac{\theta m_{t-1}}{m_{t-1}-1}\frac{B_{t-1}}{p_{t-1}}$. The constant ε is the growth rate of T-production, and the investment multiplier m_t equals $[1-\alpha_t^{-1}\beta h]^{-1}$, where $\alpha_t = \alpha$ in the risky phase and $\alpha_t = 1$ in the safe phase. It follows that along the equilibrium path q_t^n/q_t^{tr} is contemporaneously affected by neither p_t nor B_t. A linear representation of q_t^n/q_t^{tr} along the equilibrium path is

$$\frac{q_t^n}{q_t^{tr}} = \beta_1 B_{t-1} + \beta_2 p_{t-1} + u_{q,t} \tag{5.2}$$

The equilibrium real exchange rate is determined by the market clearing condition for N-goods: $p_t q_t = m_t w_t + d$, where d/p_t represents T-sector's demand for N-goods, and internal funds (w_t). As long as a crisis does not occur internal funds evolve according to $w_t = (1-c)(p_t q_t^n - \alpha_{t-1}^{-1} h m_{t-1} w_{t-1})$, while during a crisis there is a meltdown and $w_t = e$. It follows that p_t equals either $\bar{p}_t = \left[\eta_t \frac{\alpha_{t-1}^{-1} h m_{t-1}}{m_{t-1}-1} B_{t-1} - d\right]\left[q_t^n(\eta_t - 1)\right]^{-1}$ or $\underline{p}_t = [m_t e + d]/q_t^n$. Therefore, along the equilibrium path p_t is contemporaneously only affected by q_t^n/q_t^{tr}. A linear representation of p_t is

$$p_t = \delta_1 B_{t-1} + \delta_2 q_t^n/q_t^{tr} + u_{p,t} \tag{5.3}$$

In equilibrium, new credit extended to the N-sector is determined by (4.5): $B_t = [m_t - 1]w_t$. Therefore, B_t equals either $\bar{B}_t = [m_t - 1][1-c]\left[p_t q_t^n - \frac{\alpha_{t-1}^{-1} h m_{t-1}}{m_{t-1}-1} B_{t-1}\right]$ along the lucky path or $\underline{B}_t = [m_t - 1]e$ during a crisis. Hence, along the lucky path B_t is contemporaneously affected by both p_t and q_t^n/q_t^{tr}. Since crises are rare events, a linear representation of B_t along the equilibrium path is

$$B_t = \gamma_1 B_{t-1} + \gamma_2 p_t + \gamma_3 q_t^n / q_t^{tr} + u_{B,t} \tag{5.4}$$

The equations (5.2)-(5.4) can be viewed as a restricted version of the following more general system of equations:[22]

$$\begin{aligned} \widetilde{A}_0 Y_t &= \widetilde{A}_1 Y_{t-1} + ... + \widetilde{A}_p Y_{t-p} + u_t, \quad \text{where} \\ Y_t &= \begin{pmatrix} q_t^n/q_t^{tr} \\ p_t \\ B_t \end{pmatrix}, \quad \widetilde{A}_0 = \begin{bmatrix} 1 & 0 & 0 \\ \delta_2 & 1 & 0 \\ \gamma_3 & \gamma_2 & 1 \end{bmatrix} \quad \text{and} \quad u_t = \begin{pmatrix} u_{q,t} \\ u_{p,t} \\ u_{B,t} \end{pmatrix} \end{aligned} \tag{5.5}$$

Notice that the lower triangular structure of the contemporaneous correlation matrix and the VAR ordering (q_t^n/q_t^{tr}, p_t, B_t) follow directly from the model as q_t^n/q_t^{tr} is predetermined in period t and cannot be contemporaneously affected by the other two variables; the real exchange rate, p_t, contemporaneously depends on changes in q_t^n/q_t^{tr}, but not to changes in B_t; while B_t is contemporaneously affected by the other two variables. Matrix $\widetilde{A}_0$ is key to uncover the structural residuals from the estimated reduced form residuals. It will allows us to compute the impulse response functions and interpret them as the effects of structural shocks on each of the three variables.[23]

[22] The structural residuals u_t are by assumption uncorrelated and have zero mean: $E(u_t) = 0$ and $E(u_{t,}u_t') = \widetilde{D}$, where $\tilde{D}$ is a matrix with the variances of the shocks on the main diagonal and zero elements otherwise.

[23] In practice we cannot estimate the structural model directly, but instead we estimate the following reduced form of the model:

$$\begin{aligned} Y_t &= \widetilde{A}_0^{-1} \widetilde{A}_1 Y_{t-1} + ... + \widetilde{A}_0^{-1} \widetilde{A}_p Y_{t-p} + \widetilde{A}_0^{-1} u_t \\ &= A_1 Y_{t-1} + ... + A_p Y_{t-p} + \varepsilon_t, \text{ where } A_i = \widetilde{A}_0^{-1} \widetilde{A}_1. \end{aligned} \tag{5.6}$$

The relationship between the structural residuals u_t and the reduced form residuals ε_t from the estimated regression equation is: $\varepsilon_t = \widetilde{A}_0^{-1} u_t$, with $E(\varepsilon_t) = 0$ and $E(\varepsilon_{t,} \varepsilon_t') = E(\widetilde{A}_0^{-1} u_t u_t' \widetilde{A}_0^{-1\prime}) = E(\widetilde{A}_0^{-1} \widetilde{D} \widetilde{A}_0^{-1\prime}) = \Omega$. As Ω is symmetric and positive semi-definite, we can use a Choleski Decomposition to uncover the structural residuals from the estimated reduced form residuals with the VAR ordering (q_t/q_t^{tr}, p_t, B_t). This is because for any symetric and positive semi-definite matrix Ω,, there exists a triangular Matrix C, with ones on the main diagonal, such that $\Omega = CDC'$. In our case $D = \widetilde{D}$ and $C = \widetilde{A}_0^{-1}$.

We estimate the VAR model for Mexico and the United States using quarterly data on real domestic credit, the real exchange rate, and the N/T ratio, proxied by construction and manufacturing. The sample ranges from 1980:1 to 1999:4.[24]

Figure 12 shows the impulse response functions (IRFs) of a shock to N/T, the real exchange rate and credit on credit. Intuitively, the structural impulse response functions tell us how B_t reacts over time to a shock in either N/T, p or B at time $t = 1$. They are the coefficients of the moving average representation of the VAR Model (5.6).

