Investment and Bank Credit Recovery After Banking Crises

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Abstract

This paper aims to address two main questions: (a) the dynamic adjustment of investment-to-GDP ratio and bank credit-to-GDP ratio following banking crises episodes; (b) whether the adjustment of investment and bank credit ratio vary with several country characteristics. We answer these two questions in a sample of 79 developed and emerging countries over the 1973 to 2010 period. Our results suggest that in the aftermath of banking crises investment ratio declines but swiftly recovers to its pre-crisis level within two to three years. Bank credit declines significantly and remains stagnated even in the medium run. In terms of country characteristics, we find that investment and bank credit ratio decline significantly more in advanced countries and countries with higher level of capital openness. In addition, investment ratio declines significantly more in countries with higher level of financial development. Finally, we split the banking crises episodes into two categories: those preceded by a credit boom, and those that were not preceded by a credit boom. We find that dynamic adjustment of investment and bank credit ratio differs substantially across the two groups. Banking crises that are preceded by a credit boom lead to a greater and more persistent decline in investment and bank credit ratio. However, investment ratio swiftly recovers within two years of those banking crises not preceded by a credit boom.

Keywords: investment, bank credit, banking crisis, credit boom.

JEL Codes: E22, E44, G01

I. Introduction

The importance of banks and other financial intermediaries in an economy has long been recognized by the literature.[1] Financial intermediaries, such as banks, reduce the asymmetric information problem and channel loanable funds from savers to investors with productive investment opportunities. Thus, a disruption in the function of these intermediaries, i.e. banking crises, aggravates the asymmetric information problem, increases uncertainty, and leads to a decline in investment and output. The real output cost associated with banking crises has been the center of empirical studies in the recent years, especially as the financial crisis of 2008 has renewed interest in the topic (Abiad, Balakrishnan, Brooks, Leigh, and Tytell, 2009; Bordo, Eichengreen, Klingebiel, and Martinez-Peria, 2001; Boyd, Kwak, Smith, 2005; Cerra and Saxena, 2008; Dell'Ariccia, Detragiache, Rajan, 2008; Demirgüç-Kunt,Detregiache, and Gupta, 2006).

In contrast with most of the existing literature, we focus on the dynamic adjustment of investment and bank credit rather than output following a banking crisis. Tracking the path of investment provides a better assessment of the cost associated with banking crises because a boom in exports (especially if a banking crisis is accompanied by a currency crisis) may drive the output recovery, while investment may remain persistently low and endanger the prospect of long-run growth (Joyce and Nabar, 2009).

Apart from Nabar and Joyce (2009) and Rioja, Rios-Avila and Valev (2014), no other studies have explored the recovery of investment following a crisis. Our paper extends the work of these two studies from multiple ways. First, we use a larger dataset including 79 countries during the 1973-2010 period. Second, using the methodology proposed by Jorda (2005), which includes estimating Impulse Response Functions (IRF) directly from 'local projections', we track

[1] see, for example, King and Levine (1993a, 1993b); Levine, 1997 to mention a few.

the path of investment up to 6 years after the start of a banking crisis. Therefore, we are able to assess whether the decline in investment is reversed in the medium run. Third, because one of the main channels through which banking crisis can affect investment is a 'credit crunch', we also track the path of bank credit 6 years after the start of a banking crisis and investigate whether investment and bank credit recover together. Fourth, we allow the impact of banking crises on investment and bank credit ratio vary based on several country characteristics, such as the level of income and the level of trade and financial openness (see Acemoglu and Zilibotti, 1997; Aghion, Bacchetta and Banerjee, 2003). Fifth, we investigate the impact of each type of crisis resolution on the path of bank credit and investment to see whether there is a policy that generates a better post-crisis performance. Lastly, we split the banking crises episodes to those preceded by a credit boom and those that were not and re-examine the dynamics of investment and bank credit following each of these episodes.

Our results indicate that investment share declines following banking crises. However, the decline is temporary and investment-to-GDP ratio recovers to its pre-crisis level within two to three years after a banking crisis. The negative impact is stronger in advanced economies, countries with higher level of financial development and greater level of capital openness. Bank credit significantly declines following a banking crisis and does not recover to its pre-crisis level even in the medium-term (after 6 years). Country characteristics were less important for the bank credit dynamics, except for the level of capital openness. Bank credit ratio declines significantly more in countries with higher level of capital openness. We do not find policy interventions to significantly impact the dynamics of investment and bank credit, except for blanket guarantees. Finally when we split banking crises into those that were preceded by a credit boom and those that were not, we see interesting results. Investment ratio, during banking crises that are not preceded by a credit boom decline about 1 percentage point and swiftly recovers within two years.

In contrast, following banking crises that were preceded by a credit boom, investment significantly decline and do not recover to pre-crisis level within 6 years of a crisis. Bank credit declines regardless of whether or not the banking crisis was preceded by a credit boom. The decline is sharper in case of those crises that were preceded by a credit boom.

II. Overview and Empirical Literature

(a) Overview of Costs of Banking Crises

There are several ways in which banking crises can impose costs on an economy. They directly impact the banks' stockholders and may also impact the depositors. If as a part of crisis resolution, the government bails out the banking system, the taxpayers incur the fiscal cost. Also, with the collapse of the banking system, the payment system will be adversely affected bringing severe costs to the economy (Hoggarth, Reis, and Saporta, 2001). Alternatively, a systematic bank failure leads to a reduction in the money supply and contracts the output (Friedman and Schwartz, 1963).[2] Insolvency of some banks can lead to a reduction in bank loans, not only because of the bank failures but also because the healthy banks may be more cautious in their lending practices and cut back on lending (lending channel). In addition, the same adverse shock triggering the banking crisis may also hurt borrower's balance sheets (reduce net worth of borrowers), exacerbate the asymmetric information problem and prompt banks to further cut their supply of credit (balance sheet channel). As a result of the credit crunch, investment and output decline after banking crises.

Banking crises may also modify the allocation of credit to different types of investments and lead to a reduction in investment (asset allocation effect). Using industrial firm level data of

[2] Bernanke (1983), Bernanke and James (1991) and Bernanke, Gertler, and Gilchrist (1996) explain the severity and length of great depression with the credit crunch theory.

18 developed and developing countries between 1989 and 2007 period, Fernandez, Gonzalez, Suarez (2013) confirm the presence of asset allocation effect during 19 systematic banking crises. Their result suggests that firms' intangible investment is adversely affected during banking crises, intensifying the economic downturn. They find that the allocation effect is stronger in countries with highly developed financial system.

(b) Empirical Evidence: Costs Associated with Banking Crises

While the literature on the causes and early warning signs of banking crises is abundant, the real effects of these events on the economy have received much less attention. Using a panel of 24 emerging economies over the 1975-97 period, Hutchison and Noy (2005) find that banking crisis reduce output by 8-10 percent over a two year period. Cerra and Saxena (2008) use a larger panel of countries, including both developing and developed countries over the 1960-2001 period, and find that there is a long lasting decline of 7.5 percent in output 10 years following banking crises. They also report a higher output loss in high and upper middle-income countries. Similarly, Furceri and Zdzienicka (2012a) estimate a large and persistent output loss, which increases with the level of economic and financial development of the country. Abiad et al. (2009) use a cross section of banking crises episodes to investigate the impact of banking crises in the short and medium run on total factor productivity, investment, and output. They find no significant correlation between the level of income and the post-crisis output loss. However, their results suggest that higher pre-crisis investment ratio is associated with higher output loss after a banking crisis. Furceri and Zdzienicka (2012b) investigate the impact of banking crisis on public

debt. Deatragiache and Ho (2010) use a sample of 40 banking crises and find that resolution policies are not associated with better post-crisis performance.[3]

A critical issue facing the empirical studies on output loss of banking crises is to address the possibility of reverse causality in the relationship between banking crisis and output. It is quite possible that banking system problems are the consequence, not the cause, of a decline in output (recession).[4] Therefore, part of the estimated output loss would have occurred in the absence of banking crises and thus cannot be attributed to banking crisis per se.

Put it another way, one of the main channels through which banking crises negatively impacts output is through a credit crunch. However, the observed decline in the credit aftermath of banking crises can be related to a reduction in the demand for credit (for example, due to a recession and the poor investment prospects) rather than a cut in the supply of credit.

A number of studies have attempted to tackle this identification problem. For example, Hoggarth et al. (2002) construct a counterfactual by comparing the output gap of crisis-hit countries with the output gap that occurred during the episodes of banking crises in similar countries that did not experience banking crises.[5] They attribute any difference in the output gap between the crisis-hit country and the counterfactual country to the banking crisis. Their results suggest that the cumulative output losses incurred during banking crises are on average 15-20% of annual GDP. They also find that the loss is greater in more developed countries. In fact, in the emerging countries banking crises are costly only when they are accompanied by a currency crisis.

