



# IMF Working Paper

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## What's the Damage? Medium-term Output Dynamics After Banking Crises

*Abdul Abiad, Ravi Balakrishnan,  
Petya Koeva Brooks, Daniel Leigh, and  
Irina Tytell*

**IMF Working Paper**

Research Department

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**Prepared by Abdul Abiad, Ravi Balakrishnan,  
Petya Koeva Brooks, Daniel Leigh, and Irina Tytell**

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**Abstract**

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This paper investigates the medium-term behavior of output following banking crises, and its association with pre- and post-crisis conditions and policies. We find that output tends to be depressed substantially following banking crises, with no rebound to the precrisis trend. However, growth does eventually tend to return to its precrisis rate, with substantial cross-country variation in outcomes. The depressed path of output typically results from reductions of roughly equal proportions in the employment rate, the capital-to-labor ratio, and total factor productivity. Initial conditions that are strongly associated with medium-run output losses include the short-run change in output, the occurrence of a joint banking-and-currency crisis, and a high precrisis level of investment. Short-run fiscal and monetary stimulus is associated with smaller medium-run deviations of output and growth from the precrisis trend.

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Authors' E-Mail Addresses: [AAbiad@imf.org](mailto:AAbiad@imf.org), [RBalakrishnan@imf.org](mailto:RBalakrishnan@imf.org),  
[PKoeva@imf.org](mailto:PKoeva@imf.org), [DLeigh@imf.org](mailto:DLeigh@imf.org), [ITytell@imf.org](mailto:ITytell@imf.org)

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## I. INTRODUCTION<sup>1</sup>

The global economy is beginning to recover from the most severe financial crisis since the Great Depression and the deepest recession since World War II. Financial systems remain impaired and domestic and external imbalances persist in many economies. The recovery is expected to be slow, and there are concerns about the prospect of long-term damage to the path of global output, as financial institutions and markets worldwide struggle to restore their ability to intermediate and unemployment rises to high levels.

In this context, this paper examines medium-term macroeconomic performance following past banking crises in advanced, emerging, and developing economies over the past 40 years. A first glance at several previous episodes suggests that while banking crises typically lead to large output losses in the short run, what happens to output over the medium run has varied widely (Figure 1). Some countries persistently grow at a slower rate than before, moving further away from their precrisis trend, as in the case of Japan and Thailand (1997). Some return to the precrisis growth rate, but fail to recover the initial output loss, as in the case of Sweden (1991) and Korea (1997). Some eventually return to their precrisis trend (Turkey, 2000), and some recover quickly and outperform the previous trend (Mexico, 1994).

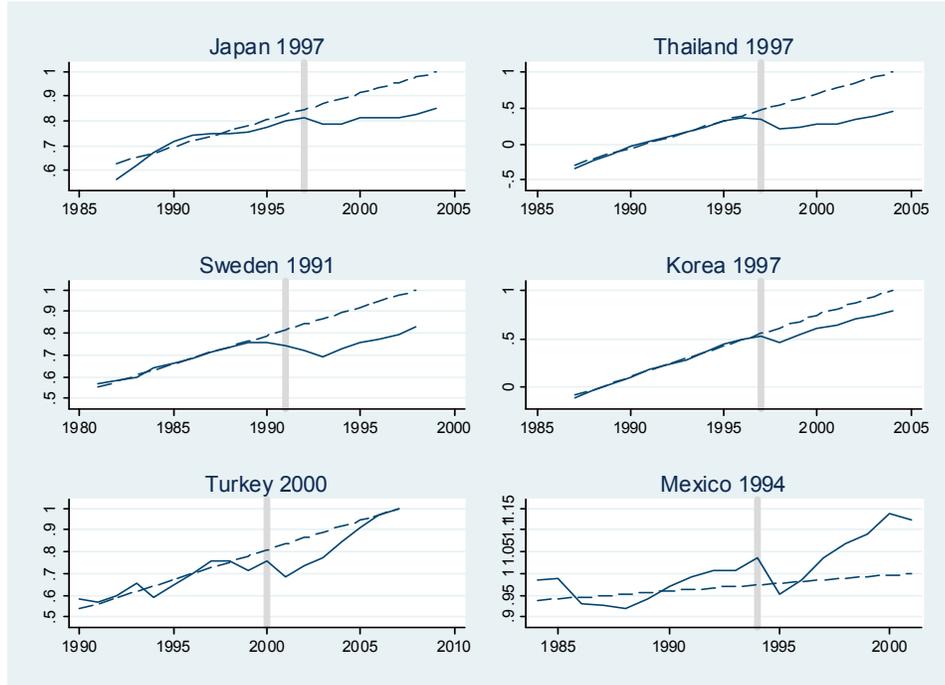
While a great deal of work exists on the output effects of financial crises in the short run, until recently, the emphasis on the medium run following banking crises has been much more limited, with the notable exceptions of Boyd et al. (2005) and Cerra and Saxena (2008).<sup>2</sup> Given the recent banking crises in a number of economies including the United States, interest in the topic has risen. For instance, Furceri and Mourougane (2009) apply the Cerra-Saxena approach, which involves using an autoregressive model of output growth rates augmented by crisis dummies, to growth rates of potential output for OECD countries. Pisani-Ferry and van Pottelsberge (2009) also discuss the persistent impact on output of banking crises using several case studies. In another recent study, Haugh, Ollivaud, and Turner (2009) analyze the impact of banking crises on potential growth in Finland, Norway, Sweden, and Japan.

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<sup>1</sup> The authors would like to especially thank David Romer for his many insights and suggestions. They are grateful also to Olivier Blanchard, Charles Collyns, Jorg Decressin, and to participants at an IMF Research Department seminar. Chris Papageorgiou kindly provided us with computer code to implement the Bayesian Model Averaging analysis. Stephanie Denis, Murad Omoev, and Min Song provided excellent research assistance. This paper expands on ideas presented in Chapter 4 of the October 2009 World Economic Outlook (International Monetary Fund, 2009a).

<sup>2</sup> Studies that examine the short-run effects of financial crises include, for example, Reinhart and Rogoff (2009), Haugh, Ollivaud, and Turner (2009), IMF (2009b), Bordo (2006), Hutchinson and Noy (2002), and Gupta, Mishra and Sahay (2007).

Figure 1. Selected Banking Crises  
(Log scale)



Note: figure reports logarithm of real GDP per capita (solid line), and its precrisis trend (dashes), vertical bar indicates first year of banking crisis.

This paper extends those studies in five main ways. First, it examines the medium-term dynamics of output in a particularly wide sample that includes 88 banking crises over the past four decades and across countries with high, middle, and low income levels. Second, it explores not only how the post-crisis level of output compares to the precrisis trend (“output loss”), but also how the postcrisis growth rate of output compares with its precrisis trend growth rate (“growth loss”). Third, in terms of methodology, the estimation of the pre-crisis trend ends several years before the crisis, so that it is not contaminated by the possibility of an unsustainable boom in the run-up to the crisis or a pre-crisis slowdown. Fourth, our analysis decomposes the medium-term dynamics of output into both factor components (capital, employment, labor-force participation, and total-factor productivity), as well as demand-side factors (consumption, investment, exports, and imports). Finally, given the wide range of post-crisis outcomes, we assess the correlation between post-crisis output and growth losses and variables measuring initial conditions and policy responses.

Our first main finding is that the path of output tends to be depressed substantially and persistently following banking crises, with no rebound on average to the precrisis trend over the medium run. Growth does, however, tend to eventually return to its precrisis rate.

Second, the depressed path of output tends to result from long-lasting reductions of roughly equal proportions in the employment rate, the capital-to-labor ratio, and total factor

productivity. In the short run, the output loss is mainly accounted for by total factor productivity, but, unlike the employment rate and capital-to-labor ratio, the level of total factor productivity recovers somewhat to its precrisis trend over the medium run. In contrast, capital and employment suffer enduring losses relative to trend.

Third, initial conditions appear to have a strong association with the size of the output loss. What happens to short-run output is also a good predictor of the medium-term outcome, as is the joint occurrence of a currency and banking crisis. This is consistent with the notion that the output drop is especially persistent following large shocks, carrying over into the medium run. A high precrisis investment share is a reliable predictor of high medium-term output losses, via its correlation with the dynamics of capital after the crisis. There is also evidence suggesting that limited precrisis policy space tends to be associated with more muted medium-term recoveries. Interestingly, post-crisis output losses are not significantly correlated with the level of income.

Finally, the medium-run output loss is not inevitable. Some countries succeed in avoiding it, ultimately exceeding the precrisis trajectory. Although post-crisis output dynamics are hard to predict, the evidence suggests that economies that apply counter-cyclical fiscal and monetary stimulus in the short run after the crisis tend to have smaller output losses over the medium run. There is also some mixed evidence that structural reform efforts are associated with better medium-run outcomes. In addition, a favorable external environment is generally associated with smaller medium-term output losses.

How do these findings relate to shifts in potential output following financial crises? The term “potential output” typically refers to the level of output consistent with stable inflation and is associated with structural and institutional factors. If an economy experiences a decline in output relative to its previous trend over the medium term, it could reflect a decline in potential output, but it could also partly reflect a persistent fall in aggregate demand. The experience of a number of economies, including Japan, suggests that if output remains below its precrisis trend over the medium term, then a substantial part of the shortfall reflects lower potential. Therefore, to the extent that this paper identifies output losses seven years after a financial crisis, it is likely that lower potential explains most of those losses. However, attempting to precisely identify shifts in potential output is beyond the scope of this paper.

The paper is organized as follows. The first section describes key features of medium-term output dynamics following banking crises based on international experience over the past 40 years. The second section decomposes medium-term output losses into their factor components (capital, labor, and productivity), as well as their demand-side drivers (consumption, investment, exports, and imports). The third section analyzes how medium-term output losses relate to country characteristics and macroeconomic conditions prevailing before the crisis. It also examines the role of domestic policies and the external environment after the onset of the crisis. The fourth section analyzes how medium-term *growth*

performance relates to country characteristics and macroeconomic conditions before and after the crisis. The last section concludes the paper.

## II. DOES OUTPUT RECOVER OVER THE MEDIUM RUN?

This section presents key stylized facts on the output losses associated with banking crises. We start with methodological issues and then report some stylized facts on the estimated output losses at both the country level and global level.

The analysis focuses on banking crises, and uses a comprehensive set of banking crisis events from Laeven and Valencia (2008) from the early 1970s up to 2002. The Laeven-Valencia dataset is constructed by combining quantitative indicators measuring banking-sector distress, such as a sharp increase in non-performing loans and bank runs, with a subjective assessment of the situation. Currency crises are also considered for purposes of comparison, and currency crisis dates are identified based on the methodology of Milesi-Ferretti and Razin (1998). This definition requires: (i) a 15 percent minimum rate of nominal depreciation vis-à-vis the U.S. dollar; (ii) a minimum 10 percent increase in the rate of depreciation with respect to the previous year; and (iii) a rate of depreciation of below 10 percent in the previous year. Our sample includes 88 banking crises and 222 currency crises, distributed across countries with high, middle and low incomes. The sample excludes transition countries, as the output developments observed in these economies were strongly related to the shift away from central planning rather than to financial crises. Countries with a population of less than one million are also dropped.

We compute the medium-term output loss for each episode as illustrated in Figure 2. The idea behind the exercise is to measure the output loss associated with a crisis as the difference between the actual level of output and the level that would have been expected based on the prevailing precrisis trend. In line with our interest in the medium run, we choose a post-crisis window of seven years, looking beyond the effects of short-run fluctuations of the economy. In addition, since it is possible that the slope of the trend may be affected by the crisis, we compute growth losses as the difference between the growth rate after the crisis and the precrisis trend growth rate. The precrisis trend growth rate is defined as the slope of the precrisis trend depicted in Figure 2.