It is remarkable how different the dynamic linkages between the variables for Mexico and the United States are. In Mexico credit responds statistically significantly to changes in the N/T ratio and has a significant negative reaction to changes in the real exchange rate (which is here defined as the inverse $1/p_t$). Meanwhile, in the United States, although the responses have the same sign as those in Mexico, they are much smaller and are not statistically significant. This suggests that there are binding credit constraints in Mexico that affect some sectors but not others, and that changes in the real exchange rate have strong balance sheet effects. In contrast, these effects are absent in the US.

6. Conclusions

In this paper we have characterized the boom-bust cycle typical of countries that have suffered twin crises, and we have linked this cycle to co-movements between key macro variables in middle income countries. Furthermore, we have considered a model where these co-movements arise along the equilibium path, and we have used the restrictions implied by the model to estimate a structural VAR.

The paper makes two key points. First, there do exist *common macroeconomic patterns* among middle income countries, and these common patterns are quite different from the ones observed in the US. Second, these common patterns indicate the existence of asymmetric financing constraints and of balance sheet effects, both of which result from the *interaction* of contract enforceability problems and bailout guarantees.

More empirical work is needed in order to better characterize the mechanisms that underlie the boom-bust cycle. First of all, it is important to develop data sets

[24] We estimate the VAR in first differences as we cannot reject the null hypothesis of a unit root for all variables expressed in level, while we reject a unit root on the first differenced series. For details see the appendix.

that will allow us to classify firms along several dimensions (for instance, small vs. large and nontradables vs. tradables). For each type of firm there should be information regarding investment opportunities and sources of external finance (e.g., bank credit, equity, bonds). Also, it is important to have a better understanding of the types of bailout guarantees which are prevalent in different economies, and the enforceability problems that pervade bank contracts in different countries.

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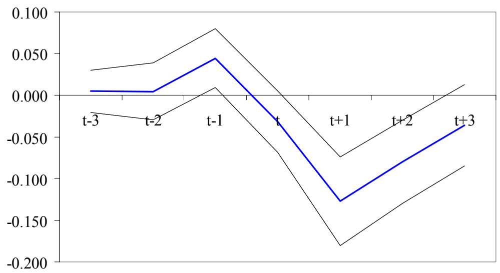
Figure 1: 1/ Real Exchange Rate (growth rates)

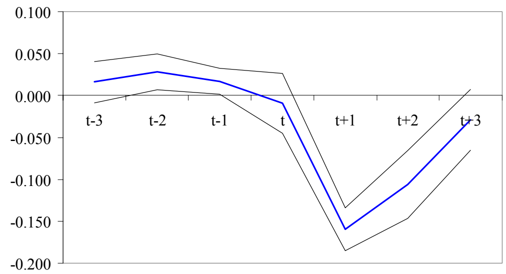


Note: The solid line traces the point estimates from the regression ; $y_{it} = a_i + \sum_{j=-3}^{3} \beta_j Dummy_{t+j} + \varepsilon_{it}$, where y is the real exchange rate (and the respective variable of interest in the graphs below), i = 1..44 denotes the 44 countries in our sample listed below, t = 1980..1999, and $Dummy_{t+j}$, with $j = -3...+3$, is a dummy variable j periods before or after the crisis. The thin lines represent the 95% confidence interval. In the panel data regressions we allow for fixed effects and use a GLS estimator in order to account for differences in the variance.

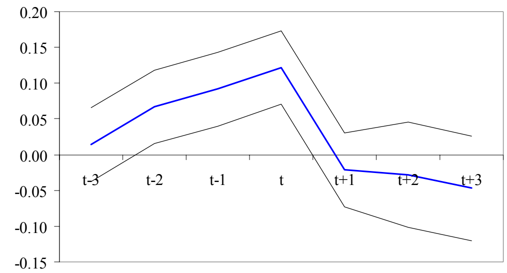
Real effective exchange rates (REER) are based on CPI's computed as a weighted geometric average of the level of consumer prices in the home country, relative to that of the trading partners. For country i , it is defined as $REER_i = \prod_{j \neq i} \left[\frac{P_i R_i}{P_j R_j} \right]^{W_{ij}}$, where j denotes 1..j trading partners, Wij is a competitiveness weight put by country i on country j (The weighting scheme is based on trade in Manufacturing, non-oil primary commodities and tourism services). P denotes the CPI's. R denotes the nominal exchange rate of currencies in US Dollars.

Figure 2: The Increasing Credit Crunch

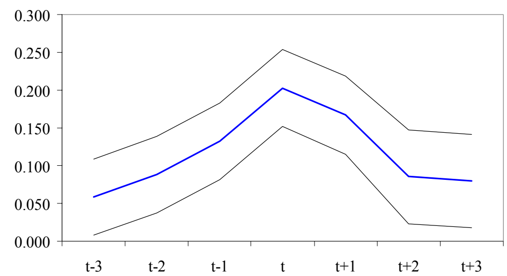
a) Real Credit (growth rates)



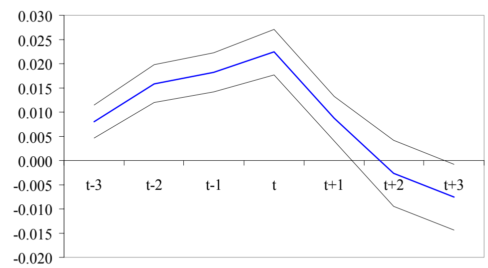
b) Real Credit (deviations from HP-Trend)



c) Credit/GDP



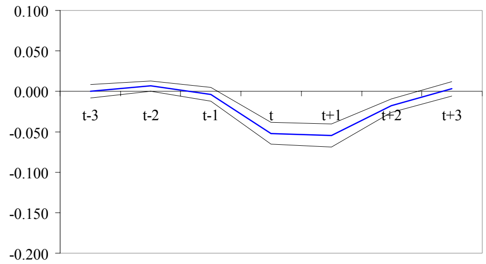
d) Credit/Deposits



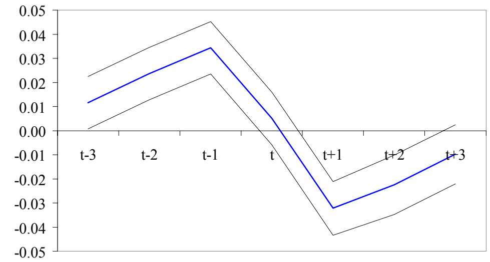
Note: The Hodrick-Prescott trend is constructed by minimizing the following objective function *S*, with respect to y_t^p, the trend component in output : $S = \sum_{t=1}^{T}(y_t - y_t^p)^2 + \lambda \sum_{t=2}^{T-1}\left[(y_{t+1}^p - y_t^p) - (y_t^p - y_{t-1}^p)\right]$, with λ=100. “Credit” is the credit provided by domestic deposit money banks to the non-government -, non financial institution – private Sector. Deposits are the sum of demand deposits and time-, savings- and foreign currency deposits, by domestic deposit money banks. For details on the construction of the windows see footnote to figure 1.