[3] Other papers on output cost of banking crises include: Bordo, Eichengreen, Klingebiel, and Martinez-Peria, 2001; Boyd, Kwak, and Smith, 2005; Kamisnksy and Reinhart, 1999

[4] During recessions, the increase in the number of nonperforming loans and the rate of default may lead to problems in the banking sector. To the extent that banking crises coincide with or caused by recessions, the output loss is overstated in the studies that ignore the possibility of endogeneity.

[5] According to Hoggarth et al. (2002):" The idea is that the movement in output relative to trend during the crisis period would have been, in the absence of a banking crisis, similar to the movement in the pairing country."

Alternatively, Kroszner et al. (2007) and Dell'Ariccia et al. (2008) argue that if a banking crisis has exogenous independent negative impact on output, then sectors more dependent on external finance should be disproportionately affected by it. They both find that indeed the differential effects across sectors are present. Krozner et al. (2007) also show that banking crises more adversely affect countries with a deeper financial development.

Overall, the existing empirical literature generally finds that banking crises have an exogenous negative effect on output, which is persistent. This negative impact is more pronounced in developed countries and countries with a more developed financial system.

III. Data

We obtain the data on GDP per capita (constant 2005$) as a measure of level of economic development, gross capital formation (% GDP) as a measure of investment ratio, CPI calculated inflation rate, and the trade openness (sum of exports and imports as a percentage of GDP) from World Development Indicators (WDI). Our measure of bank credit is the private credit provided by depository money banks (% GDP) from Financial Global Development dataset. [6] This variable has also long been used as an indicator of banking sector development (Baltagi, Demetriades and Law, 2009; Ndikumana, 2000; Rajan and Zingales, 2003).

We consider both 'de jure' and 'de facto' measures of measures of capital openness. Our de jure measure is the Chinn-Ito index of capital account openness, KAOPEN. This index is the first standardized principle component of binary dummy variables that codify the presence of restrictions on cross-border transactions reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). Our de facto measure of capital openness

[6] The variable was originally developed by Beck, Demirgüç-Kunt and Levine (2003).

is obtained from Lane and Milesi-Ferretti (2007) and is the sum of a country's foreign assets and liabilities as a percentage of GDP. We refer to this measure as INTEGRATION.

We obtain the start date of systematic banking crisis dates from the Laeven and Valencia (2012) database.[7] They identify banking crises episodes base on two main criteria: (1) if there are significant signs of financial distress (measured by bank runs, losses in the banking system, and the bank liquidation); (2) if significant policy interventions in response to losses in the banking system were implemented. We also obtain currency crises and debt crises dates from Laeven and Valencia (2008a) and construct dummies corresponding to these episodes. Currency crises are defined as episodes in which nominal exchange rate depreciates by 30 percent or more and the rate of depreciation is at least 10 percent higher than the previous period.

Finally, we exclude lower income countries with underdeveloped financial markets and low level of capital openness from our analysis.[8] Thus our sample includes 57 emerging and 22 advanced economies.[9] We end up with 88 episodes of banking crises during our sample period. Table 1 lists the sources of data in the paper and Table 2 provides a short summary statistics of the variables employed in the paper.

IV. Empirical Methodology

Our goal is to address two main questions:

a. The dynamic adjustment of investment ratio and bank credit-to-GDP in the short and medium run following the start of a systematic banking crisis.

[7] Appendix A provides the list banking crises episodes in our sample. We do not consider the length of these episodes due to uncertainty related to identifying the end dates of banking crises.
[8] Including the lower income countries does not change any of the results in this paper in any significant manner.
[9] We closely follow Gourinchas and Obstfeld (2012) and include in our sample all countries that are included in one of the following: the J.P.Morgan EMBIG index, the FTSE's Group of Advanced Secondary Emerging markets, the MSCI-Barra classification of Emerging or Frontier economies, and the Dow Jones list of Emerging Markets Economies. Israel, Hong Kong, and Singapore that are recently added to the list of advanced economies, are considered emerging in our analysis because they belong to emerging economies list for the most our sample period. The complete list of these countries is provided in the Appendix A.

b. Whether the adjustment process of investment ratio and bank credit-to-GDP ratio after a systematic banking crisis vary with different country characteristics, such as level of income, capital and trade openness.

In order to answer (a), we follow the methodology first proposed by Jorda (2005) to estimate the impulse response functions (IRFs) of investment ratio and bank credit-to-GDP ratio directly from local projections.[10] Specifically, we estimate the following equations for each future period k and each of our dependent variables,

$$I_{i,t+k} - I_{i,t} = \alpha_i^k + \gamma_t^k + \sum_{j=1}^{l=4} \delta_j^k \, \Delta I_{i,t-j} + \beta_k B_{i,t} + \varepsilon_{i,t}^k \qquad (1a)$$

$$\left(\frac{Credit}{GDP}\right)_{i,t+k} - \left(\frac{Credit}{GDP}\right)_{i,t} = \alpha_i^k + \gamma_t^k + \sum_{j=1}^{l=4} \delta_j^k \, \Delta\left(\frac{Credit}{GDP}\right)_{i,t-j} + \beta_k B_{i,t} + \varepsilon_{i,t}^k \qquad (1b)$$

where I represents investment as a share of GDP, $Credit/GDP$ is the credit provided to private sector by depository monetary institutions, B is a dummy variable taking the value of one at the start date of banking crisis episodes, β_k captures the impact of a banking crisis episode on the change of the investment ratio (or bank credit ratio) for each future period k, δ_j^k captures the persistence of investment ratio (or bank credit ratio), and l represents the number of lags, finally α_i^k and γ_t^k control for country and time fixed effects, respectively. We consider $l = 4$, however we check the robustness of our results with different lag specifications. The inclusion of the four lags of the change in the investment ratio (or bank credit-to-GDP ratio) as control variables, addresses the autocorrelation in the error term. Moreover, in order to address heteroskedasticity, we estimate all equations using White robust standard errors. We plot the IRFs by plotting the estimated coefficients β_k for $k = 1, \ldots, 6$.

[10] This methodology has also been used by other papers including: see Furceri, Guichard and Rusticelli, 2012; Furceri and Zdzienicka, 2010; Jorda, Schularick, and Taylor 2013; Teulings and Zubanov, 2014.

Dynamic panel data estimation is subject to biased estimates due to the presence of lagged dependent variable (Nickell, 1981). Yet, this bias is mitigated as the sample period increases (see and Zdzienicka, 2012a).[11] The reverse causality is addressed by estimating changes in investment to GDP ratio (or bank credit) in the years following a crisis.

An alternate popular estimating strategy is to estimate an ARDL equation of investment (or bank credit) and crisis and use the estimated coefficients to calculate the impulse responses (see Cerra and Saxena, 2008; Furceri and Mourougane, 2012). The IRFs calculated using this method are sensitive to the number of lags. Our estimation strategy does not suffer from such an issue since lags of the change in investment ratio ($\Delta I_{i,t-j}$) enter only as controls in our specifications and are not used to calculate the IRFs. Thus, the bias arising from misspecification of lags of the dependent variable will not carry over. Finally, we do not need to use Monte-Carlo simulations to compute the confidence bands, as they are easily computed using the standard errors of β_k.

In order to answer (b), we include estimate the following equation:

$$I_{i,t+k} - I_{i,t} = \alpha_i^k + \sum_{j=1}^{4} \delta_j^k \, \Delta I_{i,t-j} + \beta_k B_{i,t} + \gamma_k \left(B_{i,t} * \bar{X}_{i,t}\right) + \mu_k X_{it} + \varepsilon_{i,t}^k \qquad (2a)$$

$$\left(\frac{Credit}{GDP}\right)_{i,t+k} - \left(\frac{Credit}{GDP}\right)_{i,t} = \alpha_i^k + \sum_{j=1}^{4} \delta_j^k \, \Delta \left(\frac{Credit}{GDP}\right)_{i,t-j} + \beta_k B_{i,t} + \gamma_k \left(B_{i,t} * \bar{Y}_{i,t}\right) + \mu_k Y_{it} + \varepsilon_{i,t}^k \qquad (2b)$$

Equations (2a) and (2b) are similar to Equation (1a) and (1b), but are augmented with the interaction terms and control variables. X is the set of variables including, the level of income and financial development , the level of trade openness, or the level of capital openness. Y is the set of variables including the income level, the level of trade openness, or the level of capital openness.