Estimating the precrisis trend is challenging since we want to insulate the analysis from the impact of any immediate precrisis boom or slump, and there is no well-established method to do this.<sup>3</sup> In our work, we estimate a linear trend through the actual output series during a 7-year precrisis period that ends three years before the onset of the crisis. In a number of cases, however, the above procedure yielded negative trend growth rates, implying that output per capita would decline indefinitely even in the absence of a crisis. In

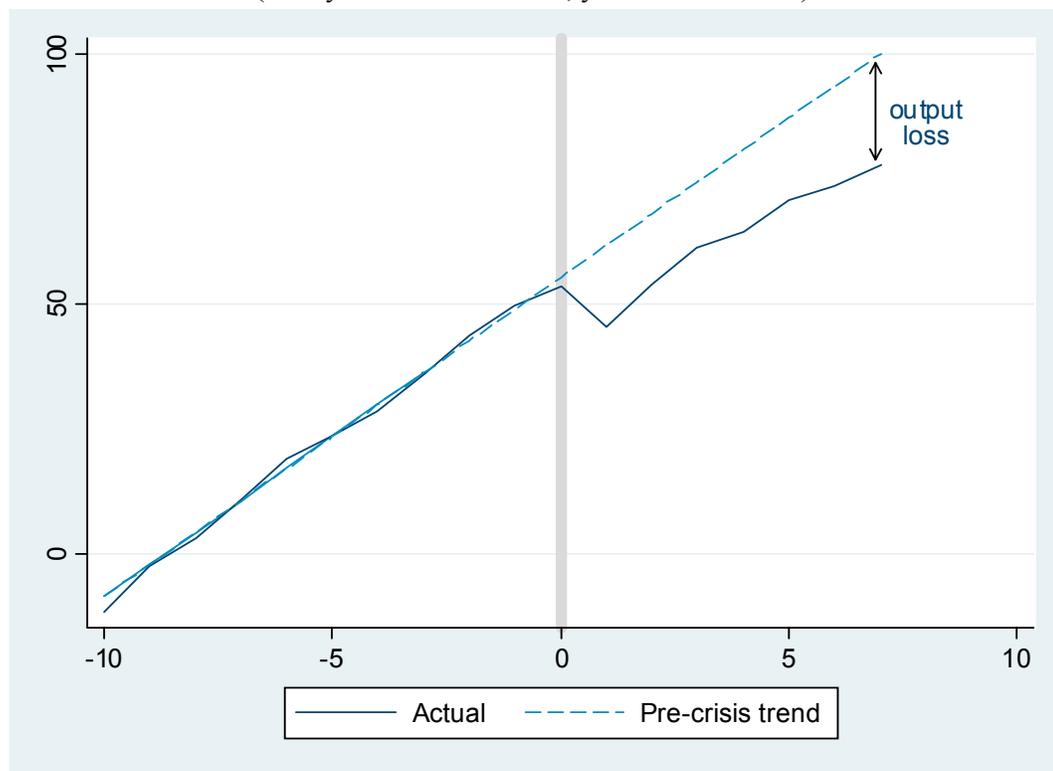
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<sup>3</sup> See Angkinand (2008) for a review of alternative methods for estimating output losses associated with a crisis.

these cases, the precrisis window was extended back from ten to twenty years before the crisis and used instead if it produced a positive trend growth rate.

One appeal of this approach is that it is simple, transparent, and easy to implement for a large set of countries. Importantly, its linearity also facilitates the decomposition of output losses into the factors of production, namely losses in capital, labor, and total factor productivity. The use of a 7-year horizon allows us to abstract from the immediate post-crisis fluctuations in output and focus on medium-run effects. An even longer horizon, such as a 10-year horizon would have been preferable, although such a horizon would have limited our ability to study a number of crises that occurred in the late 1990s and early 2000s.

Figure 2. Output Loss Methodology Example (Republic of Korea 1997)  
(First year of crisis at  $t = 0$ ; years on the x-axis)

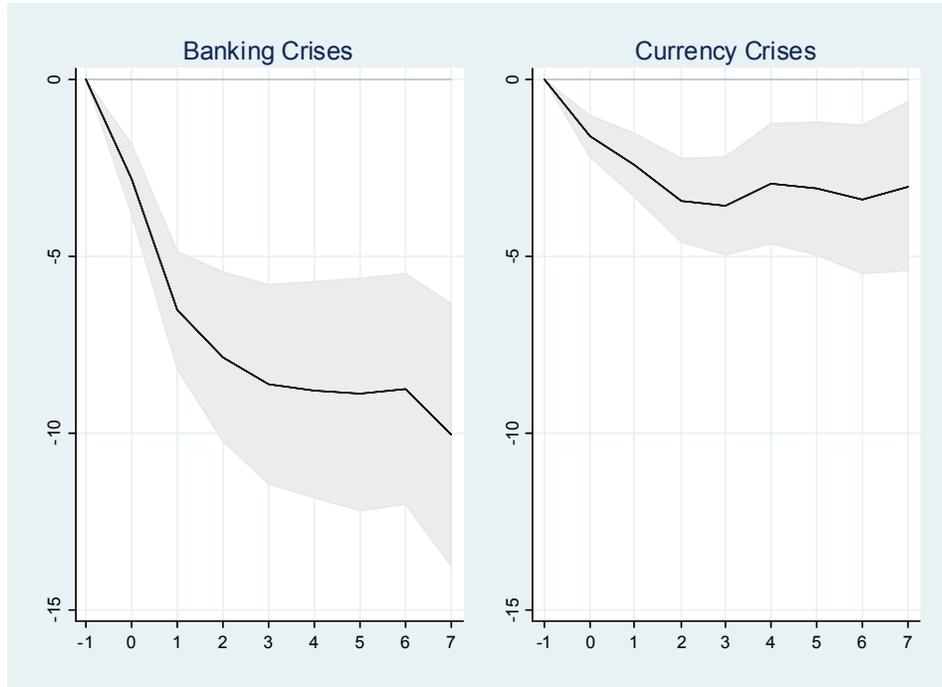


Note: The precrisis output trend is estimated up to year  $t=-3$ , and is extrapolated linearly thereafter. Trend equals 100 in year  $t=7$ .

The key stylized facts that emerge from the analysis are sobering: output typically does not recover to its precrisis trend. On average, output falls steadily below its precrisis trend until the third year after the crisis, and does not rebound thereafter (Figure 3). The medium-term output losses following banking crises are substantial: seven years after the crisis, output has declined relative to trend by close to 10 percent on average. As the shaded area measuring the 90-percent confidence band indicates, the average decline relative to trend is statistically significant. To put the losses associated with banking crises in perspective, Figure 3 also reports the evolution of output relative to trend following currency

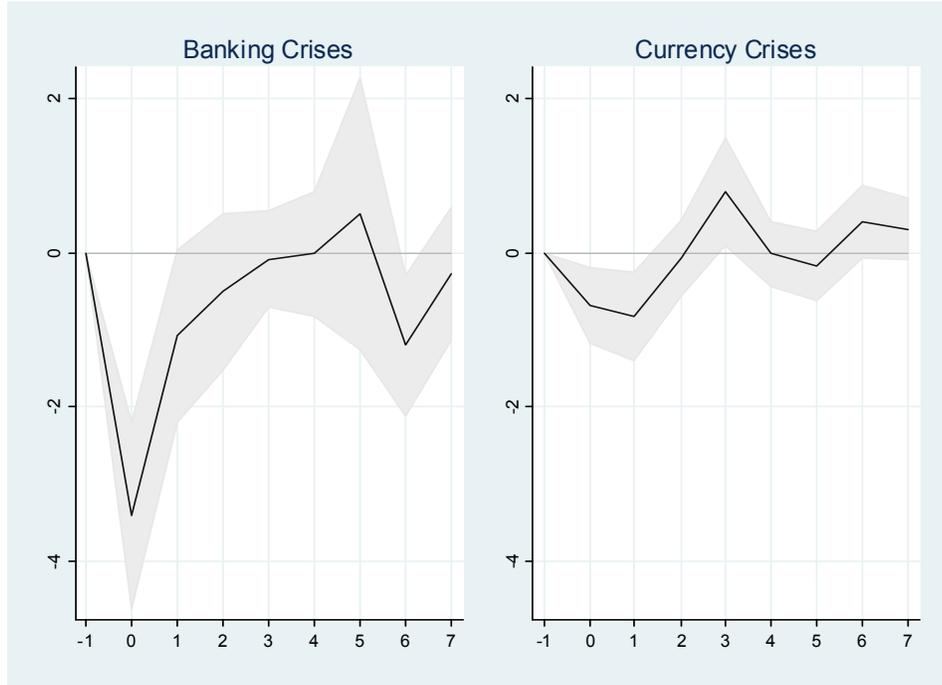
crises. Estimated losses following currency crises are much smaller, around one third of the average loss associated with banking crises.

Figure 3. Output Evolution after Banking and Currency Crises  
(Percent of precrisis trend)



Note: figure reports mean difference from year  $t - 1$ ; 90-percent confidence interval for estimated mean; first year of crisis at  $t = 0$ ; years on x-axis.

Figure 4. Growth Evolution after Banking and Currency Crises  
(Deviation from precrisis trend growth rate)



Note: figure reports mean deviation from precrisis trend growth rate in percentage points; 90-percent confidence interval; first year of crisis at  $t = 0$ .

At the same time, however, the slope of the trend itself does not appear to be affected by the crisis. While annual growth tends to fall substantially below the precrisis trend during the first two years of the crisis, it is statistically indistinguishable from the precrisis trend thereafter (Figure 4). The above-average growth required to return output to the previous trend does not tend to materialize. The four-year average of growth ending in the seventh year after the crisis has a mean difference with respect to the precrisis trend growth rate of only -0.2 percentage points per year, with a standard error of 0.5 percentage points.

In addition, the variation in outcomes is substantial. For example, while the change in output relative to trend following banking crises has a mean of -10 percent, the middle 50 percent of cases had a range of -26 percent to +6 percent. While on average there is no rebound to the precrisis trend, more than a quarter of cases ultimately exceeded the precrisis trend. Similarly, while growth tends to return to the precrisis trend rate, the middle 50 percent of cases had a deviation relative to the precrisis growth trend ranging from of -2.8 percentage points to +1.7 percent.

To set these findings against a significant historical benchmark, we applied the same methodology to a measure of global output in the aftermath of the Great Depression.<sup>4</sup> Following a stock market crash in the United States in 1929, the proportion of countries experiencing banking crises rose to over 40 percent of world GDP (Reinhart and Rogoff, 2008a). Consistent with the cross-country results discussed above, the level of global output did not return to its precrisis trend over the medium term, and was 27 percent below the precrisis trend by 1936, with the bulk of the decline occurring during 1929-1932. At the same time, the global growth rate eventually returned to the precrisis trend (by 1934), in line with the more recent crisis episodes.

We checked the robustness of our results by considering alternative approaches to estimating the precrisis trend. First, the calculations were repeated with the precrisis window ending one year rather than three years before the crisis. Second, an alternative approach was applied to computing the trend growth rates, by which a longer precrisis window from T-20 (rather than T-10) to T-3 was applied to the lowest and the highest 10 percent of trend growth rates. Third, the precrisis trend was computed based solely on the longer precrisis window (from T-20 to T-3). Finally, the precrisis trend was computed using the real-time medium-term growth projections of IMF country desks prepared for the Spring World Economic Outlook in the year before the crisis. Overall, as we report in the appendix, the output and growth losses obtained using the different approaches were highly correlated and statistically indistinguishable. Similarly, the result that growth eventually returns to the precrisis trend is robust to using these alternative precrisis trend measures. To understand better what components of output are adversely affected during banking crises, we now turn to analyzing the underlying factors behind the post-crisis medium-run output dynamics.

### **III. DECOMPOSITIONS: WHY DOES AGGREGATE OUTPUT NOT RECOVER?**

This section decomposes medium-term output losses, both in terms of factor inputs and demand components, to help understand which factors drive them. Learning about the underlying forces could provide insights into the likely evolution of output after the current set of banking crises, and what type of policies may be relevant to reduce the ultimate losses. Before presenting the results, we briefly review the main channels through which banking crises may affect output in the medium run.