Figure 3: Fast Recovery of GDP

a) Real GDP (growth rates)

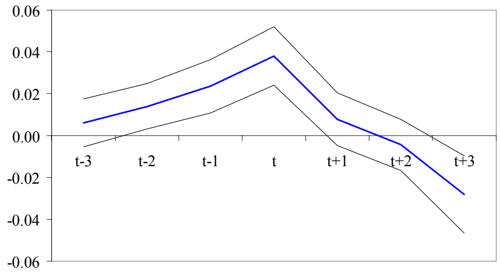


b) Real GDP (deviations from HP-Trend)



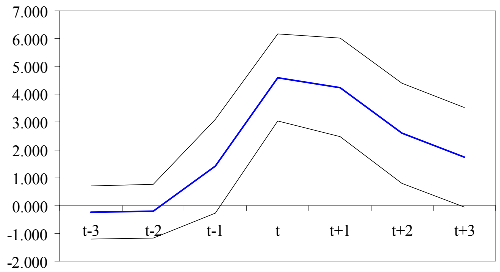
Note: See notes to figures 1 and 2 for details on the computation of the event windows and HP-trend.

Figure 4: N/T



Note: Construction, Services and Manufacturing where classified as N or T, according to the variance of the sectorial real exchange rate. In cases where sectoral price data where not available for construction, Construction was classified as N by default.

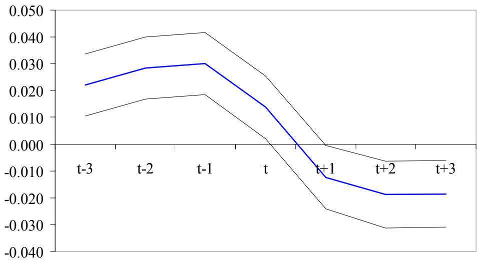
Figure 5: Interest Rate Spread



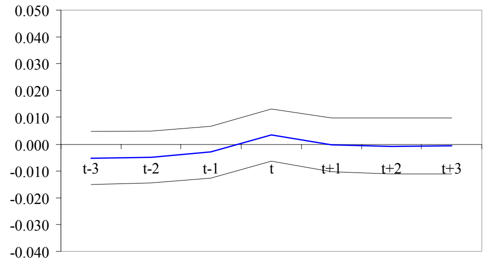
Note: The interest rate spread is the interest rate charged by banks on loans to prime customers minus the interest rate paid by commercial or similar banks for demand, time, or savings deposits. This graph only contains data for 11 countries out of the full set of 44.

Figure 6: Components of GDP

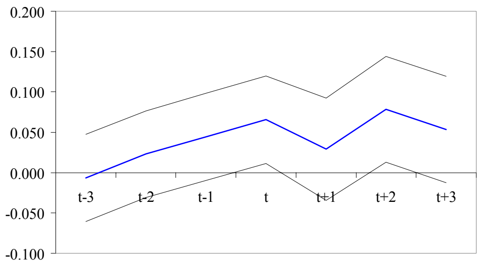
a) Investment/GDP



b) Consumption/GDP



c) Government Expenditure/GDP



d) Net Exports/GDP

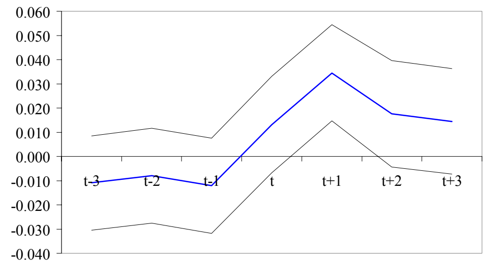
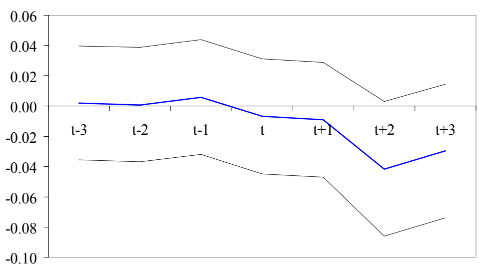


Figure 7: External shocks?

a) Terms of Trade



b) US Federal Funds Rate

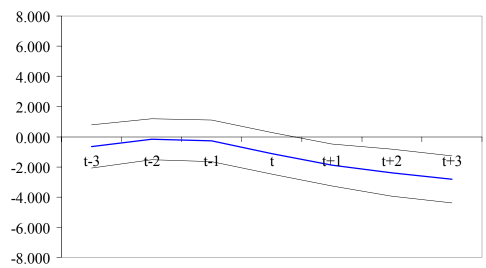
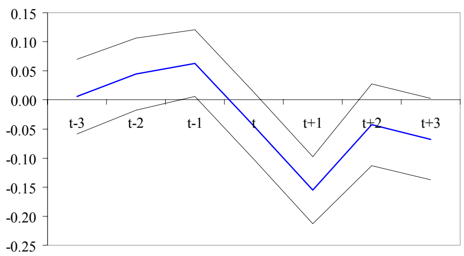
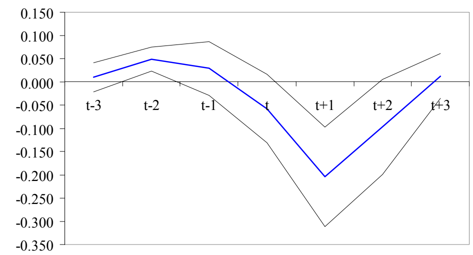