[11] Time period in our case is 37 and thus, the finite sample bias is of the order $\frac{1}{37}$ which is quite small.

In order to assess the impact of income level on investment and bank credit during banking crises, we split the sample into two groups of advanced and emerging economies and estimate equation (1a) and (1b) for each group, separately. Moreover, to test whether the impact of banking crises on investment ratio is similar between advanced and emerging countries, equation (1a) and (1b) are estimated by including an interaction term between with the crisis dummy and advanced countries' dummy:

$$I_{i,t+k} - I_{i,t} = \alpha_i^k + \sum_{j=1}^{4} \delta_j^k \Delta I_{i,t-j} + \beta_k B_{i,t} + \gamma_k (B_{i,t} * Advanced) + \varepsilon_{i,t}^k \qquad (3a)$$

$$\left(\frac{Credit}{GDP}\right)_{i,t+k} - \left(\frac{Credit}{GDP}\right)_{i,t} = \alpha_i^k + \sum_{j=1}^{4} \delta_j^k \Delta \left(\frac{Credit}{GDP}\right)_{i,t-j} + \beta_k B_{i,t} + \gamma_k (B_{i,t} * Advanced) + \varepsilon_{i,t}^k \qquad (3b)$$

V. Results

(a) Baseline

Our baseline results based on estimating the equation (1a) are presented in Table 3. The dependent variable is the changes in investment for each future period, k, where $k = 6$. As evident in Table 3, the investment ratio declines by about 1.5 in the first year after a banking crisis. The decline accumulates to about 2 percentage points in the second year, which suggest that the decline in investment is beyond the decline in GDP in the first two years after a banking crisis. In Figure 1, we plot the estimated banking crisis coefficients β_k and the confidence bands for each time horizon k=1,…, 6. The confidence bands are computed using the standard deviation of the estimated coefficients β_k. We interpret the results as statistically significant if the confidence intervals exclude the zero line.

Figure 1 suggests that the investment-to-GDP ratio rebounds to pre-crisis level within three years of a systematic banking distress, as the confidence intervals include the zero line after the third year. This does not necessarily mean that the *level* of investment fully recovers, but that

the decline in investment is at least as much as the decline in the level of GDP after the third year of a banking crisis. It is well documented in the empirical literature that the decline in GDP is significant (about 4 percentage points) and quite persistent following a banking crisis (see Cerra and Saxena, 2008; Furceri and Zdzienicka, 2010); therefore the full recovery of investment-to-GDP *ratio* can imply a similar decline in the *level* of investment.[12]

In Table 4 and Figure 2, we show the estimation results of Equation (1b). Similar to Table 3, four lags of changes in credit ratio are considered. The cumulative decline in bank credit is about 2.2 percentage points in the second year. Even after six years following the crisis, the average cumulative decline in bank credit is about 10.3 percentage points, which suggests that credit-to- GDP ratio remains significantly below pre-crisis level in the medium run. The dynamic adjustment of bank credit after banking crises can explain why the empirical literature finds such a sluggish recovery of GDP following these episodes. The long-lasting credit crunch that follows the crises episodes appears to be at the heart of the persistent decline in output.

Some episodes of banking crises were accompanied by currency or/and sovereign debt crisis. Therefore, the estimates of β_k, may be overstated since we are not controlling for other types of financial crisis that can be responsible for the decline in investment or credit-to-GDP ratio. Therefore, we augment equation (1a) and (1b) to currency and sovereign debt crises dummies and re-estimate the results. For brevity, we only report the estimated banking crisis coefficients $\beta_k$at each time horizon k (k=1,…, 6) in Table 5a. The results remain robust and we can see that 'pure' banking crises still lead to a statistically significant decline in investment in the short run and in credit-to-GDP ratio in the short and long run.

[12] Given the permanent decline in the level of GDP after banking crises, the investment ratio only fully recovers to pre-crisis level if: (a) the level of investment permanently declines as much as the decline in the level of GDP; or (b) the level of investment increases to the extant that it compensates the decline in the level of GDP. The latter situation is unlikely to happen given the credit crunch that often follows banking crises. Therefore, the recovery of investment ratio after two years more likely than not implies a permanent decline in the *level* of investment.

Finally, estimates of the effect of banking crisis on investment and bank credit could be biased due to endogeneity. It is possible that the same shock triggering the banking distress also leads to a decline in investment and bank credit. For example, a recession can increase the probability of a banking crisis via an increase in the number of non-performing loans and at the same time it can also cause firms to cut back on investment due to poor economic prospect. Thus, part of the estimated output loss would have occurred even in the absence of banking crises and cannot be attributed to banking crisis per se.

In order to address this endogeneity issue, we create a dummy variable to represent the recessionary episodes and augment equation (1a) and equation (1b) with this dummy. We use Bry and Boschan (1971) algorithm to determine the turning points in economic activity. This algorithm looks for local minima in the real GDP per capita (in levels) series. Each minimum is labeled as a trough and the preceding local maximum as a peak. [13] If banking crises dummy is still significant, it implies that banking crises have an exogenous impact on investment and bank credit.[14] The results are presented in Table 5b. Again for or brevity, we only present the estimated banking crisis coefficients for each time horizon k=1,…,6. The results remain very similar to the baseline results, suggesting that endogeneity is not a serious concern.

(b) Role of structural variables

This section assesses whether the effect of banking crises on investment ratio and bank credit-to-GDP ratio varies depending on countries' structural characteristics, such as the level of income, trade openness, and capital openness. In case of investment ratio, we also examine

[13] We identify 581 recessions and 323 peaks in our sample of 79 countries over the 1973-2010 period.
[14] We do recognize that the better way to claim that banking crises have exogenous impact on investment and bank credit is to look into the firm level or industry level data and see whether or not the firms (or industries) more dependent on bank financing are hurt more during banking crises relative to firms (or industry) that are less dependent on bank financing. However, this is beyond the scope of this paper.

whether the level of financial development affects the dynamics of investment ratio following episodes of systematic banking distress.

(i) Level of income

The empirical literature mostly finds that banking crises are associated with higher output cost in more developed economies (See Cerra and Saxena, 2008; and Zdzienicka, 2012a). Hoggarth et al. (2002) argue that one reason for this is that crises in the developed countries tend to last longer relative to the crises in the emerging economies. In addition, the developed countries are more immune to shocks, and it takes a larger shock to trigger a banking crisis.

We examine whether investment and bank credit also decline more and for a longer period of time in developed countries relative to emerging economies. We do so, by first splitting the sample into two groups of emerging and advanced economies and estimating equation (1a) and (1b) for each sub-sample. The results are presented in Figure 3. We can see that both the investment ratio and bank credit ratio decline much more during banking crises in the advanced economies. The cumulative decline in investment ratio is about 2 percentage points and in bank credit-to-GDP ratio is about 30 percentage points within six years of a systematic banking distress.

To further test whether the impact of banking crises on investment ratio is statistically different between advanced and emerging countries, we estimate equation (3a) and (3b) and check for the significance of the interaction term (γ_k) at each time horizon k. The estimation results are presented in Table 6. The results indicate that the dynamics of investment and bank credit ratio are different in the two groups of economies. The decline in bank credit ratio is especially much higher in advanced countries. This maybe because the banking sector in more developed in these countries, therefore a disruption in activity of these financial intermediaries is more disruptive.

(ii) Level of Capital and Trade Openness

Subsequently, we investigate the role of trade and capital openness by estimating equation (2a) and (2b) by alternatively including trade openness (sum of exports and imports to GDP) and capital openness (KAOPEN and INTEGRATION) as controls and interaction terms. The results are displayed in Figure 4 for three values of capital (trade) openness: (1) one standard deviation above the mean of capital (trade) openness measure; (2) the mean of capital (trade) openness measure; and (3) one standard deviation below the mean of capital (trade) openness measure. Following Furceri Zdzienicka (2012a), we highlight the statistical significance of the results, by allowing the IRFs to differ from the average effect only when the interaction term is statistically significant. We also control for currency crises, because higher level of capital and trade openness can increase the probability of currency crises.[15] Thus, in order to make sure the estimated coefficients for capital and trade openness are not capturing the impact of currency crises; we control for currency crises episodes.

The results suggest that when capital openness is measured using KAOPEN (de jure measure), the impact of banking crises on investment and bank credit ratio varies with the level of capital openness, with the effect being much larger for more open economies (corresponding to one standard deviation above the mean of KAOPEN). Trade openness does not significantly alter the dynamics of investment after banking crises. As for bank credit ratio, while in the short run higher trade openness leads to a larger decline, this impact is not significant in the medium run (Figure 4). Finally, when de facto measure of capital openness, INTEGRATION is used, we find that impact of banking crises on investment is not statistically significant across various levels of trade openness for investment or bank credit ratio.