#### **A. What are Possible Effects on the Key Sources of Output?**

A useful way to examine why output per capita often does not recover to its precrisis trend is to analyze what happens to the key elements of an economy's production process, namely labor inputs (which can be thought of as depending on the employment rate and labor

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<sup>4</sup> For this exercise, we constructed aggregate PPP-weighted real GDP of a broad sample of countries going back over 100 years, with the help of the Historical Statistics Database of Angus Maddison.

force participation), capital inputs, and total factor productivity. Of course, changes in output components following banking crises could reflect a decline in the productive potential of the economy, but also a persistent fall in aggregate demand, although the latter is likely to explain only a small part of the *medium*-run losses. From a theoretical perspective, banking crises may affect these production components in several ways.

First, the medium-run effect of a crisis on labor force participation is uncertain, as there are two opposing forces. On the one hand, grim employment prospects may discourage job-seekers and prompt them to leave the labor force, especially if there are incentives to retire early. On the other hand, in times of economic hardship, second-income earners may enter the labor force to help compensate for the loss of family income or wealth.<sup>5</sup>

Second, the medium-run employment rate would be affected adversely if banking crises lead to an increase in the underlying (so-called “structural”) unemployment rate. For example, the crisis may imply the need for a substantial reallocation of labor across sectors, something that may take time and increase medium-term frictional unemployment. Perhaps more importantly, the large initial increase in the actual unemployment rate induced by the crisis could persist for a long time if rigid labor market institutions (strict employment protection laws, generous unemployment benefits, etc.) complicate the task of finding a new job. Long spells without employment may also impair professional and on-the-job skills, making it even more difficult for the long-term unemployed to find jobs, resulting in so-called called “hysteresis effects.”<sup>6</sup>

Third, a banking crisis may slow capital accumulation by depressing investment over a protracted period. As the supply of credit becomes more limited, firms face tougher financing conditions in the form of tighter lending standards and higher effective costs of borrowing, and profit rates are likely to suffer.<sup>7</sup> The ability of firms to borrow and invest may be hampered further if the crisis leads to lower asset prices that weaken corporate balance sheets and erode collateral values (Kiyotaki and Moore, 1997). Investment may also suffer if the crisis leads to a sustained increase in uncertainty and risk premiums.

Finally, the effect on total factor productivity is ambiguous, based on theoretical considerations, but likely to be negative. On the negative side, as it recovers from the crisis, the financial system may not be able to allocate loanable funds as productively as before the

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<sup>5</sup>Indeed, there is some evidence suggesting that the additional worker effect may already be playing a role in the current crisis, as female participation rate has risen as male participation has fallen in the United States (see “Labor Supply Response to Changes in Wealth and Credit,” *FRBSF Economic Letter*, No. 2009–05, January 20, 2009).

<sup>6</sup> See Blanchard and Wolfers (2000), Bassanini and Duval (2005), and Nickell, Nunziata, and Ochel (2005), among others.

<sup>7</sup> See Bernanke and Gertler (1989), Bernanke (1995), and Bernanke and Blinder (1988).

crisis, particularly if high-risk but high-return projects are discouraged by more cautious lending attitudes. In addition, productivity may also suffer due to less innovation, as research and development spending tends to be cut back in bad times (Guellec and Van Pottelsberge, 2008). Also, high-productivity firms may go under due to lack of financing. On the positive side, however, banking crises may have a cleansing effect on the economy by removing inefficient firms and activities and creating incentives to restructure and improve efficiency.<sup>8</sup>

## B. What Do the Data Show?

Medium-term output losses following banking crisis are decomposed into underlying components using the following approach. The starting point is the observation that the logarithm of output per capita is equal to the weighted sum of the logarithms of labor force participation, employment rate, capital-to-labor ratio, and total factor productivity. Note that, due to data limitations, the decompositions into factor components are based on a smaller sample of 27 observations.

Applying the same procedure for estimating precrisis trends and computing output losses to their underlying components allows us to decompose output losses into losses due to changes in the employment rate, labor force participation, capital-to-labor ratio, or total-factor productivity. Specifically, for each output component, the precrisis trend is estimated over the same precrisis period as the output trend. This approach ensures that, based on the assumed Cobb-Douglas production function, the factor input contributions add up exactly to the total output loss.

The decompositions are based on a Cobb-Douglas production function of the form  $Y = AE^\alpha K^{1-\alpha}$ , where  $A$  denotes total-factor productivity,  $E$  denotes employment, and  $K$  denotes the capital stock. The employment share  $\alpha$  is assumed to be 0.65. Given the assumption of constant returns to scale, the production function can be expressed in per-capita terms by dividing by population,  $P$ , yielding:  $\frac{Y}{P} = A\left(\frac{E}{P}\right)^\alpha \left(\frac{K}{P}\right)^{1-\alpha}$ . Finally, taking logs, and noting that  $\frac{E}{P} = \left(\frac{E}{LF} \cdot \frac{LF}{P}\right)$  and  $\frac{K}{P} = \left(\frac{K}{E} \cdot \frac{E}{LF} \cdot \frac{LF}{P}\right)$ , where LF denotes the labor force, yields the decomposition used in the analysis:

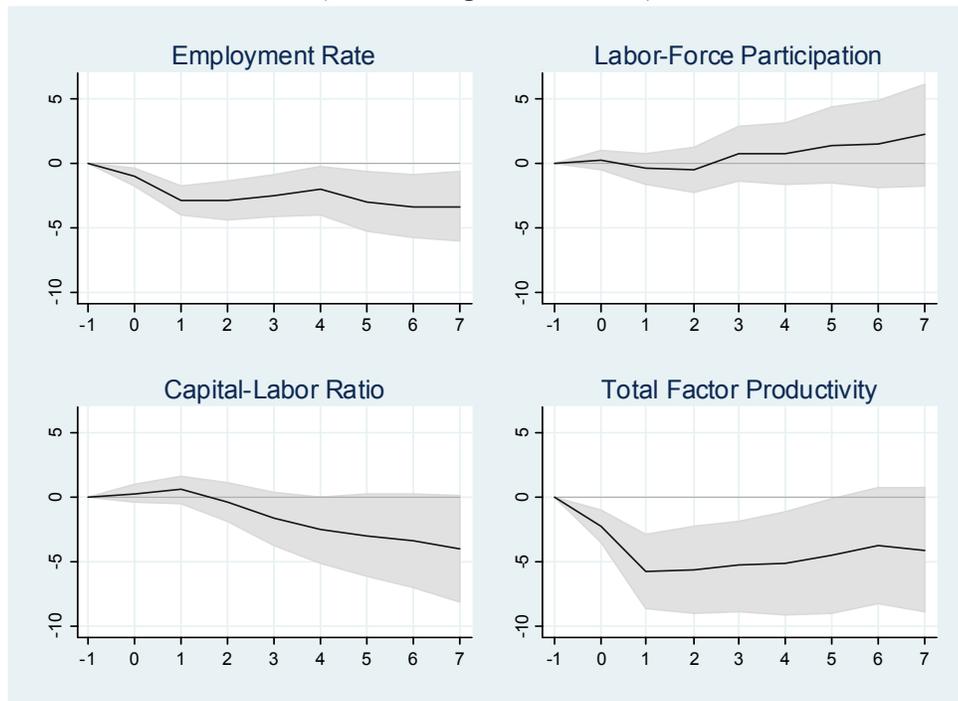
$\log\left(\frac{Y}{P}\right) = (1-\alpha)\log\left(\frac{K}{E}\right) + \log\left(\frac{E}{LF}\right) + \log\left(\frac{LF}{P}\right) + \log(A)$ , where  $\frac{K}{E}$  represents the capital-to-labor ratio,  $\frac{E}{LF}$  is the employment rate, and  $\frac{LF}{P}$  is the labor-force participation rate. Note that because total-factor productivity,  $A$ , is obtained as the residual from the decomposition, it may reflect errors in the measurement of the factor inputs.

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<sup>8</sup>See Caballero and Hammour (1994), Aghion and Saint-Paul (1998). The underlying concept of “creative destruction” was first introduced by Schumpeter (1942).

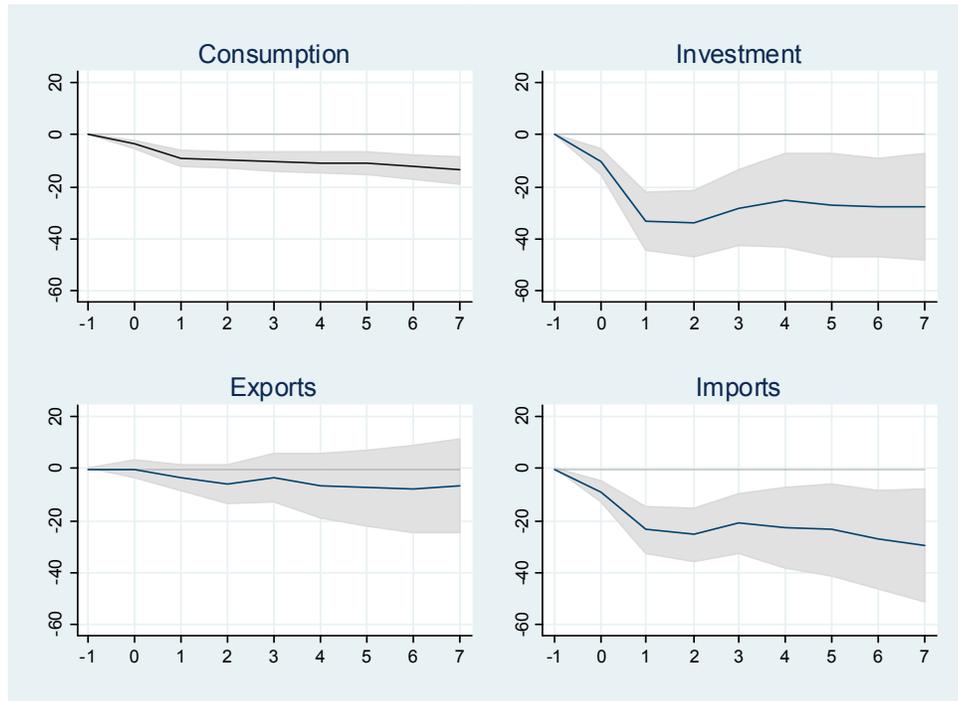
To complement the analysis, an analogous decomposition is done for the demand-side components of output: investment, consumption, exports, and imports. Note, however, that because the demand components are additive, the losses of the aggregate demand components do not sum up exactly to the total output loss. The results for both types of output loss decompositions are presented in Figure 5 and Figure 6. For each component of output, the ninety-percent confidence bands are reported to indicate the statistical significance of the estimates.

Figure 5. Output Decomposition  
(Percent of precrisis trend)



Note: figure reports mean difference from year  $t-1$ ; 90-percent confidence interval for estimated mean (shaded area); first year of crisis at  $t=0$ ; years on x-axis.

Figure 6. Demand-Side Decomposition  
(Percent of precrisis trend)



Note: figure reports mean difference from year  $t - 1$ ; 90-percent confidence interval for estimated mean (shaded area); first year of crisis at  $t = 0$ ; years on x-axis.

We find that the measured medium-run losses in GDP per capita can be attributed to roughly equal losses in three of the four components of output, namely the employment rate, capital-to-labor ratio, and total factor productivity (Figure 5).<sup>9</sup> Regarding total-factor productivity, after a significant initial decline, the level gradually moves closer to the precrisis trend toward the end of the seven-year horizon. This is consistent with the notion of labor hoarding that decreases over time. Nevertheless, the medium-run loss in total factor productivity still accounts for about one-third of the total output loss. Its magnitude, however, is not statistically significant seven years after the crisis, although it is in the short run. Regarding the other two key components, the initial loss in the employment rate persists into the medium run, while capital losses worsen steadily over time. The finding of an adverse impact on the capital-to-labor ratio is consistent with the demand-side decompositions that show a large and significant decline in investment of around 30 percent relative to its precrisis trend (Figure 6). The consumption loss is also notable and significant, at around 15 percent. These losses are partially offset by an overall improvement in net exports relative to trend.