Figure 8: the boom bust cycle under fixed and non-fixed exchange rate regimes

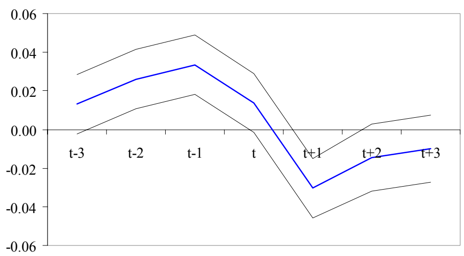
Fixed | **Non-Fixed**

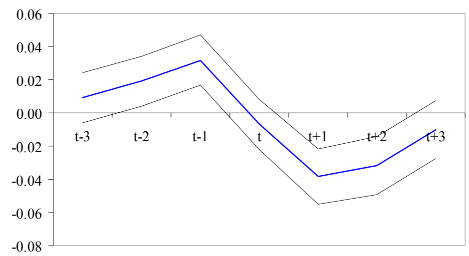
1/ Real Exchange Rate (growth rates)



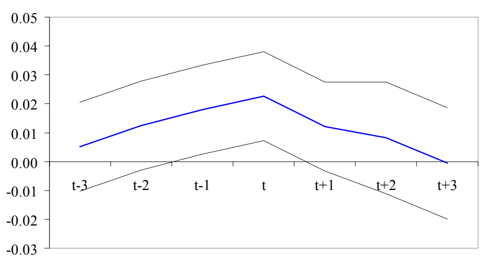


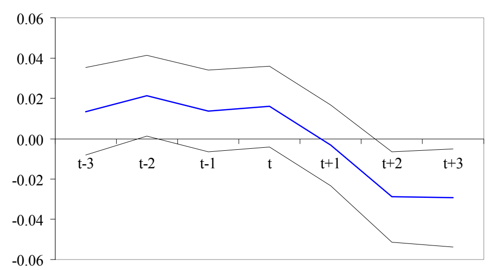
Real GDP (deviations from HP trend)



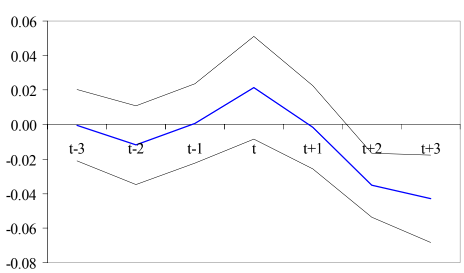


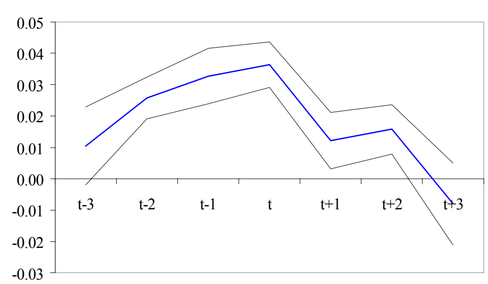
Credit/Deposits



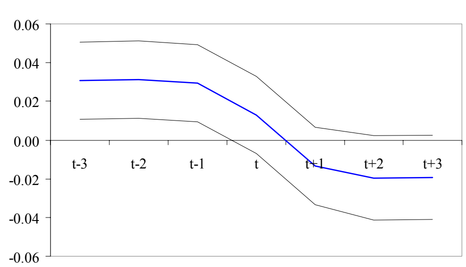


N/T





Investment/GDP



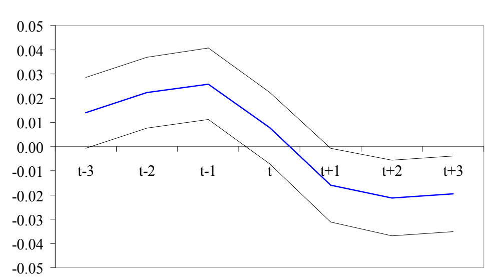
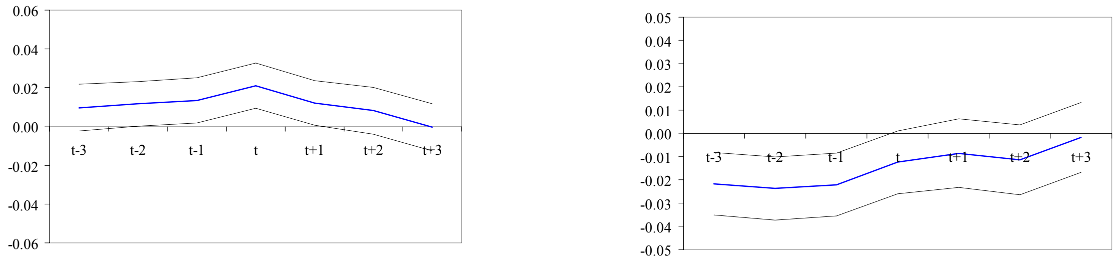