[15] In other words, higher capital and trade openness are correlated with occurrences of currency crises and thus excluding the currency crises dummy leads biases the estimates (omitted variable biased).

(iii) Level of financial development

Finally, we examine whether the impact of banking crises on investment ratio varies with the level of financial development of the country. The financial development is measured by credit to private sector by depository banks (%GDP), which has long been used as an indicator of banking sector development (Baltagi, Demetriades and Law, 2009; Ndikumana, 2000; Rajan and Zingales, 2003). [16] The results in Figure 5 suggest that in countries with higher level of financial development (corresponding to one standard deviation above the mean of financial development measure), the decline in investment ratio is deeper and it also takes longer to recover.

(c) Crises Resolutions

We have already shown that the credit provided to private sector by banks is persistently and significantly declines after systematic banking crises. Previous empirical studies find a permanent decline in the *level* of GDP. If the behavior of output is driven primarily by the bank credit, then restoring the credit and confidence in the banking system should be a top priority for the policy-makers in the aftermath of banking crises. In this section, we briefly explore the effect of different forms of policy resolutions on the recovery path of investment ratio and bank credit-to-GDP ratio. We obtain the list of policies implemented in a sub-sample of 29 banking crises episodes from Laeven and Valencia (2008b). These policies include: (1) Liquidity support; (2) Blanket guarantees; (3) Nationalization; (4) Recapitalization; and (5) Forbearance. We construct a dummy variable that corresponds to each of these policy resolutions and re-estimate equations (1a) and (1b) using these dummies. The results are displayed in Figure 6. The right panel shows the dynamics of investment ratio and the left panel represents the dynamics of bank credit-to-GDP ratio after implementation of each type of banking crises resolution. The investment losses

[16] This is variable is also or credit/GDP measure and thus for obvious reasons we only look at the impact of financial development on dynamics of investment ratio and not the bank credit following banking crises.

are similar regardless of the type of resolution implemented. Blanket guarantees are the only exceptions, which are associated with the largest decline in the investment ratio. The decline in investment ratio is about 6 percentage points in the first year after the start of the policy and about 4 percentage points in the medium run (6 years). The decline in bank credit varies with the type of banking intervention policy adopted. Blanket guarantees are again associated with the largest decline in bank credits.

These results are in line with and Zdzienicka (2012a) who find that blanket guarantees are associated with about 11 percentage points drop in real output in the medium run. In fact, the large decline in real output following blanket guarantee policies, can be somewhat explained through the large decline in bank credit during these episodes. The results should be interpreted with caution, as the data on banking resolution policies are available only for a small sub-sample of our banking crises episodes (about 29 episodes). Moreover, sometimes several policy resolutions are implemented together and thus detangling the cost associated with each type of resolution is difficult.

VI. Credit Booms and Dynamics of Investment-to-GDP and Bank Credit-to-GDP Ratio

Credit booms are known to be a good predictor of a banking crisis (Schularick and Taylor, 2009). In this section, we explore whether the dynamic adjustment of investment and bank credit ratio is different in banking crisis episodes preceded by a credit boom or not. In particular, we are interested to see whether the deleveraging process following a credit boom that led to a systematic banking distress is costly. In order to investigate this question, we undertake two different methodologies. In our first approach, we focus on banking crises episodes in isolation. Essentially, we consider each banking crises as one observation and follow the following steps:

(1) Calculate the deviation of credit-to-GDP ratio from its tranquil years trend in each banking crisis episode and in the three previous years. Following Hong and Tornell (2005), we

define tranquil years as all years with available data excluding the crisis year and the 3 years before and after the crisis. We call this deviation credit gap.

(2) Calculate the average of the credit gap in the three years prior to each banking crises episodes.

(3) Divide the sample into two categories: (i) banking crises in which the average of the credit gap is above its mean across all banking crises episodes and ; (ii) banking crises in which the average of the credit gap is below its mean across all banking crises episodes.[17] Specially, we construct two dummy variables:

Low_CG=1 if Bank Crisis=1 & Credit Gap < mean of Credit Gap across all banking crises episodes

High_CG=1 if Bank Crisis=1 & Credit Gap > mean of Credit Gap across all banking crises episodes

We end up with 26 episodes of banking crises in which the credit gap is above its mean and 48 episode in which it is below its mean. We re-estimate equation (1a) and (1b) by alternatively using Low_ CG and High_CG dummies. The results are displayed in Figure 7 for each of the dummies.

The interesting result is that the pattern of recovery in investment and bank credit-to-GDP ratio is completely different aftermath each type of banking crises. In fact, the magnitude of the decline in investment and bank credit is much smaller and the recovery is much swifter, when average pre-crisis credit gap is below its mean. The patterns of recoveries remain very similar when we use the median of pre-crisis credit gap to split the sample.[18] These results provide some

[17] Out of 74 episodes of banking crises in which the credit data was available for, the pre-crisis average of the credit gap is below mean for 48 episodes and above mean for 26 episodes of systematic banking crises.

[18] For robustness purposes, we also use a broader measure of credit (credit provided to private sector by banks or other financial institutions) to construct the credit gap variable and the results remain similar.

primary evidence that the cost of banking crises depends on the extent of pre-crisis credit expansion. In other words, macroeconomics adjustment is different during a banking crisis preceded by a credit boom and the one that is not.

In order to investigate this hypothesis further, we use our second approach. We first identify all episodes of credit booms in the sample and then divide the banking crises episodes into two groups of those preceded by a credit boom and those that did not.[19] Again, we construct two dummy variables: PRE-BOOM and NO_BOOM. The PRE_BOOM dummy variable is equal to one if there is a banking crisis in a country in a year, which is preceded by a credit boom and zero otherwise. The NO_BOOM dummy variable captures all episodes of banking crises that were not preceded by a credit boom. We use these two dummies alternatively in equation (1a) and equation (1b) and estimate the dynamics of investment and bank credit-to-GDP ratio following each type of banking crises. Number of banking crises episodes falling into PRE_BOOM and NO_BOOM categories is almost the same.[20]

We use two measure of credit-to-GDP ratio to define credit boom episodes. One measure is the credit to private sector by depository money bank (IFS line 22d). The other measure is a broader measure of credit and is taken from Gourinchas and Obstfeld (2012). The broader measure is the total domestic claims of depository corporations (central banks and other depository corporations- IFS line 32- minus net claims on central government (IFS line 32a).[21]

The results are presented in Figure 8. It is evident that again the pattern of recovery in investment and bank credit ratio is quite different after each type of banking crises. Specifically, if

[19] A banking crisis episode is considered to be preceded by a credit boom, if there is a credit boom in any of the three years before the banking distress. In order to identify credit booms we closely follow the previous literature (See Barajas, Dell' Arccia, and Levchenko, 2007; Gourinchas,Valdes, and Landerretche, 2001; Mendoza and Terrones, 2012).

[20] Please see the Appendix for the detailed description of credit boom identification. Because credit boom identification is beyond the scope of this paper, we did not include the detailed description in the text.

[21] Exceptions include: for Brazil (IFS, line 22d+22g), for Argentina, Australia, Ivory Coast (IFS 32d+32g), and for Norway (domestic credit data from Schularick and Taylor, 2009).

a credit boom precedes a banking crisis, investment and bank credit-to-GDP ratio decline significantly. The decline is not reversed in the medium run and the cumulative decline is about 2 and 10 percentage points in investment ratio and bank credit-to-GDP ratio, respectively. On the other hand, investment ratio swiftly recovers to its pre-crisis level within two years (similar to baseline results) if the banking crisis is not preceded by a credit boom. Bank credit ratio declines after both types of banking crises, however, the decline is more gradual and less severe in case of banking crises that are not preceded by a credit boom. Overall, these results stress the need for further research on this topic.

VII. Conclusion

How does banking crises impact investment ratio and bank credit-to-GDP ratio in the short and medium run? Does the impact vary with country characteristics, such as the level of income, level of financial development, or the level of capital and trade openness? This paper explores the answer to these questions using a panel of 79 developed and emerging economies over the period 1973 to 2010 period.