<sup>9</sup>The contribution of labor force participation is positive, albeit small and statistically insignificant.

Overall, the decompositions suggest that higher unemployment rates, slower capital accumulation, and lower productivity growth play an important role in explaining medium-term output losses following banking crises. In other words, output per capita does not recover to its precrisis trend because capital per worker, the unemployment rate, and productivity do not typically return to their precrisis trends within seven years after the crisis. This finding suggests that pre- and post-crisis macroeconomic conditions and policies could play a role in shaping medium-run output dynamics—an issue that we examine in the next section.

#### IV. WHAT FACTORS ARE ASSOCIATED WITH MEDIUM-TERM OUTPUT LOSSES?

As illustrated in the previous sections, there is substantial variation in medium-term output losses across banking crises. To explain the observed variation, this section explores how output losses are related to various factors—such as macroeconomic, structural, and policy conditions—both before and after the crisis. The subsequent section explores the relationship between these factors and the postcrisis growth losses.

The analysis of pre- and post-crisis factors proceeds using a broadly similar empirical strategy, which examines the associations of these factors with medium-run output losses as follows. We first present the results of small-scale ordinary least squares (OLS) regressions that consider several factors at a time. These small-scale regressions typically include one or two variables of interest in addition to key control variables. We then explore the robustness of the results using a large-scale OLS regression that includes all of the factors considered simultaneously.

In addition to the OLS regressions, we also use Bayesian model averaging (BMA), which allows us to examine whether the associations found for each variable are robust to including additional controls in *all* the possible ways that those additional controls can be added. The procedure summarizes the results obtained across all possible specifications using two key statistics: (i) the average coefficient value obtained for each variable, and (ii) the probability that each variable is statistically “effective” and should be used to predict output losses. A conventional approach in the BMA literature is to refer to a variable as “effective” if its estimated inclusion probability is greater than 50 percent.<sup>10</sup> BMA is particularly useful in our investigation as theory is not sufficiently explicit regarding which variables should be included in the “true” regression. At the same time, however, BMA has substantial data requirements that, here, reduce the number of available observations by half. This is why we use both the small-scale results (based on a broad sample) and the larger-scale models (based on a restricted sample).

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<sup>10</sup> For additional details on BMA, see, for example, Hoeting et al. (1999), and Masanjala and Papageorgiou (2009). We are grateful to Chris Papageorgiou for providing us with R programs that implement BMA.

### A. Do Initial Conditions Help to Predict Medium-term Output Losses?

What are the precrisis factors that may explain the magnitude of the eventual output losses? Our analysis examines the importance of a range of macroeconomic, structural and policy environment variables. The sources of the data are reported in the appendix.

The precrisis output position (which identifies the starting position of output relative to trend) and the initial change in output during the first year of the crisis (which indicates the severity of the crisis in the short run) are potentially important control variables. Both the small-scale OLS results and the BMA analysis indicate that the severity of the crisis, measured by the first-year change in output, has strong predictive power for medium-run output losses (Table 1, Row 20). A one-percentage point fall in output relative to trend in the first year of the crisis is associated with a 1.1-1.8 percentage gap between output and the precrisis trend by year T+7. This result underscores the notion that banking crises have long-lasting effects on output. The finding also appeals to a wider literature related to output fluctuations.<sup>11</sup> At the same time, a depressed level of output relative to trend before the crisis appears to carry over, and is associated with a significantly larger medium-run output loss (Table 1, Row 19).<sup>12</sup> Based on these results, the two initial output variables are included as controls in all the remaining regressions.

A possible concern about controlling for short-run crisis severity, proxied by the decline in output in the crisis year, is that crisis severity could be correlated with other explanatory variables, potentially complicating the interpretation of the regression coefficients. For example, a greater precrisis investment share could be associated with a sharper short-run decline in output. To address this possible concern, the regressions reported in Table 1 are also implemented while omitting the short-run crisis severity control variable, and the coefficient estimates do not change substantially, as reported in the appendix.

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<sup>11</sup> In particular, the findings reported here are consistent with Campbell and Mankiw's (1987) finding that "an unexpected change in real GNP of 1 percent should change one's forecast by over 1 percent over a long horizon" (Campbell and Mankiw, 1987, p. 857).

<sup>12</sup>Note that, in the last three years prior to a banking crisis episode, the level of output is, on average, below its trend, suggesting that banking crises are not typically preceded by a precrisis boom. In the sample of 88 banking crises, the average deviation is about -3 percent.

Table 1. Output Losses versus Initial Conditions  
(Dependent variable: output at T+7 in percent of precrisis trend)

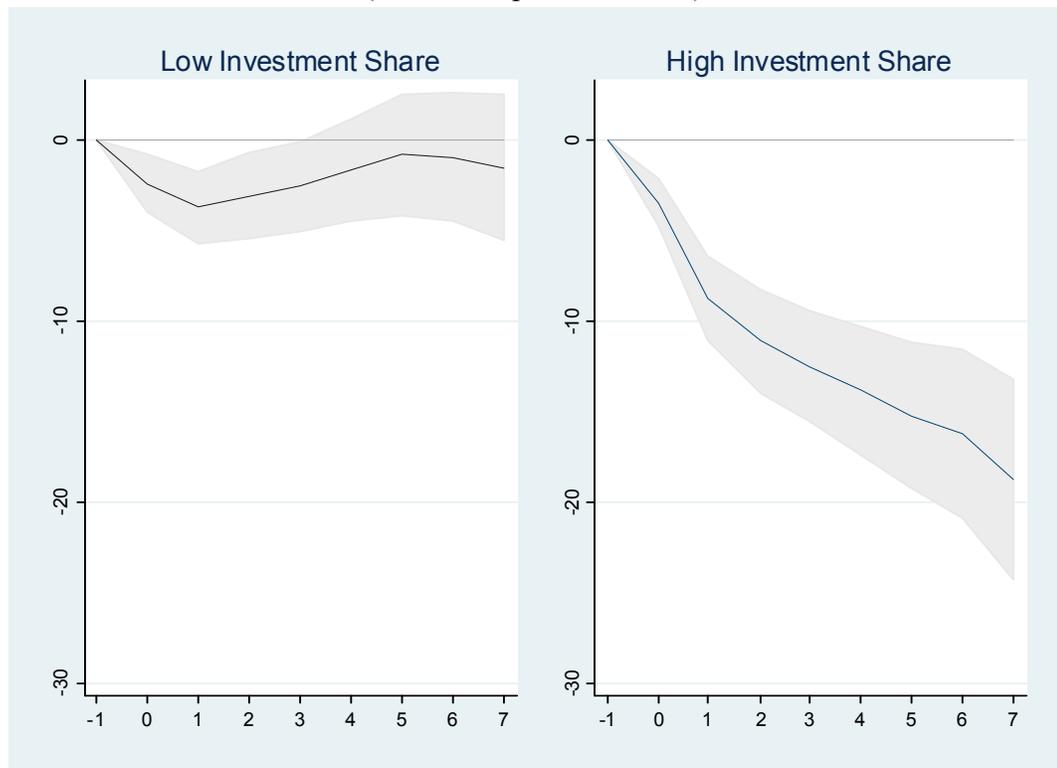
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) investment/GDP		-0.989*** [-3.120]										-1.211*** [-2.825]	-1.602 (1.000)
(2) investment/GDP gap		0.335 [0.889]										-1.049 [-1.671]	-0.388 (0.381)
(3) current account/GDP			0.765** [2.016]									0.063 [0.167]	0.000 (0.000)
(4) current account/GDP gap			0.964 [1.593]									0.525 [0.571]	0.189 (0.196)
(5) inflation				0.116 [1.500]								0.005 [0.063]	-0.002 (0.042)
(6) inflation gap				-0.196** [-2.243]								-0.063 [-0.475]	-0.032 (0.258)
(7) fiscal balance					0.501 [1.205]							-0.541 [-1.102]	0.000 (0.000)
(8) fiscal balance gap					1.256** [2.042]							0.480 [0.796]	0.013 (0.022)
(9) real exchange rate gap						-0.176 [-1.274]						...	...
(10) real interest rate gap						-0.127 [-0.166]						...	...
(11) log (PPP GDP per capita)							0.018 [0.736]					0.028 [0.635]	0.000 (0.000)
(12) credit/GDP								-0.152 [-1.616]				-0.032 [-0.299]	0.005 (0.073)
(13) credit/GDP gap								0.204 [0.503]				0.438 [0.993]	0.027 (0.109)
(14) currency crisis									-0.141* [-1.878]			-0.155 [-1.483]	-0.082 (0.558)
(15) U.S. T-bill rate										0.543 [0.528]		1.011 [0.999]	0.026 (0.038)
(16) external demand shock										-0.100 [-1.200]		-0.113* [-1.960]	-0.012 (0.089)
(17) financial openness/GDP											0.059*** [3.031]	0.008 [0.499]	0.002 (0.094)
(18) trade openness/GDP												-0.133 [-1.549]	-0.030 [-0.421]
(19) pre-crisis output	1.601*** [3.844]	1.328*** [3.875]	1.598*** [4.855]	1.027*** [2.691]	0.950*** [3.174]	1.425** [2.435]	1.538*** [3.639]	0.900*** [2.700]	1.685*** [3.931]	1.632*** [3.807]	0.751** [2.175]	0.901 [1.437]	0.916 (0.871)
(20) first-year output change	1.681*** [3.051]	1.583*** [3.551]	1.573*** [3.608]	1.781*** [3.406]	1.841*** [3.547]	1.069 [0.992]	1.752*** [3.039]	1.665*** [3.280]	1.552*** [2.694]	1.699*** [3.046]	1.799*** [3.271]	1.289*** [3.379]	1.175 (1.000)
(21) constant term	-0.056** [-2.652]	0.162** [2.156]	-0.018 [-0.726]	-0.093*** [-2.759]	-0.051* [-1.970]	-0.066 [-1.182]	-0.077** [-2.036]	-0.021 [-0.806]	-0.045** [-2.003]	-0.086 [-1.271]	-0.049 [-1.159]	0.125 [0.791]	0.337 (1.000)
Number of observations	88	85	80	87	81	26	88	77	88	88	52	44	44
R-squared	0.334	0.408	0.409	0.334	0.369	0.256	0.338	0.295	0.353	0.339	0.314	0.763	...

Note: columns 1–12 report estimation results based on OLS with robust t-statistics in square brackets. \*\*\*, \*\*, and \* indicate significance at the 1, 5, and 10 percent level, respectively. Column 13 reports estimation results based on Bayesian model averaging with the estimated probability of inclusion of each variable in parentheses. The term “gap” denotes the deviation of variable from precrisis historical average (years T-10 to T-7 where T denotes the crisis year) during the last three years preceding the crisis.

The prominent role of investment and capital losses would suggest that the level and evolution of precrisis investment would be good predictors of the eventual output losses. Indeed, regression results provide strong evidence that countries with high precrisis investment-to-GDP ratios, measured as the average investment-to-GDP ratio during the last

three years before the crisis, tend to have large output losses (Table 1, Row 1; Figure 7).<sup>13</sup> In contrast, the investment gap, defined as the deviation of the investment-to-GDP ratio during the last three years from its historical average, is not statistically significant (Table 1, Row 2).<sup>14</sup> We return to potential interpretations of these results later in the section. Nevertheless, it is worth mentioning here that the precrisis investment share result is particularly robust and holds even after controlling for the level of the current account balance. This suggests that countries that have high investment rates tend to experience larger output declines following banking crises, irrespective of whether the investment is financed by foreign or domestic savings.

Figure 7. Output Evolution and Precrisis Investment Share  
(Percent of precrisis trend)



Note: figure reports mean difference from year  $t - 1$  for countries with precrisis investment share below median (left panel) and above median (right panel); 90-percent confidence interval for estimated mean (shaded area); first year of crisis at  $t=0$ ; years on x-axis.