Figure 8: Continued

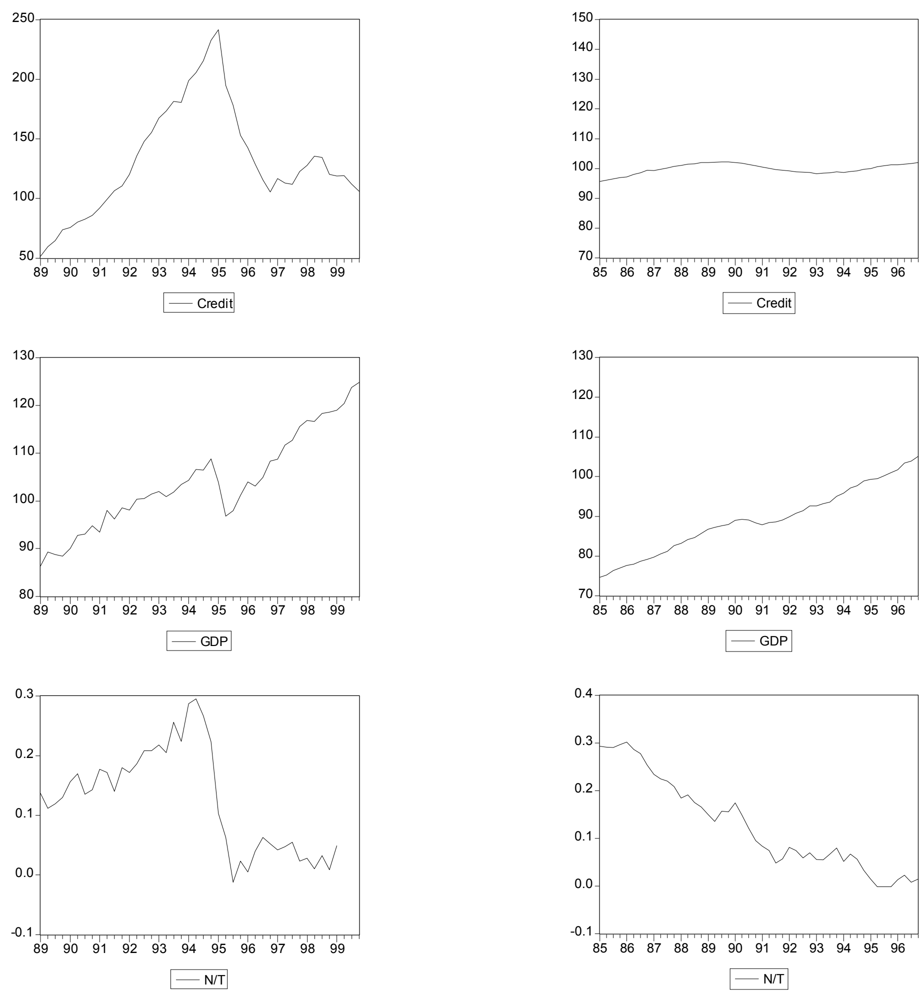
Consumption/GDP



Note: Fixed and non-fixed regimes are determined according to the de facto classification by Levy-Yeyati and Sturzenegger (2001). For the construction of the event windows see footnote to figure 1.

Figure 9: Credit, GDP and N/T in Mexico and the US

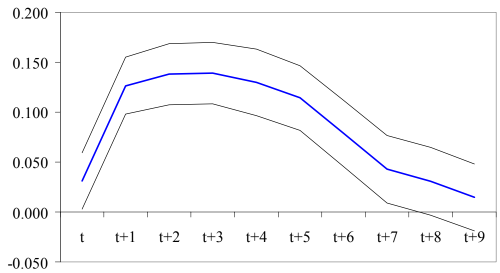
Mexico United States



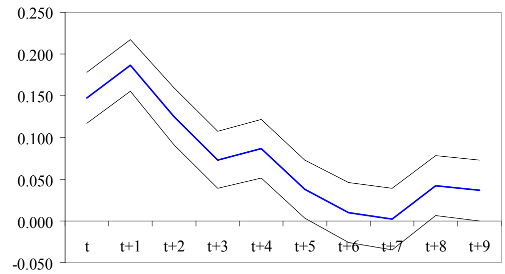
Note: The figures display the time path of real domestic credit, the real exchange rate and the ratio of non-tradable to tradable output, as proxied by Construction and Manufacturing.

Figure 10: Soft Landing after a Lending Boom

a) Deviation from HP-Trend



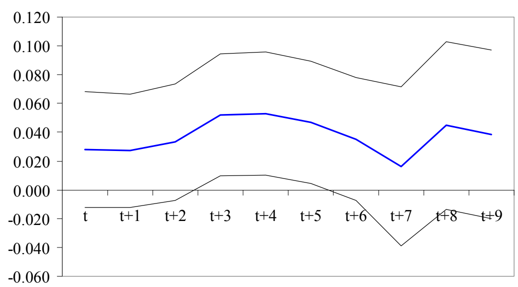
b) Growth rates



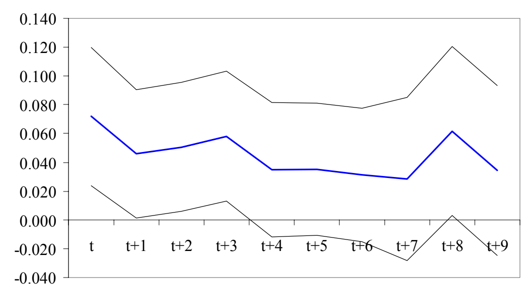
Note: The event windows in figure 10 are centered around the beginnings of lending booms. The beginning of the lending boom is the fist year of a period of at least 2 years with more that 10% real credit growth. For the construction of the event windows see footnote to figure 1.

Figure 11: Real Credit after Financial Liberalization

a) Deviation from an HP-trend

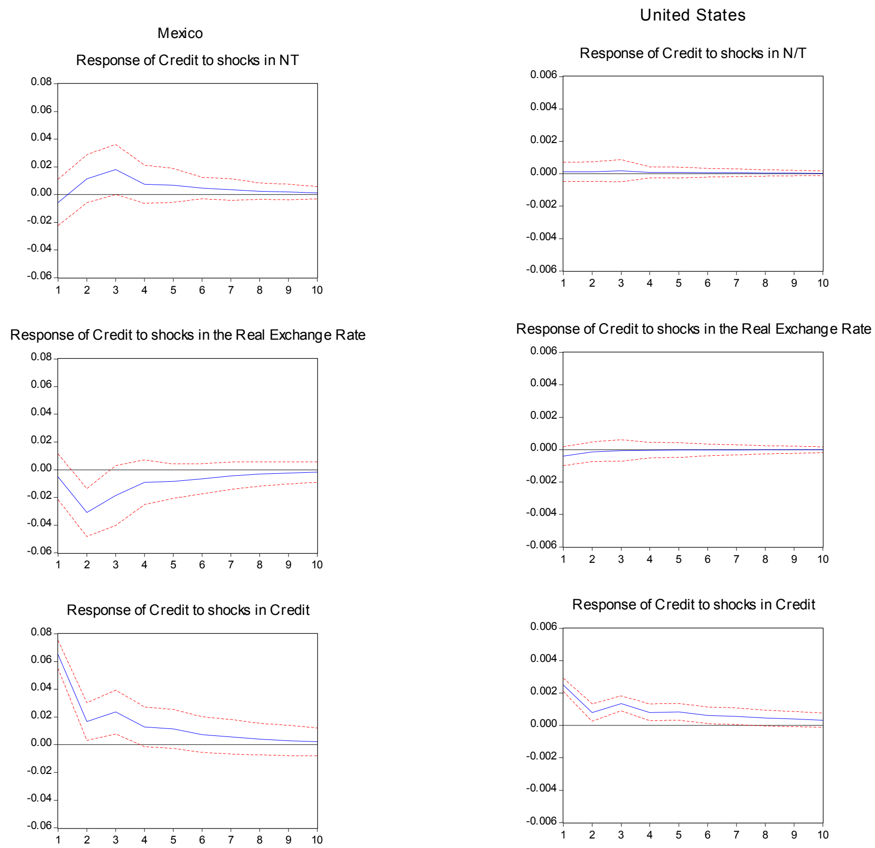


b) Growth rates



Note: The event windows in figure 10 are centered dates of financial liberalization. Dates for financial liberalization are taken from Baekert et.al (2001)

Figure 12: Impulse response functions



Note: the solid lines trace the effects of a shock in the growth rate of N/T, the real exchange rate and credit to the growth rate in credit, in Mexico and the US. The dotted lines denote the 2 standard deviations. The standard deviations where computed by 1000 Monte Carlo replications. The VAR is estimated in growth rates with two Lags. The optimal lag length was chosen by AIC criterion.