Our results suggest that following banking crises investment and bank credit-to-GDP ratio both decline in the short run, however investment rebounds to its pre-crisis level within three years. Nevertheless, bank credit does not recover in the medium run (6 years). Furthermore, we find that several country characteristics are important in determining the dynamics of investment and bank credit following banking crises. Advanced countries and countries with greater level of capital openness experience a greater decline in investment and bank credit ratio. Also, higher level of financial development is associated with a larger decline in investment after a banking crisis. Additionally, we investigate whether a particular type of crisis resolution policy is associated with a better post-crisis performance. We do not find any of the resolution policies to significantly improve the post-crisis performance. Finally, we split the banking crises episodes

into two categories of those that were preceded by a credit boom and those that were not. Our results suggest that in aftermath of systematic banking distress episodes that are not preceded by a credit boom, investment ratio declines only in the short-run and swiftly recovers to its pre-crisis level. However, those crises preceded by a credit boom experience a significant and persistent decline in both investment and bank credit.

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Table 1- Sources of Data:

Variable	Description	Source
Investment Ratio	Fixed capital formation (% GDP)	World Development Indicators
Credit-to-GDP	Credit to private sector by depository money banks	Financial Global Development
KAOPEN	Capital Openness (de jure)	Chinn and Ito (updated to 2012)
INTEGRATION	Capital Openness (de facto)	Lane and Milesi-Ferretti (2007)
Trade Openness	(Exports+Imports)/GDP	World Development Indicators
B	Banking Crisis dummy	Laeven and Valencia (2012)
CC	Currency Crisis	Laeven and Valencia (2008a)
DC	Debt Crisis	Laeven and Valencia (2008a)
gdppc	GDP per capita	World Development Indicators
Resolution	Resolution Policies	Laeven and Valencia (2008b)
Leverage	Alternative Credit Measure	Gournchas and Obstfeld (2012)

Table 2- Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
Capital Formation/GDP	2594	22.25	5.75	2.65	46.25
Credit/GDP	2259	51.51	39.99	1.12	272.81
(Exports+Imports)/GDP	2602	76.85	54.18	8.78	439.66
KAOPEN	2291	0.55	1.62	-1.81	2.53
Log(Real GDP per capita)	2639	8.78	1.34	5.09	11.31

Table 3- Unconditional Path of Investment After Banking Crises

	T+1	T+2	T+3	T+4	T+5	T+6
$\Delta I_{i,t-1}$	-0.132*	-0.269*	-0.359*	-0.416*	-0.462*	-0.533*
	(0.038)	(0.050)	(0.052)	(0.038)	(0.044)	(0.053)
$\Delta I_{i,t-2}$	-0.116*	-0.171*	-0.227*	-0.267*	-0.331*	-0.367*
	(0.028)	(0.030)	(0.033)	(0.033)	(0.038)	(0.053)
$\Delta I_{i,t-3}$	-0.075*	-0.134*	-0.158*	-0.209*	-0.251*	-0.266*
	(0.025)	(0.025)	(0.029)	(0.037)	(0.052)	(0.047)
$\Delta I_{i,t-4}$	-0.089*	-0.154*	-0.213*	-0.280*	-0.294*	-0.317*
	(0.026)	(0.026)	(0.043)	(0.063)	(0.058)	(0.065)
Banking Crisis	-1.510*	-2.016*	-0.608	0.173	0.561	0.060
	(0.363)	(0.501)	(0.681)	(0.725)	(0.756)	(0.658)
Constant	-0.108	-1.773*	0.280	-2.222*	-0.957	-2.052*
	(0.300)	(0.377)	(0.564)	(0.501)	(0.751)	(0.743)
R^2	0.131	0.169	0.178	0.194	0.209	0.218
Groups	79	79	79	79	77	77
N	2106	2025	1944	1863	1784	1708

Robust standard errors are in parentheses. + $p < 0.10$, * $p < 0.05$. Dependent variable is investment ratio= Investment/GDP. Banking Crisis is a dummy variable equal to one when a country during the sample experiences a banking crisis. The sample includes about 79 countries in 1973-2011 period.

Table 4- Unconditional Path of Bank Credit After Banking Crises

Time	T+1	T+2	T+3	T+4	T+5	T+6
$\Delta(Credit/GDP)_{i,t-1}$	0.119*	0.005	-0.241	-0.065	0.154+	0.120
	(0.040)	(0.162)	(0.365)	(0.282)	(0.090)	(0.103)
$\Delta(Credit/GDP)_{i,t-2}$	-0.207	-0.229	-0.007	0.029	-0.107*	-0.145+
	(0.155)	(0.178)	(0.107)	(0.107)	(0.051)	(0.074)
$\Delta(Credit/GDP)_{i,t-3}$	0.034	0.034	0.004	0.007	0.059	-0.124
	(0.028)	(0.046)	(0.089)	(0.102)	(0.076)	(0.126)
$\Delta(Credit/GDP)_{i,t-4}$	-0.033	-0.044	-0.083	-0.179	-0.445*	-0.663*
	(0.028)	(0.039)	(0.065)	(0.108)	(0.160)	(0.170)
Banking Crisis	0.448	-2.299*	-5.898*	-8.314*	-10.529*	-10.397*
	(0.762)	(1.102)	(2.057)	(2.660)	(3.111)	(3.267)
Constant	1.104*	1.503+	2.721	3.089	4.524+	12.880*
	(0.503)	(0.896)	(2.030)	(2.096)	(2.502)	(3.133)
R^2	0.079	0.060	0.061	0.058	0.068	0.075
Countries	73.00	73.00	73.00	72.00	72.00	72.00
N	1747	1665	1591	1516	1443	1372

Robust standard errors are in parentheses. + $p < 0.10$, * $p < 0.05$. Dependent variable is bank credit-to-GDP ratio. Banking Crisis is a dummy variable equal to one when a country during the sample experiences a banking crisis. The sample includes about 79 countries in 1973-2011 period.

Table 5a- Path of Investment After Pure Banking Crises

	T+1	T+2	T+3	T+4	T+5	T+6
Investment ratio	-1.478*	-2.015*	-0.655	0.031	0.432	-0.067
	(0.367)	(0.502)	(0.674)	(0.707)	(0.762)	(0.696)
Credit/GDP	0.68	-1.935+	-5.481*	-7.991*	-10.369*	-10.202*
	(0.802)	(1.121)	(2.029)	(2.709)	(3.218)	(3.421)

Robust standard errors are in parentheses. + $p < 0.10$, * $p < 0.05$. The reported estimates represent estimates of coefficients β_k for k=1,..., 6, when we estimate Equation (1a) and (1b), while controlling for currency and debt crises episodes. The sample includes about 79 countries in 1973-2011 period.

Table 5b- Path of Investment After Banking Crises Controlling for Recessions

	T+1	T+2	T+3	T+4	T+5	T+6
Investment ratio	-1.295*	-1.821*	-0.526	0.192	0.535	0.01
	(0.358)	(0.496)	(0.671)	(0.709)	(0.752)	(0.672)
Credit/GDP	0.809	-1.385	-4.608*	-6.788*	-8.863*	-8.466*
	(0.776)	(1.088)	(1.878)	(2.331)	(2.766)	(2.922)

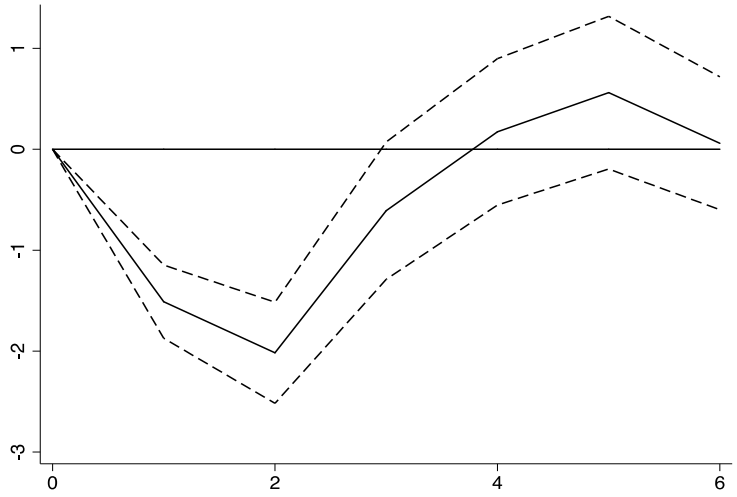
Robust standard errors are in parentheses. + $p < 0.10$, * $p < 0.05$. The reported estimates represent estimates of coefficients β_k for k=1,.., 6, when we estimate Equation (1a) and (1b), while controlling for recessionary episodes with a dummy variable for recessions (using Bry and Boschan (1971) algorithm). The sample includes about 79 countries in 1973-2011 period.