By limiting the room for policy maneuver, the build-up of macroeconomic imbalances may also imply higher medium-term output losses after a crisis. We consider the precrisis levels and dynamics of several variables—such as inflation, the current account

<sup>13</sup>The two lines represent the mean evolution of output for each group of countries relative to trend, while the shading reports the ninety-percent confidence interval for the mean.

<sup>14</sup>The precrisis historic average level is based on the seven-year period ending three years before the crisis.

balance, the fiscal balance, the real exchange rate, the real interest rate—that may capture the notion of macroeconomic imbalances.<sup>15</sup> We find mixed evidence that rising imbalances, and, by implication, more limited policy space that would constrain the ability of countries to run countercyclical macroeconomic policies, are associated with larger output losses. In particular, the results based on the small-scale regressions suggest that countries with larger current account deficits, rising inflation, and a deteriorating fiscal balance before the crisis experienced significantly larger output losses (Table 1, Rows 3, 6, 8). But the BMA analysis (Table 1, Column 13) suggests that the evidence is strong only for rising inflation before the crisis. Here it is important to bear in mind that more policy space does not necessarily mean that it was used—an issue to which we return later.<sup>16</sup>

Interestingly, post-crisis output losses are not significantly correlated with the level of income (Table 1, Row 11). In fact, the evolution of output after banking crises for upper-income, middle-income, and lower-income countries is similar (Figure 8). This finding is consistent with the notion that banking crises represent an “equal opportunity menace” (Reinhart and Rogoff, 2009a) for countries across the income distribution. At the same time, there is mixed evidence that a higher precrisis level of financial development is associated with larger output losses (Table 1, Row 12).<sup>17</sup>

Currency crises that coincide with banking crises, so called “twin crises,” are robustly associated with larger output losses (Table 1, Row 14). The results for the openness indicators, on the other hand, are mixed (Table 1, Row 17 and Row 18). The small-scale regression approach suggests that financial openness is associated with smaller losses, and is consistent with recent work that finds that deeper financial integration reduces the risk of a “sudden stop” in capital flows, and enhances the ability to smooth spending.<sup>18</sup> However, the evidence is weaker based on the broader specification. Evidence for trade is even weaker. Turning to external conditions, the level of the U.S. Treasury-bill rate before the crisis is not

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<sup>15</sup>The dynamics are captured by considering the deviations of these variables from their country-specific historical averages during the precrisis period (the so-called “gaps”). Using country-specific averages allows for the possibility that different countries may have different explicit or implicit inflation targets or fiscal rules. For example, a 3 percent inflation rate may imply less space for monetary easing in a country with inflation normally at 1 percent, than in a country with an inflation norm of 5 percent. For each variable, the “gap” value is constructed as a deviation of the average precrisis value (from T-3 to T-1) from the country-specific average value (from T-10 to T-3). Using government debt to measure fiscal space was not possible for the sample of countries considered here due to limited data availability.

<sup>16</sup>Note that two other domestic policy variables—the real interest rate and the real exchange rate before the crisis, measured relative to their historic averages—do not appear to have predictive power for medium-run output losses (Table 1, Row 9 and Row 10).

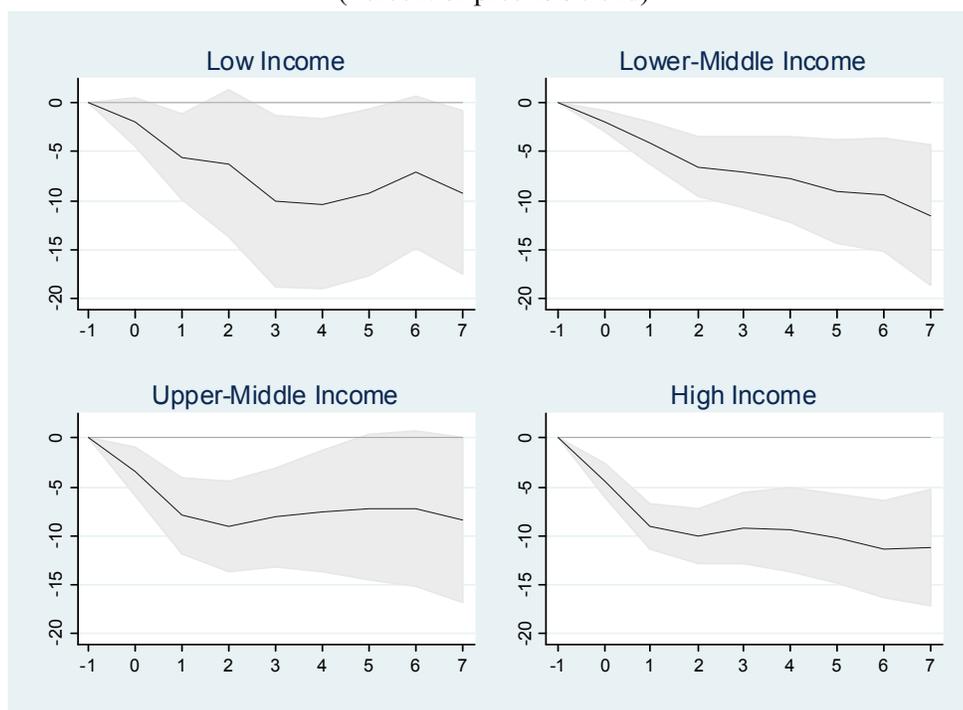
<sup>17</sup>The analysis also considers whether an increase in the credit-to-GDP ratio relative to each country’s own historic average level (the credit-to-GDP “gap”) plays a role, finding it to be statistically insignificant. The question of whether there is a non-linear link between the level of financial deepening and output losses is left for further research.

<sup>18</sup>See Calvo et al. (2008) and Abiad et al. (2009).

found to be a significant predictor of output losses (Table 1, Row 15). The evidence that an adverse external demand shock occurring at the time of the banking crisis is correlated with larger output losses is mixed (Table 1, Row 16).<sup>19</sup>

Finally, the precrisis levels of various structural policy reform indicators are not significantly correlated with medium-run output losses, and are not presented in Table 1. We return to the possible role of structural policies in the next section, where we consider whether countries that undertook structural reforms following the crisis experienced smaller output losses.<sup>20</sup>

Figure 8. Output Evolution and Precrisis Income Level  
(Percent of precrisis trend)



<sup>19</sup> The external demand shock is measured as a dummy variable which equals one in year  $t$  whenever partner-country growth from year  $t$  to  $t+4$  is in the lowest 5 percent of the entire sample. Partner country growth is defined as the percapita output growth of a country's trading partners weighted by their shares in the country's total exports.

<sup>20</sup> The analysis draws on the database of structural reforms prepared by the Research Department of the IMF. It covers 150 industrial and developing countries and eight sectors. In this paper, we use the domestic financial sector reform index (which includes measures of securities markets and banking sector reforms) and the capital account liberalization index (which summarizes a broad set of restrictions), the trade liberalization index (based on average tariffs), and the fiscal sector reform index (based on tax rates and the efficiency of revenue collection and public spending). We also use various measures of labor market flexibility, including on employment protection, unemployment benefit replacement ratios, and tax wedges. See IMF (2008) and Giuliano et al. (2009), for more details. The indices for product market reforms were not used in the analysis due to insufficient data coverage.

Note: figure reports mean difference from year  $t - 1$  by quartile of real PPP GDP per capita; 90-percent confidence interval for estimated mean (shaded area); first year of crisis at  $t = 0$ ; years on x-axis.

What are the key points to take away from these regression results? The empirical analysis suggests that the first-year loss is important in predicting the eventual output losses following a banking crisis. This is consistent with the notion that output dynamics are especially persistent following large shocks. What could explain this? A possible explanation is that bankruptcies leading to fire sales of capital assets that have significant sunk costs and take time to rebuild. Also, an impaired financial system may need time to heal and intermediate financial capital effectively, and labor and product market rigidities could impede the necessary reallocation of labor and capital following a crisis. These interpretations are consistent with the finding that all factors of production contribute to the medium-term output losses.

Related to the dynamics of capital accumulation, the finding that the precrisis investment rate is a robust predictor of the post-crisis output loss is particularly striking. This finding, together with the earlier result that investment and capital deepening decline over the medium-run following banking crises, is consistent with a number of potential interpretations.<sup>21</sup> In some cases, it may be that the output loss reflects the unwinding of excessive investment built up over a protracted period. To the extent that some investment during the precrisis period was wasteful, output losses may have taken place even without a crisis, but gradually. However, a full investigation into the underlying reasons for the remarkably strong correlation between the precrisis investment level and medium-run output losses is an issue that merits further investigation but is beyond the scope of this paper.

### **B. After the Crisis: What is Associated with Smaller Output Losses?**

What role do policies have in mitigating the ultimate output loss after the crisis has hit? It is important to acknowledge that the following discussion seeks to identify patterns rather than establish causality between post-crisis output evolution and policies. As discussed in the literature, the two-way relationship between post-crisis policies and outcomes complicates any causal inference. For example, is it that financial reform during or after a banking crisis leads to increased financial intermediation and a lower output loss? Or, that a lower output loss leads to higher demand and thus higher financial intermediation and also gives the authorities the policy space to implement important financial sector reforms? These difficult questions cannot be answered within our regression framework.

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<sup>21</sup> Note that the correlation between the precrisis investment share and the medium-run output loss is largely a reflection of large post-crisis investment losses. In particular, additional regression results not reported here reveal that while a large precrisis investment share is strongly correlated with medium-run investment losses, it is only weakly correlated with medium-term consumption and export losses.

The discussion focuses on domestic macroeconomic policies and structural reforms, and on external conditions and policies abroad. As in the analysis of precrisis factors, we present the regression results (Table 2) based on both full-sample OLS, and BMA analysis on a restricted sample. As before, all regressions control for key initial output variables.

Short-run demand management policies (fiscal and monetary) implemented after the crisis has hit may play a role both in terms of reducing the size of the initial output loss, and in aiding the recovery. To measure changes in discretionary fiscal policy, we follow the approach of IMF (2009b) and use the growth in real government consumption. Given data availability, we measure the monetary policy stance as the change in real lending rates. In both cases, to capture the short-run response of macroeconomic policies, the variables are computed for the crisis year and the following three years. The variables are designed to measure a notion of stimulus (rather than policy space), and thus differ from those used in the precrisis analysis. We find that a stronger short-run fiscal policy response (a larger increase in government consumption) is significantly associated with smaller medium-run output losses (Table 2, Row 1).<sup>22</sup> The evidence on the monetary policy stance is mixed, possibly reflecting a weaker monetary-policy transmission mechanism after banking crises. A decline in real lending rates is associated with smaller output losses, but only in some specifications (Table 2, Row 2). There is also some mixed evidence that real exchange rate depreciations are associated with smaller output losses (Table 2, Row 3).

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<sup>22</sup>The results imply that raising government consumption by one percent of GDP is associated with a reduction in the medium-run output loss by about 1.5 percentage points. The change in government consumption, rather than the change in tax revenue or the fiscal balance, is used as a measure of fiscal stimulus as it lessens reverse-causality concerns. Measuring fiscal stimulus based on the change in tax revenue, or the change in the fiscal balance would be problematic. A larger deterioration in output implies a greater deterioration in tax revenue, and the fiscal balance, complicating the interpretation of the regression coefficients. As expected, repeating the analysis using the change in the fiscal balance yielded a regression coefficient that was statistically indistinguishable from zero.