Table 1: Probability of a crisis given a lending boom (and vice versa)

	LB2	LB3	LB4
Pr(crisis in j+1 | LB (j))	6.2%	6.6%	8.3%
Pr(crisis in j+2 | LB (j))	5.7%	6.6%	6.5%
Pr(crisis in j+3 | LB (j))	5.2%	5.5%	4.7%
Pr(crisis in tranquil times)	3.7%	3.7%	3.1%
Pr(LB | Crisis (j))	85.7%	82.1%	75.0%

Note: LB 2-4 denotes 3 different definitions of a lending boom. LB2 is a period of a cumulative increase in real credit over the past 2 years of more than 20% (30% for LB3 and 40% for LB4). Pr(crisis in j+i | LB (j)) with i=1..3 denotes the probability of a crisis during the year j+i. Pr(crisis in tranquil times) denotes the probability of a crisis in all other years. Pr(LB | Crisis (j)) denotes the probability that a lending boom was present within the 3 years before the crisis or during the year of the crisis .

Table 2: Co-movement of real credit growth with other macro variables

Variable		Reg. 1	Reg. 2	Reg. 3	Reg. 4	Reg. 5
1/Real Exchange Rate		0.363	0.187	0.204	0.350	0.222
	St. Er.	0.060	0.064	0.073	0.074	0.066
	P-val.	0.000	0.004	0.006	0.000	0.001
N/T		0.352	0.229	0.238	0.356	0.242
	St. Er.	0.052	0.081	0.081	0.089	0.070
	P-val.	0.000	0.005	0.004	0.000	0.001
Real Investment			0.280	0.287		0.316
	St. Er.		0.061	0.067		0.061
	P-val.		0.000	0.000		0.000
Real GDP				-0.118	0.559	0.260
	St. Er.			0.269	0.189	0.248
	P-val.			0.661	0.003	0.296
Crisis/GDP Interact. Dummy					-0.950	-1.403
	St. Er.				0.361	0.397
	P-val.				0.009	0.001
Adjusted R-squared		0.298	0.346	0.341	0.321	0.377
Durbin-Watson stat.		1.731	1.671	1.660	1.744	1.757

Note: Domestic credit is the dependent variable. All panel data regressions are estimated allowing for fixed effects and a GLS estimator. All variables enter the regression in growth rates. Standard errors and P-values are given below the point estimates. The interaction dummy for GDP is equal to 1 from period, t to t+3 of the crisis and is zero otherwise. The variable ”Real GDP Interaction Dummy” is this dummy*(real GDP).

Appendix

Criteria for country selection:

Out of 207 countries in the world bank development indicators data base, we consider countries:

a) that have a stock market and the value of the stocks traded as a share of GDP is larger than 1%.
b) that have more than 1 million people.
c) that are non-G7 countries
d) with per capita income of more than 1000$ but less than 30000$
e) that are not engaged in war or civil war (Iran, Irak, Yugoslavia and lebanon)
f) Leave out small Island economies (Mauritius and Trinidad)

The sample covers 20 years, from 1980 to 1999. The panel is unbalanced, as not all series cover the full sample or are available for all countries. The data set is available from the authors upon request.

Crisis dates:

BC and CC dates are taken from Frankel and Rose (1996), Capiro and Klingbiel (1996) and Tornell (1999). A Joint crisis is defined as an event where A) BC and CC occurs in the same year, or consecutive years. B) in consecutive years, the year of the crisis is the year of the latter of the two. C) A joint crisis does not count if it occurs within three year before or after another joint crisis, or when crisis occur three or more years in a row. Out of our sample of 44 countries, 20 are characterized by joint crisis. The remaining 24 are part of the control group and effect the regression results only via affecting the mean of tranquil times.

The Boom Bust Cycle

The graphs in the text illustrate the typical pattern of a boom-burst cycle in emerging markets around events that are characterized by both, banking and currency crisis. The graphs are visual representations of the point estimates and standard errors from the regression exercise – here we report the parameter estimates for a more exact evaluation of the level of significance. The regressions are specified with the respective variable in the graph as dependent variable, regressed on dummy variables proceeding and following a crisis. We estimate the following pooled regression:

$$y_{it} = a_i + \sum_{j=-3}^{3} \beta_j Dummy_{t+j} + \varepsilon_{it},$$

where y is the respective variable of interest in the graph, i = 1..44 denotes the 44 countries in our sample listed below, t = 1980..1999, and $Dummy_{t+j}$ with $j = -3...+3$ is a dummy variable j periods before or after the crisis. As the mean of the variable is likely to be different across countries we allow for country specific fixed effects in the regression, i.e. we estimate a intercept for each pool member α_i. Also, in order to avoid the possibility that a country with high variance influences the parameter estimates by large changes in either direction, we apply a GLS weighing scheme, using the estimated cross section residual variances. This captures the presence of cross section heteroscedasticity.

1/ Real exchange rate (growth rates)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dummy T-3	0.005	0.013	0.366	0.715
Dummy T-2	0.005	0.017	0.263	0.793
Dummy T-1	0.044	0.018	2.452	0.015
Dummy T	-0.032	0.019	-1.684	0.093
Dummy T+1	-0.127	0.027	-4.695	0.000
Dummy T+2	-0.080	0.026	-3.138	0.002
Dummy T+3	-0.036	0.025	-1.454	0.147

Note: The graphs show the behavior of the real effective exchange rate (REER), based on CPI’s. REER’S are computed as a weighted geometric average of the level of consumer prices in the home country, relative to that of the trading partners. For country i , it is defined as $REER_i = \prod_{j \neq i} \left[\frac{P_i R_i}{P_j R_j} \right]^{W_{ij}}$, where j denotes 1..j trading partners, Wij is a competitiveness weight put by country i on country j (The weighting scheme is based on trade in Manufacturing, non-oil primary commodities and tourism services). P denotes the CPI's. R denotes the nominal exchange rate of currencies in US Dollars.