Table 6- Impact of Banking Crisis on Investment and Bank Credit Ratio in Advanced Versus Emerging Economies

		T+1	T+2	T+3	T+4	T+5	T+6
Investment ratio	Banking Crisis	-1.540*	-1.974*	-0.319	0.493	0.904	0.315
		-0.46	-0.625	-0.756	-0.778	-0.813	-0.71
	Banking Crisis*Advanced	0.122	-0.167	-2.291+	-3.447*	-3.686*	-2.787*
		-0.688	-0.895	-1.202	-1.22	-1.103	-1.206
Credit/GDP	Banking Crisis	0.552	-3.051*	-5.789*	-6.363*	-7.351*	-6.957*
		-0.841	-1.367	-2.146	-2.662	-2.667	-2.676
	Banking Crisis*Advanced	-0.374	2.66	-0.716	-16.914*	-27.510*	-29.594*
		-3.009	-3.761	-5.14	-6.161	-11.818	-13.207

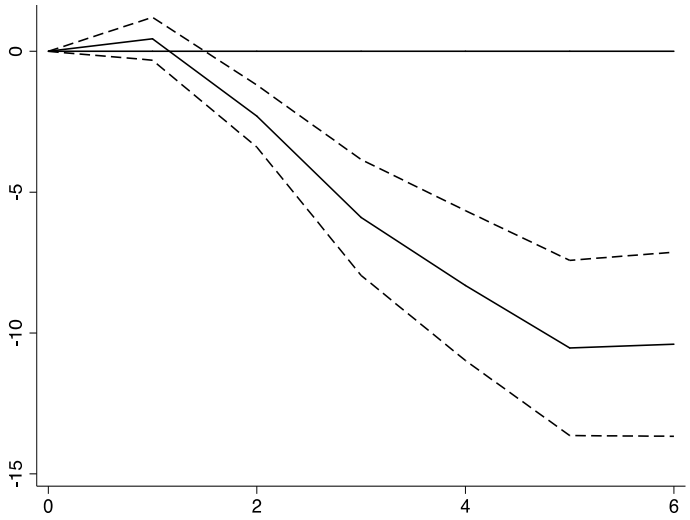
Robust standard errors are in parentheses. + $p < 0.10$, * $p < 0.05$. The dependent variable is the investment-to-GDP (I) or bank credit-to-GDP ratio. The reported estimates represent estimates of coefficients β_k and γ_K for k=1,.., 6, when Equation (3a) and (3b) are estimated. The sample includes 22 advanced and 57 emerging economies. The sample period is 1973-2010.

Figure 1- Impulse Response of Investment Ratio to a Banking Crisis



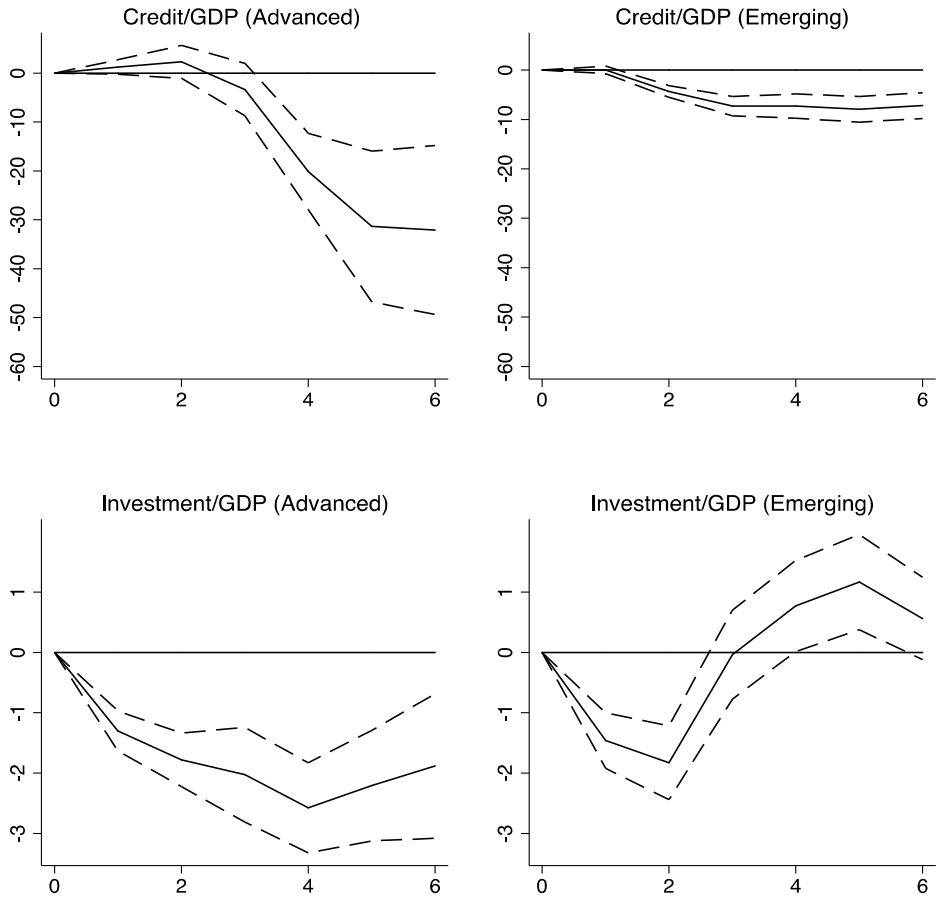
Note: The horizontal axis indicates time in years. The vertical axis measures response of investment-to-GDP ratio in percentage points. The dotted lines represent one standard deviation confidence bands. The sample includes 79 in the 1973-2010 period. Equation (1a) is estimated and the IRF is obtained by plotting the estimated coefficients β_k for k=1,…,6. Confidence bands represent the standard deviation of β_k at each time horizon k. Impulse responses is derived using local projections.

Figure 2- Impulse Response of Bank Credit to a Banking Crisis



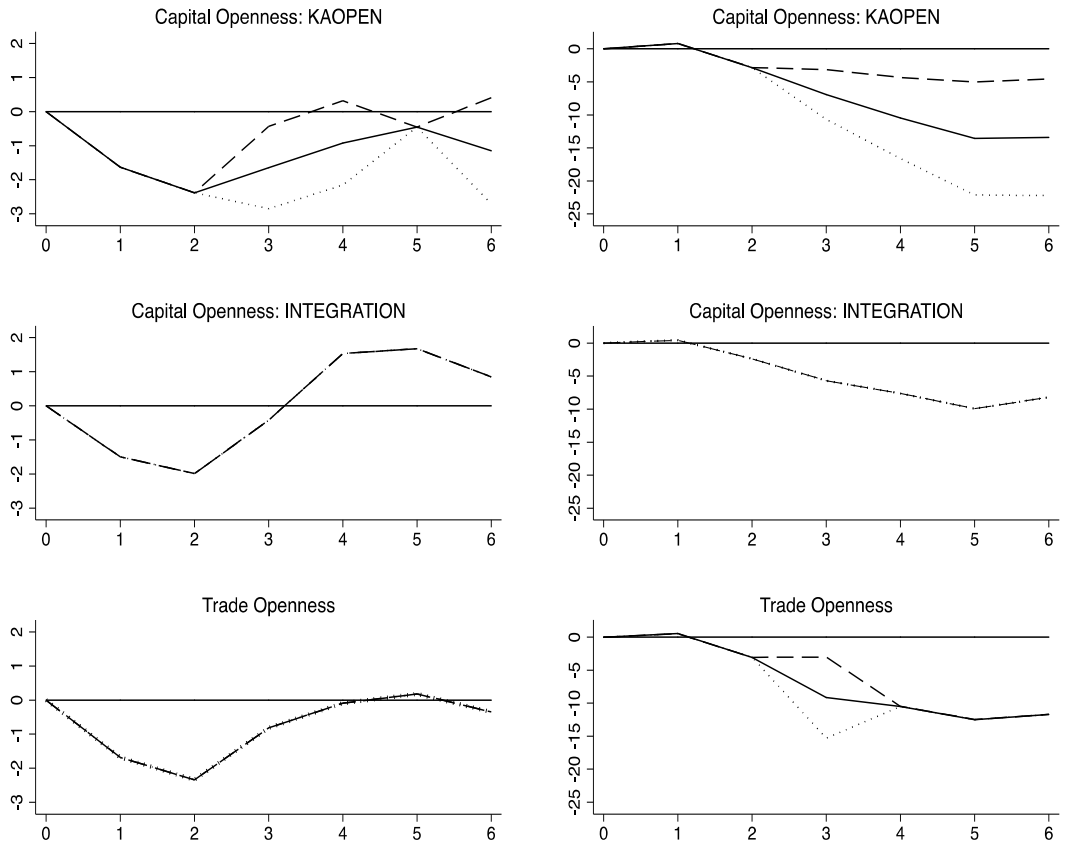
Note: The horizontal axis indicates time in years. The vertical axis measures response of bank credit-to-GDP ratio in percentage points. The dotted lines represent one standard deviation confidence bands. The sample includes 79 in the 1973-2010 period. Equation (1b) is estimated and the IRF is obtained by plotting the estimated coefficients β_k for k=1,…,6. Confidence bands represent the standard deviation of β_k at each time horizon k. Impulse response is derived using local projections.