Table 2. Output Losses versus Post-Crisis Conditions and Policies  
(Dependent variable: output at T+7 in percent of precrisis trend)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) real government consumption growth	0.202** [2.520]									0.244* [1.843]	0.405** [2.264]	0.263 (0.648)	
(2) change in real interest rate		-0.085 [-0.404]								-0.493** [-2.280]	-0.580 [-1.577]	-0.530 (0.708)	
(3) real appreciation			0.135* [1.785]							-0.011 [-0.075]	-0.418* [-2.047]	-0.038 (0.166)	
(4) change in capital-account liberalization index				0.166*** [4.267]							0.147** [2.290]	0.030 [0.433]	0.007 (0.085)
(5) change in financial liberalization index					0.108** [2.583]						0.017 [0.302]	0.149* [1.769]	0.002 (0.044)
(6) change in trade liberalization index						-0.046 [-0.950]					-0.063 [-1.123]	-0.122 [-1.506]	-0.013 (0.149)
(7) change in government efficiency index							-0.005 [-0.077]				0.013 [0.213]	0.129* [2.044]	0.078 (0.608)
(8) U.S. T-bill rate								-1.404 [-1.012]		0.490 [0.178]		-4.459 [-1.524]	-2.820 (0.400)
(9) external demand shock									-0.960*** [-3.156]	-1.161 [-1.611]		-1.073 [-1.668]	-0.415 (0.411)
(10) pre-crisis output	1.213*** [4.666]	1.038*** [2.791]	1.371*** [4.292]	1.079*** [3.537]	0.997*** [4.358]	1.384*** [4.456]	1.162** [2.398]	1.601*** [3.783]	1.753*** [4.427]	1.137*** [3.453]	1.124*** [3.061]	0.907 [1.687]	0.143 (0.184)
(11) first-year output change	2.032*** [3.396]	2.107*** [2.941]	1.750*** [2.884]	2.191*** [3.560]	2.262*** [3.529]	2.145*** [3.526]	1.749** [2.591]	1.714*** [3.158]	1.875*** [3.558]	2.365** [2.667]	2.220*** [3.330]	3.136*** [2.889]	2.693 (1.000)
(12) constant term	-0.056** [-2.065]	-0.047** [-2.059]	-0.034 [-1.471]	-0.093*** [-4.010]	-0.088*** [-3.510]	-0.020 [-0.869]	-0.054 [-1.485]	0.023 [0.284]	-0.004 [-0.177]	-0.037 [-0.260]	-0.079* [-1.964]	0.064 [0.385]	0.052 (1.000)
Number of observations	77	59	74	65	65	78	53	88	88	50	49	30	30
R-squared	0.398	0.283	0.342	0.459	0.397	0.388	0.281	0.344	0.396	0.506	0.450	0.709	...

Note: columns 1–12 report estimation results based on OLS with robust t-statistics in square brackets. \*\*\*, \*\*, and \* indicate significance at the 1, 5, and 10 percent level, respectively. Column 14 reports estimation results based on Bayesian model averaging with the estimated probability of inclusion of each variable in parentheses. Structural reform variables (trade, financial, capital-account, and government efficiency) measure change in index from T to T+7.

Advancing structural reforms may also play a role in boosting output during the post-crisis period. We consider reform efforts in several areas, such as domestic financial reform, capital account and trade liberalization, as well as structural fiscal reforms. In each case, the reform effort is measured as the *change* in various indices mentioned earlier during the post-crisis period (rather than the levels that were used in the precrisis analysis).<sup>23</sup> Overall, there is mixed evidence that structural reform efforts are significantly associated with smaller output losses. Liberalization of the capital account is highly correlated with smaller output losses in small-scale regressions, although its statistical significance declines when considered in larger-scale frameworks (Table 2, Row 4). Domestic financial reforms are also significantly positively associated with output losses in small-scale regressions, but less so in larger-scale frameworks (Table 2, Row 5). Trade liberalization is not significantly related to output losses (Table 2, Row 6). Finally, there is some positive evidence on the link between improvements in government efficiency and output losses, although the increased significance of this structural variable in the broader specifications appears to be partly due to the change in the sample composition (as the number of observations drops to 30).

<sup>23</sup>Regarding labor market liberalization indicators, data availability is limited for the sample of banking crisis countries. Moreover, when data are available, there is often little change post crisis. For both these reasons, we do not report results for post-crisis labor market indicators.

Finally, policies and conditions abroad may also be important in reducing output losses by improving the external environment during the post-crisis period. The results indicate that larger domestic output losses are significantly related to the occurrence of adverse external demand shocks during the post-crisis period (Table 2, Row 9). In addition, there is some evidence that larger output losses are significantly associated with higher global short-term interest rates (Table 2, Row 8).<sup>24</sup>

How should we interpret these empirical findings? Overall, our findings suggest that expansionary short-run macroeconomic policies are associated with smaller medium-term output losses. This is consistent with the notion that counter-cyclical fiscal and monetary policies may help dampen path-dependence effects by cushioning the downturn after the crisis, which carry over into smaller measured output losses in the medium run.

The relationship between post-crisis structural policy reforms and output losses is somewhat weaker. However, this could be due to well-known difficulties in measuring the timing, magnitude, and sequencing of structural reforms,<sup>25</sup> as well as the possibility that structural reforms and capacity building may take a longer time than considered here to bear fruit in terms of output. At the same time, the spillover effects of global conditions may be important, given the strong association between the external environment and the eventual output losses.

Overall, the regression analysis provides suggestive evidence that domestic fiscal and monetary stimulus, and favorable global conditions may mitigate medium-term output losses. There is also some mixed evidence on the beneficial role of structural policy reform. However, there is still much to learn about the processes and interactions associated with output losses following banking crises.

## V. WHAT FACTORS ARE ASSOCIATED WITH MEDIUM-TERM GROWTH LOSSES?

As discussed in Section II, growth tends to return to the precrisis trend following banking crises. However, in a number of cases, such as that of Japan's 1997 crisis, growth did not fully recover to its precrisis trend. In other cases, output grew at a faster rate than before the crisis, as in the case of Chile's 1981 crisis. This section explores this variation in growth outcomes based on the explanatory variables considered in Section IV.

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<sup>24</sup>Unlike in the small-scale regressions, the global interest rate is significantly related to output losses in the large-scale OLS regression and has a relatively high probability of inclusion (0.63) in the BMA framework.

<sup>25</sup>Note that measurement error in the structural reform indicators will bias the regression coefficients toward zero, making it more difficult to find that the results are statistically significant. Also, the size of the bias depends directly on the magnitude of the measurement error, which is likely to be much larger for unobserved structural reform indicators (such as labor market flexibility or financial sector reform) than for macroeconomic variables (such as government consumption or interest rates).

In particular, the section repeats the regression analysis with growth relative to the precrisis growth trend replacing the output level as the dependent variable. To abstract from the short-run fluctuations associated with the crisis, the analysis focuses on the average growth rate over the four years starting in T+4 relative to the precrisis trend. For the purposes of this section, this gap is referred to as the medium-run growth loss. The explanatory variables considered are those used for the output loss analysis in the previous section.

Regarding variables measuring initial conditions, the results are broadly consistent with those reported above for output losses, but explaining postcrisis growth performance based on initial conditions appears to be harder than explaining postcrisis output levels. In particular, while in the equations estimated for output (Tables 4.1 and 4.2), the R-squared statistic ranges from 26 percent to 76 percent, it ranges only 8 percent to 57 percent for the growth equations (Table 4.3 and 4.4). Also, the statistical significance of a number of the explanatory variables weakens. The first-year change in output, and the level of output relative to trend before the crisis no longer have strong predictive power (Table 3, Rows 19-20). Similarly, the variables measuring precrisis macroeconomic imbalances are weakly correlated with postcrisis medium-run growth performance, and the occurrence of a twin banking-and-currency crisis has mixed explanatory power. Nevertheless, the precrisis investment share remains a strong predictor (Table 3, Rows 1-2).

Regarding post-crisis policies and conditions, the results are again broadly consistent with those obtained for output losses, but the R-squared statistics are lower. Short-run fiscal and monetary policy stimulus is correlated with smaller subsequent growth losses (Table 4, Rows 1-2), as is a real exchange rate depreciation (Table 4, Row 3). There is again some mixed evidence regarding the beneficial role of structural policy reforms (Table 4, Rows 4-7). Evidence regarding the role of external conditions is weaker than before (Table 4, Rows 8-9).

Overall, this section suggests that it may be harder to predict postcrisis medium-term growth relative to the precrisis trend than to predict the postcrisis level of output relative to trend. This finding applies particularly in relation to the predictive power of variables measuring initial conditions observed at the onset of the crisis. The results are consistent with a view of output as being typically trend-stationary following banking crises, with no predictable change in the growth rate.

Table 3. Growth Losses versus Initial Conditions  
(Dependent variable: five-year average growth ending in T+8 less precrisis trend)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) investment/GDP		-0.104** [-2.234]										-0.129 [-1.058]	-0.204 (0.953)
(2) investment/GDP gap		0.0390 [0.548]										-0.265* [-1.789]	-0.146 (0.604)
(3) current account/GDP			0.141** [2.264]									0.0721 [0.754]	0.033 (0.255)
(4) current account/GDP gap			0.123 [1.617]									0.188 [0.824]	0.051 (0.222)
(5) inflation				0.0104 [0.925]								-0.0134 [-1.059]	-0.001 (0.063)
(6) inflation gap				-0.0166 [-1.003]								0.00247 [0.133]	0.000 (0.000)
(7) fiscal balance					0.0936 [1.193]							-0.0652 [-0.592]	-0.001 (0.008)
(8) fiscal balance gap					0.144 [1.667]							-0.0509 [-0.265]	-0.002 (0.026)
(9) real exchange rate gap						-0.0511** [-2.731]						...	...
(10) real interest rate gap						-0.0165 [-0.189]						...	...
(11) log (PPP GDP per capita)							0.00342 [0.853]					0.00973 [0.977]	0.000 (0.035)
(12) credit/GDP								-0.0193 [-1.315]				-0.0230 [-1.048]	0.002 (0.067)
(13) credit/GDP gap								0.0780 [1.070]				0.175** [2.214]	0.069 (0.674)
(14) currency crisis									-0.00273 [-0.282]			-0.00565 [-0.322]	-0.002 (0.073)
(15) U.S. T-bill rate										0.100 [0.608]		0.362 [1.607]	0.208 (0.593)
(16) external demand shock										-0.00473 [-0.363]		-0.0176 [-1.289]	-0.001 (0.038)
(17) financial openness/GDP											0.00692* [1.988]	2.47e-05 [0.00707]	0.000 (0.000)
(18) trade openness/GDP												-0.0121 [-0.830]	-0.00878 [-0.707]
(19) pre-crisis output	-0.150 [-1.026]	0.0111 [0.194]	0.0607 [0.986]	-0.0136 [-0.227]	-0.0431 [-0.736]	0.0877 [1.043]	-0.162 [-1.124]	-0.0659 [-1.108]	-0.148 [-0.992]	-0.146 [-0.985]	-0.0905 [-0.949]	-0.0258 [-0.122]	-0.003 (0.039)
(20) first-year output change	0.134 [1.399]	0.0319 [0.448]	0.0223 [0.380]	0.0550 [0.749]	0.0574 [0.840]	-0.0420 [-0.430]	0.148 [1.620]	0.0674 [0.888]	0.132 [1.298]	0.139 [1.434]	0.0778 [0.714]	0.0889 [0.763]	0.004 (0.049)
(21) constant term	-0.00363 [-1.050]	0.0197* [1.857]	0.00343 [0.782]	-0.00650 [-1.447]	-0.00209 [-0.534]	-0.000669 [-0.104]	-0.00780 [-1.228]	-0.000425 [-0.0958]	-0.00342 [-0.924]	-0.00989 [-0.886]	-0.00312 [-0.444]	-0.000941 [-0.0198]	0.032 (1.000)
Number of observations	88	85	80	87	81	26	88	77	88	88	52	44	44
R-squared	0.081	0.075	0.154	0.022	0.073	0.296	0.087	0.044	0.082	0.084	0.080	0.565	...

Note: columns 1–12 report estimation results based on OLS with robust t-statistics in square brackets. \*\*\*, \*\*, and \* indicate significance at the 1, 5, and 10 percent level, respectively. Column 13 reports estimation results based on Bayesian model averaging with the estimated probability of inclusion of each variable in parentheses. The term “gap” denotes the deviation of variable from precrisis historical average (years T-10 to T-7 where T denotes the crisis year) during the last three years preceding the crisis.