Real GDP (deviations from HP-Trend)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dummy T-3	0.012	0.006	2.091	0.037
Dummy T-2	0.024	0.006	4.257	0.000
Dummy T-1	0.034	0.006	6.167	0.000
Dummy T	0.005	0.006	0.906	0.365
Dummy T+1	-0.032	0.006	-5.612	0.000
Dummy T+2	-0.022	0.006	-3.585	0.000
Dummy T+3	-0.010	0.006	-1.567	0.118

Note: the Hodrick-Prescott trend is constructed by minimizing the following objective function *S*, with respect to y_t^p , the trend component in output : $S = \sum_{t=1}^{T} (y_t - y_t^p)^2 + \lambda \sum_{t=2}^{T-1} \left[(y_{t+1}^p - y_t^p) - (y_t^p - y_{t-1}^p) \right]$, with λ=100.

Real GDP (growth rates)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dummy T-3	0.000	0.004	0.027	0.979
Dummy T-2	0.007	0.003	2.108	0.035
Dummy T-1	-0.004	0.004	-0.838	0.402
Dummy T	-0.052	0.007	-7.602	0.000
Dummy T+1	-0.054	0.007	-7.361	0.000
Dummy T+2	-0.018	0.004	-4.046	0.000
Dummy T+3	0.003	0.005	0.737	0.461

Real Credit (deviations from HP-Trend)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dummy T-3	0.014	0.026	0.534	0.593
Dummy T-2	0.067	0.026	2.552	0.011
Dummy T-1	0.092	0.026	3.493	0.001
Dummy T	0.122	0.026	4.654	0.000
Dummy T+1	-0.021	0.026	-0.810	0.418
Dummy T+2	-0.028	0.037	-0.748	0.455
Dummy T+3	-0.047	0.037	-1.256	0.210

Note: "Credit" is the credit provided by domestic deposit money banks to the non-government -, non financial institution – private Sector.

Real credit (growth rates)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dummy T-3	0.016	0.012	1.286	0.199
Dummy T-2	0.028	0.011	2.559	0.011
Dummy T-1	0.017	0.008	2.116	0.035
Dummy T	-0.009	0.018	-0.518	0.605
Dummy T+1	-0.159	0.013	-12.183	0.000
Dummy T+2	-0.106	0.021	-5.143	0.000
Dummy T+3	-0.029	0.018	-1.575	0.116

Note: "Credit" is the credit provided by domestic deposit money banks to the non-government -, non financial institution – private Sector.

Credit/GDP (levels)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dummy T-3	0.058	0.026	2.258	0.024
Dummy T-2	0.088	0.026	3.413	0.001
Dummy T-1	0.132	0.026	5.104	0.000
Dummy T	0.203	0.026	7.824	0.000
Dummy T+1	0.167	0.026	6.342	0.000
Dummy T+2	0.085	0.032	2.696	0.007
Dummy T+3	0.079	0.032	2.515	0.012

Credit/Deposits (levels)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dummy T-3	0.008	0.002	4.580	0.000
Dummy T-2	0.016	0.002	7.934	0.000
Dummy T-1	0.018	0.002	8.754	0.000
Dummy T	0.022	0.002	9.366	0.000
Dummy T+1	0.009	0.002	3.704	0.000
Dummy T+2	-0.003	0.003	-0.770	0.442
Dummy T+3	-0.008	0.003	-2.186	0.029

Note: Deposits are the sum of demand deposits and time-, savings- and foreign currency deposits, by domestic deposit money banks.

N/T (levels)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dummy T-3	0.006	0.006	1.034	0.302
Dummy T-2	0.014	0.006	2.515	0.012
Dummy T-1	0.024	0.006	3.657	0.000
Dummy T	0.038	0.007	5.393	0.000
Dummy T+1	0.008	0.006	1.195	0.233
Dummy T+2	-0.004	0.006	-0.712	0.477
Dummy T+3	-0.028	0.009	-2.981	0.003

Note: Construction, Services and Manufacturing where classified as N or T, according to the variance of the sectorial real exchange rate. In cases where sectoral price data where not available for construction, Construction was classified as N by default.

Terms of Trade (levels)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dummy T-3	0.002	0.019	0.105	0.916
Dummy T-2	0.001	0.019	0.044	0.965
Dummy T-1	0.006	0.019	0.307	0.759
Dummy T	-0.007	0.019	-0.358	0.720
Dummy T+1	-0.009	0.019	-0.469	0.639
Dummy T+2	-0.042	0.023	-1.835	0.067
Dummy T+3	-0.030	0.023	-1.318	0.188

Interest rate spread (levels)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dummy T-3	-0.239	0.487	-0.491	0.625
Dummy T-2	-0.200	0.487	-0.411	0.682
Dummy T-1	1.420	0.859	1.653	0.102
Dummy T	4.602	0.799	5.759	0.000
Dummy T+1	4.246	0.908	4.676	0.000
Dummy T+2	2.603	0.918	2.837	0.006
Dummy T+3	1.734	0.918	1.890	0.062

Note: The interest rate spread is the interest rate charged by banks on loans to prime customers minus the interest rate paid by commercial or similar banks for demand, time, or savings deposits. This graph only contains data for 11 countries out of the full set of 44.

Real interest rate (levels)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dummy T-3	-3.896	1.360	-2.864	0.004
Dummy T-2	-1.731	1.360	-1.273	0.204
Dummy T-1	0.537	1.221	0.440	0.660
Dummy T	2.102	1.221	1.722	0.086
Dummy T+1	-0.033	1.156	-0.028	0.977
Dummy T+2	-1.058	1.358	-0.779	0.436
Dummy T+3	-0.661	1.358	-0.486	0.627

Note: Real interest rate is the lending interest rate adjusted for inflation as measured by the GDP deflator.