Figure 3- The Impulse Response of Investment ratio and Bank Credit-to-GDP Ratio to a Banking Crisis in Advanced Versus Emerging Economies



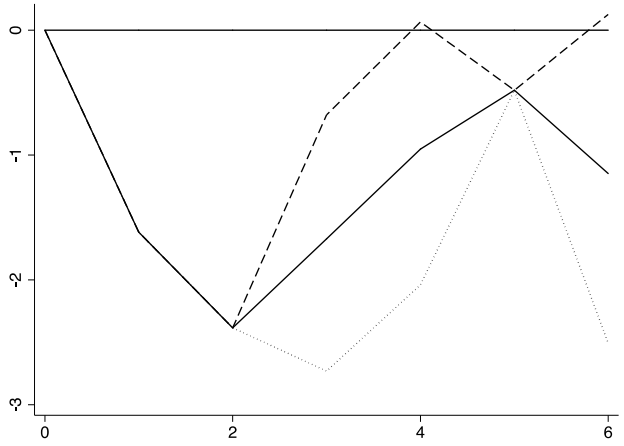
Note: The horizontal axis indicates time in years. The vertical axis measures response of investment (credit-to-GDP) ratio to a banking in percentage points. The sample includes 22 advanced and 57 emerging economies. The sample period is 1973-2010. Impulse responses are derived using local projections.

Figure 4- The Impulse Response of Investment and Bank Credit-to-GDP Ratio to a Banking Crisis Controlling for the Level of Capital openness and Trade Openness



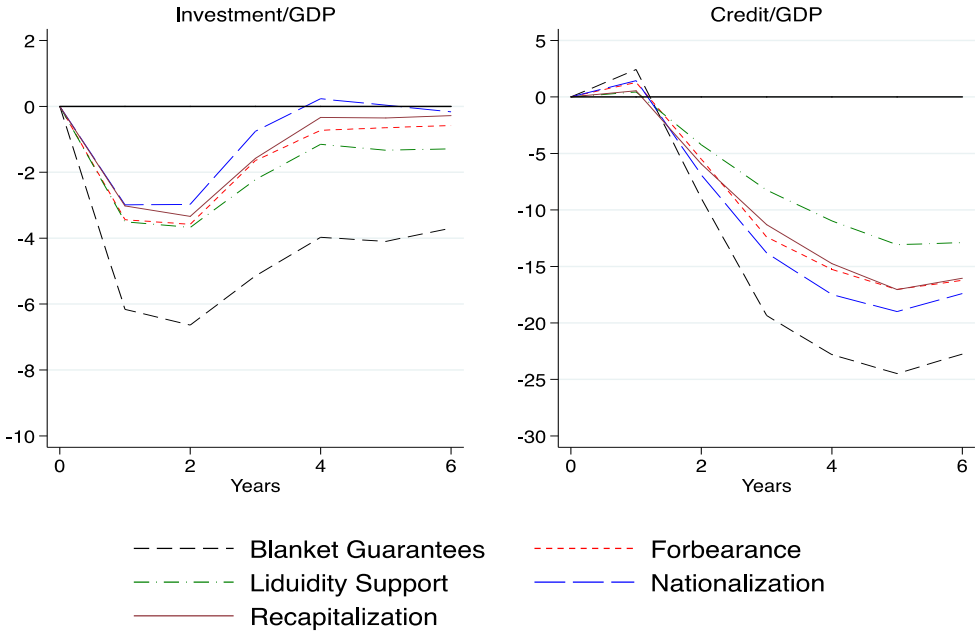
Note: The impact of banking crises on investment and bank credit is evaluated at three values of capital (trade) openness: one standard deviation below the mean of capital (trade) openness measure (dashed line); (2) the average response (solid line); and (3) one standard deviation below the mean of capital (trade) openness measure (dotted line). The KAOPEN is Chinn-Ito index (de jure measure of capital openness). INTEGRATION is the sum of a country's foreign assets and liabilities as a percentage of GDP (de facto measure of capital openness) and is taken from Lane and Milesi-Ferretti (2007). Trade openness is proxied by the sum of exports and imports as a percentage of GDP. The sample includes total of 79 countries and the sample period is 1973-2010. Impulse responses are derived using local projections.

Figure 5- The Impulse Response of Investment Ratio to a Banking Crisis Controlling for the Level of Financial Development



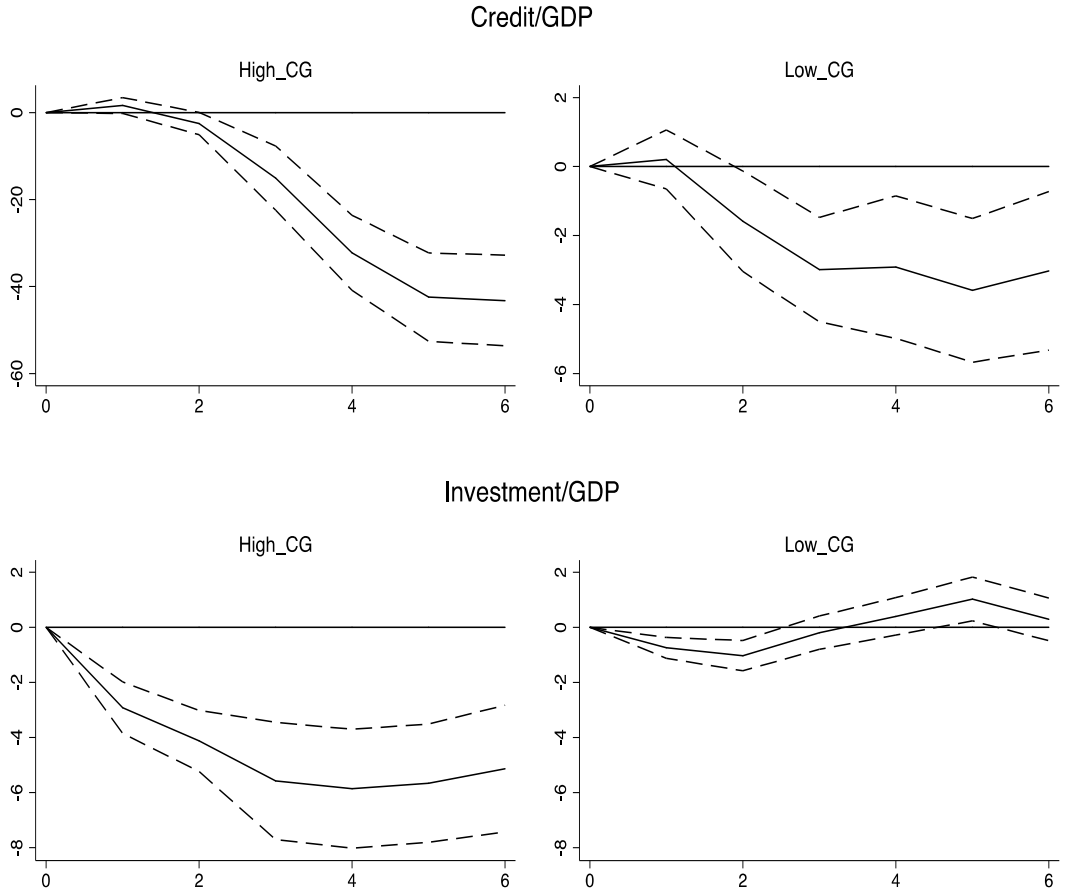
Note: The impact of banking crises on investment is evaluated at three values of capital (trade) openness: one standard deviation below the mean of financial development measure (dashed line); (2) the average response (solid line); and (3) one standard deviation below the mean of financial development measure (dotted line). Finnancial development is bank credit defined as the credit provided by depository money banks to the private sector (%GDP). The sample includes total of 79 countries and the sample period is 1973-2010. Impulse response is derived using local projections

Figure 6- Dynamics of Investment and Bank Credit Ratio and Banking Crises Resolutions