Table 4. Growth Losses versus Post-Crisis Conditions and Policies  
(Dependent variable: five-year average growth ending in T+8 less precrisis trend)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) real government consumption growth	0.0225*									0.0338		0.0861**	0.090
	[1.859]									[1.576]		[2.493]	(0.993)
(2) change in real interest rate		-0.00723								-0.0702**		-0.131**	-0.143
		[-0.236]								[-2.041]		[-2.780]	(0.993)
(3) real appreciation			0.0113							-0.0169		-0.114***	-0.094
			[0.973]							[-0.724]		[-4.056]	(0.993)
(4) change in capital-account liberalization index				0.0248***							0.0204**	0.0102	0.005
				[4.126]							[2.377]	[1.082]	(0.318)
(5) change in financial liberalization index					0.0166**						0.00154	0.0237*	0.007
					[2.195]						[0.173]	[2.028]	(0.356)
(6) change in trade liberalization index						-0.00698					-0.00661	-0.0159	-0.002
						[-1.030]					[-0.804]	[-1.694]	(0.199)
(7) change in government efficiency index							-0.000853				0.00171	0.0215**	0.018
							[-0.0868]				[0.186]	[2.456]	(0.842)
(8) U.S. T-bill rate								-0.414**		0.390		-0.410	-0.017
								[-2.010]		[0.790]		[-0.713]	(0.068)
(9) external demand shock									-0.101**	-0.109		-0.0697	-0.010
									[-2.132]	[-0.943]		[-0.828]	(0.135)
(10) pre-crisis output	-0.00578	-0.0424	0.0240	-0.0240	-0.0358	0.0220	-0.0598	-0.151	-0.134	-0.0294	-0.0755	-0.0681	-0.015
	[-0.114]	[-0.610]	[0.414]	[-0.405]	[-0.712]	[0.392]	[-0.603]	[-1.034]	[-0.925]	[-0.409]	[-0.713]	[-0.630]	(0.166)
(11) first-year output change	0.0860	0.0326	0.0250	0.141	0.152	0.117	0.105	0.141	0.154	0.0385	0.140	0.239	0.093
	[0.910]	[0.334]	[0.342]	[1.454]	[1.514]	[1.390]	[1.009]	[1.485]	[1.577]	[0.256]	[1.306]	[1.670]	(0.503)
(12) constant term	-0.00288	-0.00145	-0.000449	-0.00797**	-0.00746	0.00251	-0.00113	0.0195	0.00180	-0.0194	-0.00578	-0.0132	-0.030
	[-0.683]	[-0.344]	[-0.121]	[-2.078]	[-1.541]	[0.595]	[-0.188]	[1.569]	[0.426]	[-0.774]	[-0.704]	[-0.434]	(1.000)
Number of observations	77	59	74	65	65	78	53	88	88	50	49	30	30
R-squared	0.063	0.009	0.015	0.203	0.133	0.054	0.036	0.106	0.105	0.169	0.185	0.677	...

Note: columns 1–12 report estimation results based on OLS with robust t-statistics in square brackets. \*\*\*, \*\*, and \* indicate significance at the 1, 5, and 10 percent level, respectively. Column 14 reports estimation results based on Bayesian model averaging with the estimated probability of inclusion of each variable in parentheses. Structural reform variables (trade, financial, capital-account, and government efficiency) measure change in index from T to T+7.

## VI. CONCLUSIONS

Using a sample of 88 banking crises over the past four decades in a wide range of countries, we find that, on average, output does not rebound to its precrisis trend path, but remains permanently below it. The above-average growth required to return output to the previous trend does not tend to materialize. The possible good news is that the trend growth rate itself appears to be unaffected: on average, growth eventually returns to its precrisis rate. Also, the depressed path of output tends to result from reductions of roughly equal proportions in the employment rate, the capital-to-labor ratio, and total factor productivity.

At the same time, however, we find a large variation across countries, with output outperforming precrisis expectations in about a quarter of all cases. In exploring this variation in outcomes, we find that medium-run output losses are robustly correlated with a number of variables observed at the onset of the crisis, including the change in output in the first year of the crisis, the occurrence of a joint banking-and-currency crisis, and a high precrisis level of investment. Short-run fiscal and monetary stimulus is also associated with smaller medium-run deviations of output and growth from the precrisis trend. There is also some mixed evidence relating to the beneficial role of structural policy reforms implemented after the onset of the crisis. While the contemporaneous nature of these variables complicates any causal interpretation, the results are consistent with the notion that policies implemented in the aftermath of a crisis can help to mitigate the impact on output.

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## Appendix

This appendix provides details on the data used in the analysis, a list of the 88 banking crisis episodes considered in the analysis, the results of robustness exercises on measuring output losses, and the results of reestimating the regressions reported in Table 1 while omitting the short-run crisis severity variable.

### Data Sources

The main data source for this chapter is the *World Economic Outlook* (WEO) and International Financial Statistics (IFS) databases of the International Monetary Fund (IMF), and the World Bank's *World Development Indicators* (WDI). Additional data sources are listed below.

Data on real GDP and its demand components are from the WDI, and are spliced with WEO data for observations after 2007 for which WDI data are unavailable. The current account balance, the GDP deflator, and the fiscal balance, are also taken from WEO, while the exchange rate series are taken from IFS. The domestic real interest rate is defined as the difference between the nominal lending rate, taken from IFS, and GDP deflator inflation.

For the growth accounting exercises, the capital stock data are taken from Bosworth and Collins (2003). For observations not included in the Bosworth and Collins dataset, the capital stock is constructed using the perpetual inventory method, with a depreciation rate of 5 percent, and using real investment data. The employment and labor-force data come from WEO.

Financial development is measured using the ratio of bank credit to GDP, following Abiad, Dell'Araccia, and Li (2009). Bank credit to the private non-financial sector is taken from IFS database of the IMF. Breaks in these data are identified using the IFS *Country Notes* publication, and data are growth-spliced at these points.

Financial openness is calculated as the sum of foreign assets and foreign liabilities divided by GDP, using the *External Wealth of Nations Mark II* database of Lane and Milesi-Ferretti (2006). Trade openness is defined as the sum of exports and imports divided by GDP. Partner-country growth, used to compute the external demand shocks is taken from WEO, while the three-month U.S. Treasury bill rate is obtained from Datastream.

The structural reform indicators measuring trade liberalization, capital-account liberalization, financial liberalization, and government efficiency come from the IMF, and are described in greater detail by Giuliano et al. (2009), and IMF (2008).

Global GDP is constructed by aggregating individual country series in 2008 purchasing-power-parity dollars. The data sources are the IMF World Economic Outlook database, the Total Economy Database of the Conference Board ([www.conference-board.org/economies/database.cfm](http://www.conference-board.org/economies/database.cfm)), and the Historical Statistics Database of Angus Maddison ([www.ggdnc.net/madison](http://www.ggdnc.net/madison)). Changes in sample composition are smoothed by pasting together the aggregate growth rates before and after each change.

**Table A1. List of Banking Crisis Episodes**

Country	Year	Output Level in T+7 (percent of precrisis trend)	Average Growth During T+4:T+7 (deviation from precrisis trend)
Algeria	1990	-20.4	-0.5
Argentina	1980	-12.6	-0.6
Argentina	1989	15.4	2.7
Argentina	1995	7.8	-5.5
Argentina	2001	-7.7	4.5
Bangladesh	1987	16.9	2.1
Benin	1988	-17.7	-0.4
Bolivia	1986	-18.7	1.0
Bolivia	1994	6.6	-0.3
Brazil	1990	-13.6	0.4
Brazil	1994	-3.0	-0.6
Burkina Faso	1990	-0.4	1.8
Burundi	1994	-47.2	-2.5
Cameroon	1987	-85.9	-9.8
Cameroon	1995	-29.3	1.1
Central African Rep.	1976	-17.7	-3.9
Central African Rep.	1995	12.1	1.4
Chad	1983	25.8	2.3
Chad	1992	-43.7	-2.8
Chile	1976	-14.5	-2.7
Chile	1981	21.0	4.6
Colombia	1982	-15.2	-0.3
Colombia	1998	-16.3	0.1
Congo, Dem. Rep. of	1983	-18.9	-3.2
Congo, Dem. Rep. of	1991	-85.0	-4.6
Congo, Dem. Rep. of	1994	-72.8	-4.3
Congo, Republic of	1992	-58.8	-3.9
Costa Rica	1987	-1.3	2.2
Costa Rica	1994	8.8	1.1
Côte d'Ivoire	1988	-37.3	-1.4
Ecuador	1982	-37.9	-3.0
Ecuador	1998	9.6	3.6
Egypt	1980	-8.9	-2.8
El Salvador	1989	37.2	5.3
Finland	1991	-14.8	1.6
Ghana	1982	-9.4	2.7
Guinea	1993	-1.7	1.0
Guinea-Bissau	1995	-46.8	-2.3
Haiti	1994	-32.8	-0.1
India	1993	-1.9	-0.1
Indonesia	1997	-48.5	-3.1
Israel	1977	-48.5	-4.8
Jamaica	1996	-36.8	-3.1
Japan	1997	-15.0	-1.2

Note: Table reports first year of banking crisis (T), and medium-run output and growth performance based on baseline measure of precrisis trend.

**Table A1 (Continued). List of Banking Crisis Episodes**

Country	Year	Output Level in T+7 (percent of precrisis trend)	Average Growth During T+4:T+7 (deviation from precrisis trend, percentage points)
Jordan	1989	-36.9	-0.1
Kenya	1985	-19.6	-2.5
Kenya	1992	-19.2	-1.3
Korea	1997	-22.3	-2.2
Kuwait	1982	-12.5	7.8
Liberia	1991	-102.0	29.1
Madagascar	1988	6.3	0.8
Malaysia	1997	-37.0	-4.3
Mali	1987	-24.5	-1.1
Mauritania	1984	-13.4	-1.3
Mexico	1981	-19.1	-4.0
Mexico	1994	12.4	1.9
Morocco	1980	-28.9	-2.6
Nepal	1988	14.3	1.2
Nicaragua	1990	3.8	5.3
Nicaragua	2000	13.7	2.1
Niger	1983	-54.6	-3.3
Nigeria	1991	17.7	0.6
Norway	1991	-8.2	0.3
Panama	1988	-3.6	1.9
Paraguay	1995	-28.3	-4.6
Peru	1983	-45.9	-7.7
Philippines	1983	-38.5	-0.4
Philippines	1997	23.9	2.6
Senegal	1988	-3.2	-0.5
Sierra Leone	1990	-66.6	-8.3
Spain	1977	-45.4	-4.5
Sri Lanka	1989	-3.4	0.8
Swaziland	1995	-30.4	-4.1
Sweden	1991	-16.9	0.0
Thailand	1983	1.7	4.4
Thailand	1997	-55.9	-3.3
Togo	1993	-4.2	0.8
Tunisia	1991	18.8	2.6
Turkey	1982	-12.0	0.3
Turkey	2000	-0.1	3.2
Uganda	1994	19.6	1.3
United States	1988	4.9	0.5
Uruguay	1981	-26.4	1.2
Uruguay	2002	-3.7	4.0
Venezuela, Rep. Bol.	1994	-2.2	-1.5
Vietnam	1997	9.3	0.9
Zambia	1995	11.2	3.2
Zimbabwe	1995	-23.6	-6.6

Note: Table reports first year of banking crisis (T), and medium-run output and growth performance based on baseline measure of precrisis trend.

## **Robustness: Alternative Measures of Output Losses**

The baseline measure of the output loss is compared to the following four alternative measures based on different versions of the precrisis trend.

**Alternative 1. Precrisis window ending one year before crisis.** Here, the precrisis trend is computed as in the baseline, except that the estimation window for the precrisis trend ends one year before the crisis, rather than three years before the crisis as it does in the baseline.