Investment/GDP (levels)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dummy T-3	0.022	0.006	3.736	0.000
Dummy T-2	0.028	0.006	4.815	0.000
Dummy T-1	0.030	0.006	5.068	0.000
Dummy T	0.014	0.006	2.317	0.021
Dummy T+1	-0.012	0.006	-2.034	0.042
Dummy T+2	-0.019	0.006	-2.967	0.003
Dummy T+3	-0.019	0.006	-2.930	0.004

Consumption/GDP (levels)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dummy T-3	-0.005	0.005	-1.023	0.307
Dummy T-2	-0.005	0.005	-0.977	0.329
Dummy T-1	-0.003	0.005	-0.603	0.547
Dummy T	0.003	0.005	0.681	0.496
Dummy T+1	0.000	0.005	-0.051	0.960
Dummy T+2	-0.001	0.005	-0.146	0.884
Dummy T+3	-0.001	0.005	-0.125	0.900

Exports (as % of GDP)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dummy T-3	-0.009	0.006	-1.498	0.135
Dummy T-2	-0.002	0.006	-0.344	0.731
Dummy T-1	0.005	0.006	0.859	0.391
Dummy T	0.015	0.006	2.317	0.021
Dummy T+1	0.022	0.006	3.409	0.001
Dummy T+2	0.020	0.006	3.157	0.002
Dummy T+3	0.022	0.006	3.433	0.001

Government expenditure (as % of GDP)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dummy T-3	-0.007	0.028	-0.250	0.803
Dummy T-2	0.023	0.028	0.827	0.409
Dummy T-1	0.044	0.028	1.602	0.110
Dummy T	0.065	0.028	2.355	0.019
Dummy T+1	0.029	0.033	0.887	0.375
Dummy T+2	0.078	0.034	2.337	0.020
Dummy T+3	0.053	0.034	1.580	0.115

Soft Landing (Deviation from HP-Trend)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dummy T	0.031	0.014	2.155	0.032
Dummy T+1	0.126	0.015	8.716	0.000
Dummy T+2	0.138	0.016	8.876	0.000
Dummy T+3	0.139	0.016	8.876	0.000
Dummy T+4	0.130	0.017	7.693	0.000
Dummy T+5	0.114	0.016	6.939	0.000
Dummy T+6	0.079	0.017	4.674	0.000
Dummy T+7	0.043	0.017	2.464	0.014
Dummy T+8	0.031	0.017	1.793	0.074
Dummy T+9	0.015	0.017	0.862	0.389

Note: the beginning of the lending boom is the fist year of a period of at least 2 years with more that 10% real credit growth.

Soft Landing (growth rates)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dummy T	0.147	0.016	9.467	0.000
Dummy T+1	0.187	0.016	11.843	0.000
Dummy T+2	0.125	0.017	7.184	0.000
Dummy T+3	0.073	0.017	4.187	0.000
Dummy T+4	0.087	0.018	4.868	0.000
Dummy T+5	0.038	0.018	2.150	0.032
Dummy T+6	0.010	0.018	0.559	0.576
Dummy T+7	0.002	0.019	0.109	0.913
Dummy T+8	0.042	0.018	2.307	0.022
Dummy T+9	0.037	0.019	1.971	0.049

Financial liberalization: Deviation of real credit from HP-Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dummy T	0.028	0.021	1.371	0.171
Dummy T+1	0.027	0.020	1.352	0.177
Dummy T+2	0.033	0.021	1.611	0.108
Dummy T+3	0.052	0.021	2.427	0.016
Dummy T+4	0.053	0.022	2.430	0.016
Dummy T+5	0.047	0.022	2.169	0.031
Dummy T+6	0.035	0.022	1.619	0.106
Dummy T+7	0.016	0.028	0.578	0.564
Dummy T+8	0.045	0.030	1.505	0.133
Dummy T+9	0.038	0.030	1.286	0.199

Note: Dates for financial liberalization are taken from Baekert et.al (2001)

Financial liberalization: Growth rate of real credit

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Dummy T	0.072	0.024	2.938	0.004
Dummy T+1	0.046	0.023	2.015	0.045
Dummy T+2	0.051	0.023	2.218	0.027
Dummy T+3	0.058	0.023	2.523	0.012
Dummy T+4	0.035	0.024	1.459	0.145
Dummy T+5	0.035	0.023	1.503	0.134
Dummy T+6	0.031	0.024	1.322	0.187
Dummy T+7	0.028	0.029	0.982	0.327
Dummy T+8	0.062	0.030	2.059	0.040
Dummy T+9	0.034	0.030	1.141	0.254

Table 3: Unit root tests

	Phillips-Perron Test Levels	1^{st} differences
Mexico		
Real Credit	-1.10	-8.44**
Real GDP	-1.39	-9.72**
N/T	-1.64	-9.90**
Real Exchange Rate	-2.75	-9.43**
United States		
Real Credit	-0.98	-4.71**
Real GDP	-0.86	-5.97**
N/T	-1.17	-9.11**
Real Exchange Rate	-1.49	-6.29**

Note: The Phillips Perron test was estimated with a truncation lag of 3. The tests are specified with a constant and a time trend in the levels and a constant only, in the first differences. The optimal lag length was chosen by the AIC criterion.

Table 4: Johansen Cointegration test

Mexico		*United States*	
Eigenvalue	Likelihood Ratio	Eigenvalue	Likelihood Ratio
0.27	44.64	0.25	53.62
0.13	21.81	0.21	32.23
0.11	11.20	0.17	14.94
0.03	2.46	0.01	0.86

Note: Although the test statistic for the US is significant according to asymptotic critical values, none of the test statistics are significant according to the finite sample critical values proposed by Cheung and Lai (1993).

Data sources:

Real exchange rate: IMF, International financial Statistics, CD-ROM. (Lines ..RECZF)

Real GDP growth rates: World Bank Development indicators (Code: NY.GDP.MKTP.KN)

Real credit growth: IMF, International financial Statistics, CD-ROM. Claims on private sector by deposit money banks (Lines 22d..ZF), divided by CPI (Lines 64..ZF)

Deposits: IMF, International financial Statistics, CD-ROM. (Demand deposits, Lines 24..ZF + Time, savings and foreign currency deposits, Lines 25..ZF)

N/T: Services: World Bank Development indicators (Code: NV.SRV.TETC.KN), Manufacturing: World Bank Development indicators (Code: NV.IND.MANF.KN), Construction: OECD Statistical Compendium, Main indicators of industrial activity and individual central banks.

Interest rate spread: World Bank Development indicators (Code: FR.INR.LNDP)

Real interest rate: World Bank Development indicators (Code: FR.INR.RINR)

Gross domestic fixed investment: World Bank Development indicators (Code: NE.GDI.FTOT.KN)

Private Consumption: World Bank Development indicators (Code: NE.CON.PRVT.KN)

Crisis Dates: Argentina: 84, 89, 95, Brazil: 90, 95, Chile: 82, Ecuador: 83, 98, Egypt: 90, Finland: 91, Jordan: 89, Korea: 97, Malysia:97, Mexico:82, 94, Morocco: 83, New Zealand: 88, Peru: 83, Philippines: 97, South Africa: 85, Sweden:91, Thailand: 97, Turkey: 94, Uruguay: 82, Venezuela: 92.

Dates of financial liberalization: see Baekert et.al (2001).

Graph 1