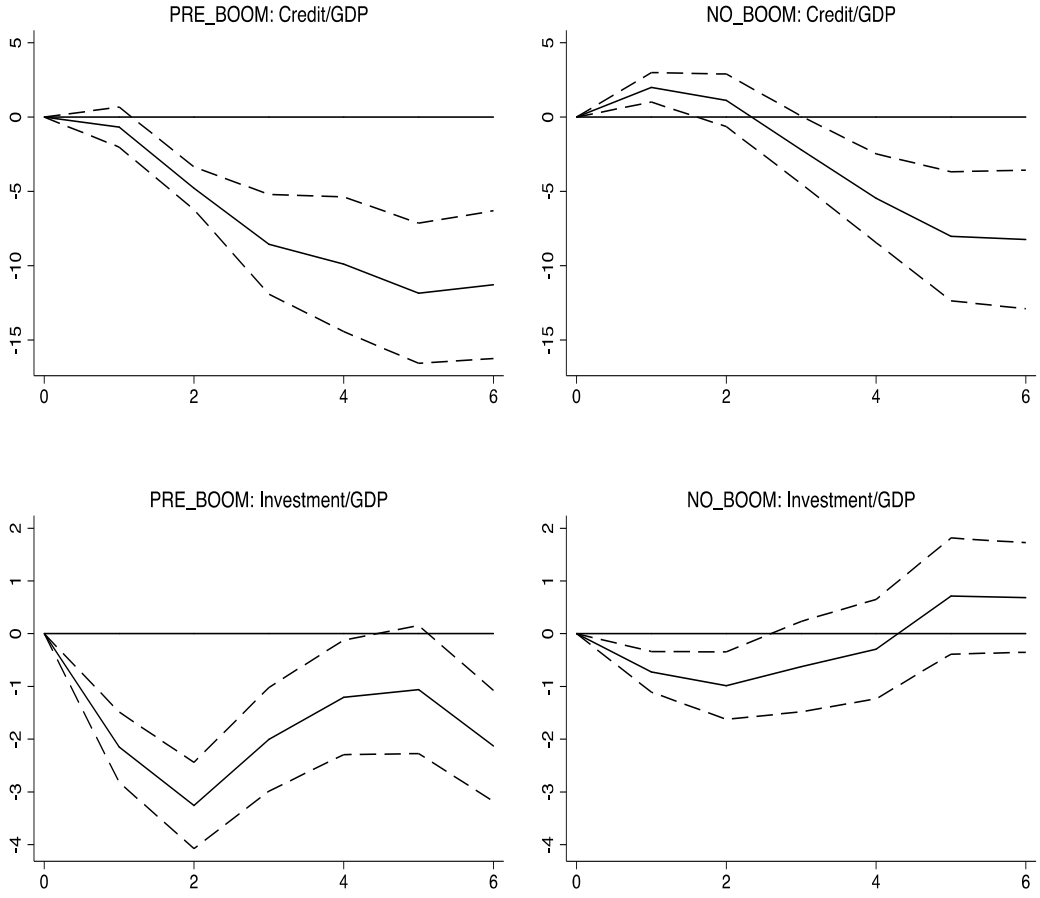
Note: The impact of different policy resolutions aftermath of a sub-sample (29) of banking crises episodes. The period is 1973-2010.

Figure 7- The Impulse Response of Investment Ratio to a Banking Crisis When Credit Gap is Higher and Lower Than its Mean



Note: The horizontal axis indicates time in years. The vertical axis measures response of investment (credit-to-GDP) ratio to a banking in percentage points. We split the banking crises sample into two groups of High_CG and low_CG. High(Low)_CG includes those episodes of systematic banking distress in which the average of credit gap (defined as deviation of credit-to-GDP ratio from its tranquil years average) three years before the crisis is above (below) its mean across all banking crises episodes. Out of 74 episodes of banking crises with available data for credit gap, 26 fall above the mean and 48 fall below the mean of average pre-crisis credit gap (across all banking crises episodes). The sample period is 1973-2010. Equation (1a) and (1b) are estimated with the High_CG and Low_CG dummies to derive the impulse responses.

Figure 8- The Impulse Response of Investment Ratio to a Banking Crisis Preceded by a Credit Boom and a Banking Crisis Not Preceded by a Credit Boom



Note: The horizontal axis indicates time in years. The vertical axis measures response of investment (credit-to-GDP) ratio to a banking in percentage points. We split the banking crises sample into two groups of those preceded by a credit boom and those not preceded by a credit boom. The sample splits almost in the middle between the two types of banking crises. The sample includes 79 countries over the 1973-2010 period. Equation(1a) and (1b) are estimated with the PRE_BOOM and NO_BOOM dummies to derive the impulse responses.

Appendix- A: List of Countries and Banking Crises Episodes:

Country	Year	Country	Year
ARG	1980 *, 1989 *, 1995 *, 2001	JOR	1989*
AUT	2008	JPN	1997
BEL	2008*	KAZ	2008*
BGR	1996*	KOR	1997
BIH	1992	KWT	1982*
BLR	1995	LBN	1990
BRA	1990*	LKA	1989
CHE	2008	LTU	1995*
CHL	1976*, 1981*	LVA	1995, 2008*
CHN	1998	MAR	1980
CIV	1988	MEX	1981, 1994*
COL	1982, 1998	MKD	1993
CZE	1996	MYS	1997*
DEU	2008	NGA	1991, 2009*
DNK	2008	NLD	2008
DOM	2003*	NOR	1991*
ECU	1982, 1998	PAN	1988
ECU	1998*	PER	1983
EGY	1980*	PHL	1983*, 1997*
ESP	1977, 2008*	POL	1992*
EST	1992	PRT	2008
FIN	1991*	ROM	1990
FRA	2008*	RUS	1998*, 2008*
GBR	2007	SLV	1989*
GEO	1991	SVK	1998*
GRC	2008*	SVN	1992, 2008*
HRV	1998*	SWE	1991
HUN	1991, 2008*	SWE	2008, 1991
IDN	1997*	THA	1983, 1997*
IND	1993	TUN	1991*
IRL	2008*	TUR	1982, 2000*
ISL	2008*	UKR	1998*
ISR	1977*	UKR	2008*
ITA	2008	URY	1981, 2002*
JAM	1996	USA	1988, 2007
		VEN	1994

Note: The * represent periods of banking crises that are preceded by a credit boom based on our definition of credit boom in the paper. The banking crises episodes are taken from Laeven and Valencia (2012).

Appendix B: Description of Credit Booms:

First Approach:

1.$Capital\ Gap = CG = (\frac{Bank\ Credit}{GDP} - \overline{\frac{Bank\ credit}{GDP}})$

Where $\frac{Bank\ credit}{GDP}$ is tranquil years credit-to-GDP ratio trend. Tranquil years include all years excluding the crisis and three years before and after.

2. For each banking crisis episode, we compute the average of CG three years before each banking crisis episode:

$(CG_{t-1} + CG_{t-2} + CG_{t-3})/3$= AVE_PRE_CG

3. Calculate the mean value of AVE_PRE_CG across all banking crises episodes (MEAN)

4. For each banking crisis episode if

AVE_PRE_CG > MEAN ➔ banking crises that are preceded by a credit boom ➔ 26 episodes

AVE_PRE_CG < MEAN ➔ banking crisis that are not preceded by a credit boom ➔48 episodes

Second Approach:

A credit boom is an episode in which the deviation of credit-to-GDP ratio from its country-specific Hodrick Prescott trend ($\lambda = 100$) exceeds a certain threshold. The idea is that the trend represents the normal pace of credit expansion in each country. More specifically, we following Barajas et al. (2001), an episode becomes a boom if credit-to-GDP ratio exceeds or meets either of the following conditions:[22]

i) The deviation from trend is greater than 1.5 times country specific standard deviation and the growth rate of the Credit-to-GDP ratio is greater than 10 percent.

ii) The growth rate of the Credit-to-GDP ratio is greater than 20 percent.

[22] This definition considers country-specific conditions and takes into account both the relative level and speed of the credit-to-GDP ratio. A country-specific approach is more appropriate because a large deviation in one country may not be considered as large in another country with a volatile credit growth history. The rate of growth of Credit-to-GDP ratio is included to control for cases in which, extremely fast credit growth may occur while the actual ratio is close to its trend.

Once a credit boom is identified, the starting date of the boom is the earliest year in which:

i) The Credit-to-GDP ratio exceeds its trend by more than three-fourth of its standard deviation and its annual growth rate exceeds 5 percent.

ii) Its annual growth rate exceeds 10 percent.

A boom ends as soon as one of the two following criteria is satisfied:

i) The growth rate of the Credit-to-GDP ratio turns negative

ii) The Credit-to-GDP ratio falls below three-fourth of its standard deviation and its annual growth rate is below 20 percent.