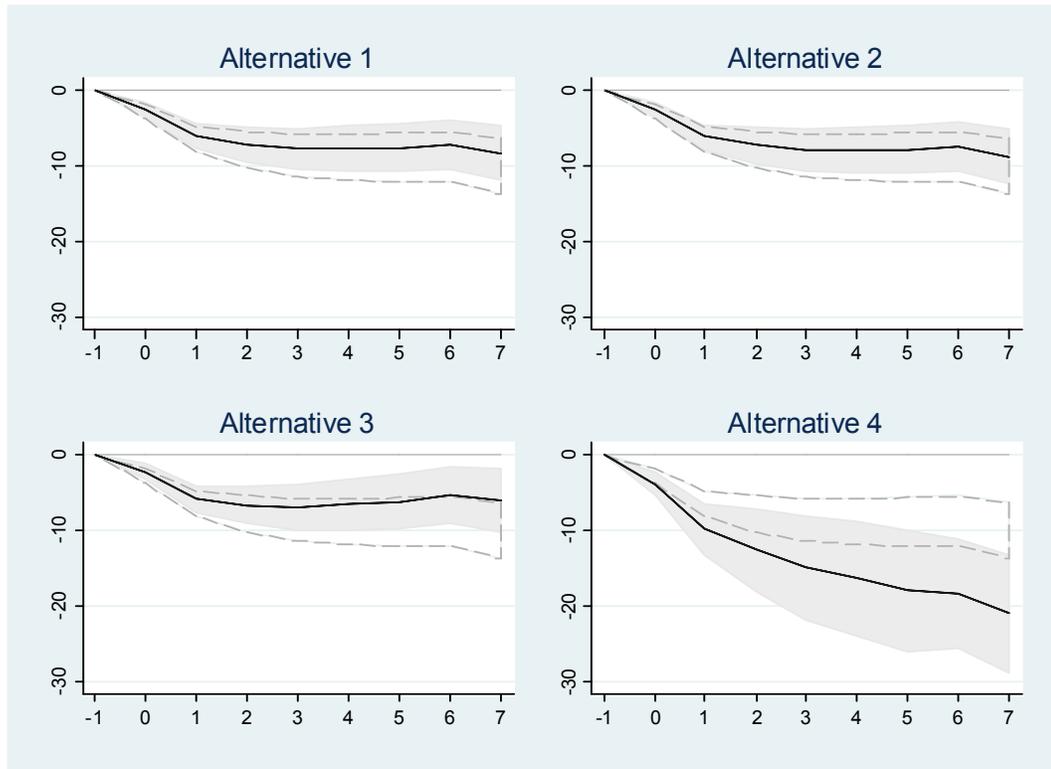
**Alternative 2. Longer estimation window application.** As in the baseline, an initial estimate of the precrisis trend is obtained based on the seven-year sample ending three years before the crisis. In the baseline approach, initial estimates that were negative were replaced with trends based on a longer precrisis window going back 20 years before the crisis. Here, the longer precrisis window is applied to the lowest and the highest 10 percent of the initial estimates of the trend growth rates. As in the baseline approach, if the trend estimate based on the longer sample is unavailable, or even further from zero than the initial estimate, the initial estimate is kept.

**Alternative 3. Longer estimation window applied to all crises.** Here, the estimate of the precrisis trend is obtained based solely on the longer precrisis window going back 20 years before the crisis, and ending three years before the crisis.

**Alternative 4. Precrisis trend based on real-time IMF country desk forecasts.** Here, the output losses were re-computed using the real-time medium-term growth projections of IMF country desks prepared for the Spring World Economic Outlook in the year before the crisis. In particular, the precrisis trend growth rate is defined as the desk forecast for real GDP growth in year  $t=4$  made in year  $t=-1$ , where  $t=0$  is the year of the crisis. The corresponding *per-capita* growth forecast is obtained by subtracting population growth in year  $t-1$ . Note that the availability of these real-time forecasts was limited to the post-1989 period.

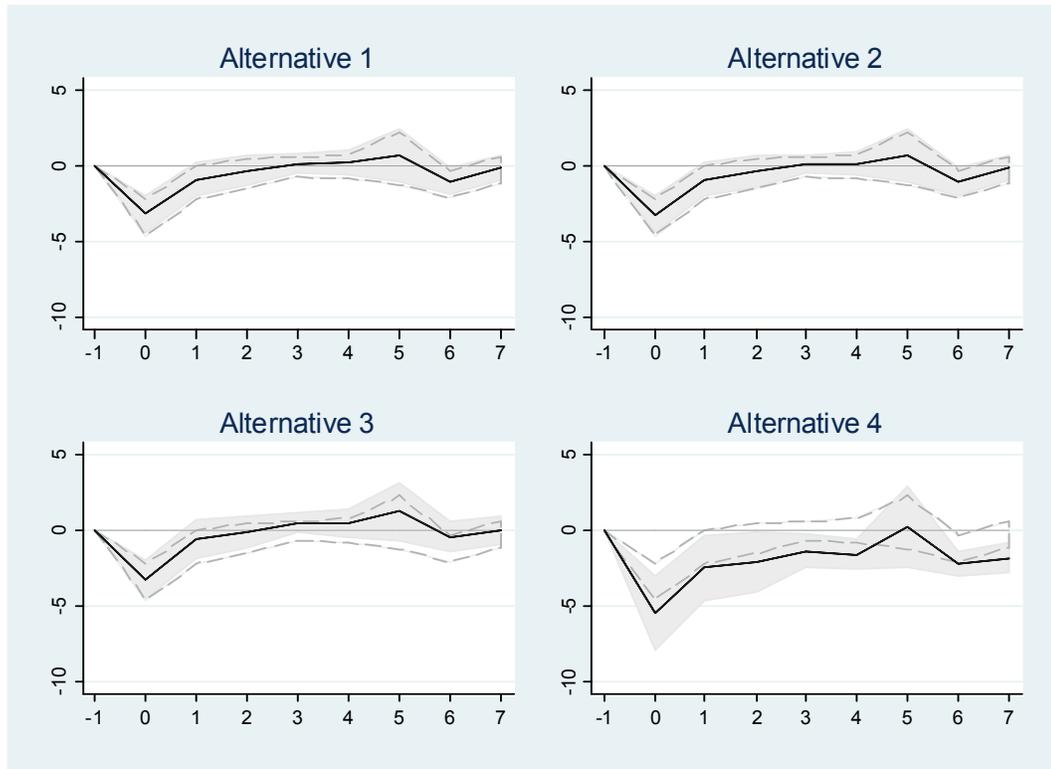
Overall, as Figures A1 and A2 report, the losses obtained using the different approaches were highly correlated, and all confirm the finding of large and statistically significant output losses after banking crises. The 90-percent confidence bands for each measure overlap with the 90-percent confidence band of the baseline measure. In the case of alternatives 1, 2, and 3, the overlap is substantial, and the mean output and growth losses are statistically indistinguishable from the baseline. In the case of alternative 4, the average output and growth losses are even greater than in the baseline. This finding is due to the IMF country desk forecasts being, on average, more optimistic than the baseline precrisis trend. Therefore, the corresponding underperformance relative to the forecast is, on average, significantly greater than in the baseline.

Figure A1. Robustness: Alternative Precrisis Trends  
 Output Evolution after Banking Crises  
 (Percent of precrisis trend)



Note: figure reports the estimated mean difference from year t-1 (line) and 90-percent confidence interval for the estimated mean (shading); first year of crisis at  $t = 0$ ; years on x-axis. Dashes indicate 90-percent confidence interval for the baseline output-loss measure.

Figure A2. Robustness: Alternative Precrisis Trends  
Growth Evolution after Banking Crises  
(Deviation from precrisis trend)



Note: figure reports mean difference relative to precrisis growth trend in percentage points; 90-percent confidence interval for estimated mean (shaded area); first year of crisis at  $t = 0$ . Dashes indicate 90-percent confidence interval for the baseline measure.

### Estimation Results without Controlling for Short-Run Crisis Severity

The short-run crisis severity variable, measured by the change in output relative to trend in the crisis year, was found to be a strong predictor of medium-run output losses (Tables 4.1 and 4.2). However, there is a possible concern that short-run crisis severity may be correlated with other explanatory variables included in the regression, potentially complicating the interpretation of the regression coefficients. To address this concern, the regressions are repeated with omission of the short-run crisis severity variable, and the results are reported in Tables 4.3 and 4.4. Overall, the coefficients are similar. However, given the strong predictive power of the short-run crisis severity variable, the regression fit, measured by the R-squared statistic, declines substantially relative to the baseline specifications, in some cases by more than one-half.

**Table A2. Robustness: Output Losses versus Initial Conditions  
Crisis Severity Omitted**

(Dependent variable: output at T+7 in percent of precrisis trend)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) investment/GDP		-1.242***										-0.930	-1.167
		[-4.195]										[-1.660]	(0.962)
(2) investment/GDP gap		0.687										-1.233*	-0.698
		[1.597]										[-1.724]	(0.575)
(3) current account/GDP			0.677*									-0.002	-0.002
			[1.848]									[-0.003]	(0.019)
(4) current account/GDP gap			1.245*									1.178	0.037
			[1.814]									[0.819]	(0.070)
(5) inflation				0.145*								0.018	0.000
				[1.781]								[0.221]	(0.054)
(6) inflation gap				-0.246***								-0.081	-0.023
				[-3.004]								[-0.668]	(0.199)
(7) fiscal balance					0.428							-0.247	-0.012
					[0.754]							[-0.354]	(0.064)
(8) fiscal balance gap					0.983							0.006	0.000
					[1.032]							[0.008]	(0.000)
(9) real exchange rate gap						-0.182							...
						[-1.143]							...
(10) real interest rate gap						-0.184							...
						[-0.232]							...
(11) log (PPP GDP per capita)							-0.005					0.001	0.000
							[-0.225]					[0.014]	(0.044)
(12) credit/GDP								-0.191				-0.021	0.001
								[-1.583]				[-0.192]	(0.022)
(13) credit/GDP gap								0.041				0.398	0.016
								[0.095]				[0.923]	(0.083)
(14) currency crisis									-0.201***			-0.255**	-0.217
									[-2.729]			[-2.292]	(0.962)
(15) U.S. T-bill rate										0.082		0.295	0.005
										[0.063]		[0.215]	(0.023)
(16) external demand shock										-0.093		-0.117	-0.015
										[-0.908]		[-1.601]	(0.108)
(17) financial openness/GDP											0.026	-0.022	0.000
											[1.675]	[-1.149]	(0.044)
(18) trade openness/GDP											-0.126	-0.040	-0.001
											[-1.483]	[-0.442]	(0.032)
(19) pre-crisis output	1.695***	1.421***	1.833***	1.138**	1.189***	1.386**	1.712***	1.117***	1.804***	1.707***	1.057***	1.283*	1.225
	[4.127]	[3.751]	[5.138]	[2.569]	[3.289]	[2.220]	[4.199]	[2.961]	[4.266]	[4.048]	[3.267]	[1.759]	(0.958)
(20) constant term	-0.099***	0.176**	-0.061**	-0.147***	-0.097***	-0.104*	-0.093**	-0.047	-0.079***	-0.100	-0.070*	0.168	0.219
	[-3.974]	[2.497]	[-2.651]	[-4.170]	[-2.717]	[-1.892]	[-2.221]	[-1.375]	[-2.935]	[-1.179]	[-1.770]	[0.817]	(1.000)
Number of observations	88	85	80	87	81	26	88	77	88	88	52	44	44
R-squared	0.214	0.294	0.282	0.185	0.201	0.195	0.214	0.135	0.254	0.218	0.134	0.676	...

Note: columns 1–12 report estimation results based on OLS with robust t-statistics in square brackets. \*\*\*, \*\*, and \* indicate significance at the 1, 5, and 10 percent level, respectively. Column 13 reports estimation results based on Bayesian model averaging with the estimated probability of inclusion of each variable in parentheses. The term “gap” denotes the deviation of variable from precrisis historical average (years T-10 to T-7 where T denotes the crisis year) during the last three years preceding the crisis.