



WP/19/83

# IMF Working Paper

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## The Global Economic Recovery 10 Years After the 2008 Financial Crisis

by Wenjie Chen, Mico Mrkaic, and Malhar Nabar

**IMF Working Papers** describe research in progress by the author(s) and are published to elicit comments and to encourage debate. The views expressed in IMF Working Papers are those of the author(s) and do not necessarily represent the views of the IMF, its Executive Board, or IMF management.

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**IMF Working Paper**

Research Department

**The Global Economic Recovery 10 Years After the 2008 Financial Crisis<sup>1</sup>**

**Prepared by Wenjie Chen, Mico Mrkaic, and Malhar Nabar**

Authorized for distribution by Oya Celasun

March 2019

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**Abstract**

This paper takes stock of the global economic recovery a decade after the 2008 financial crisis. Output losses after the crisis appear to be persistent, irrespective of whether a country suffered a banking crisis in 2007–08. Sluggish investment was a key channel through which these losses registered, accompanied by long-lasting capital and total factor productivity shortfalls relative to precrisis trends. Policy choices preceding the crisis and in its immediate aftermath influenced postcrisis variation in output. Underscoring the importance of macroprudential policies and effective supervision, countries with greater financial vulnerabilities in the precrisis years suffered larger output losses after the crisis. Countries with stronger precrisis fiscal positions and those with more flexible exchange rate regimes experienced smaller losses. Unprecedented and exceptional policy actions taken after the crisis helped mitigate countries' postcrisis output losses.

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## I. INTRODUCTION

The 2008 financial crisis was the most severe shock to hit the global economy in more than 70 years. The most acute phase of the crisis followed the September 15, 2008 collapse of the investment bank Lehman Brothers.<sup>2</sup> The post-Lehman scramble for liquidity and the ensuing panic—marked by distressed asset sales, deposit withdrawals from banks and money market funds, and the freezing of credit—triggered a collapse in cross-border trade and led to the worst global recession in seven decades. During the final quarter of 2008 and the first quarter of 2009, the downturn spread rapidly to countries that were initially not affected by the banking crisis.

Ten years later, the sequence of aftershocks and policy responses that followed the Lehman bankruptcy has led to a world economy in which the median general government debt-GDP ratio stands at 51 percent, up from 36 percent before the crisis; central bank balance sheets, particularly in advanced economies, are several multiples of the size they were before the crisis; and emerging market and developing economies now account for 60 percent of global GDP in purchasing-power-parity terms (compared with 44 percent in the decade before the crisis), reflecting in part a weak recovery in advanced economies.

Against this backdrop, this paper takes stock of the global recovery 10 years after the financial meltdown of 2008 and the policy lessons that can help prepare for the next downturn. Specifically, the paper addresses the following questions:

- Compared with precrisis trends, how did output evolve across countries in the aftermath of the crisis?
- How did the associated components—capital, labor inputs, total factor productivity—advance after the crisis? What does this decomposition show about why it took a long time for output in many economies to return to its precrisis level?
- Even as the world economy experienced its worst slump in seven decades, postcrisis macroeconomic performance varied across countries. What accounts for this variation? Which policies and structural attributes helped limit the damage and facilitate recovery?

The paper uses a sample of 180 countries—covering advanced, emerging market, and low-income developing economies—to quantify output losses, explore the precrisis correlates of postcrisis variation in output performance, and examine whether actions taken in the immediate aftermath of the crisis are associated with limiting output losses over the medium term (2015–17). Previous *World Economic Outlook* (WEO) analysis (October 2009)

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<sup>2</sup> Identifying a precise starting point for the timeline—the “patient zero” of the epidemic—is difficult. This paper takes the April 2007 collapse of subprime mortgage lender New Century Financial as the first major distress sign following the mid-2006 turn in the US housing market. Key markers of financial stress over the subsequent 18 months include the suspension of redemptions from mortgage-related hedge funds associated with Bear Stearns (June 2007) and BNP Paribas (August 2007); the UK’s first bank run since the 19th century, on Northern Rock (September 2007); the failure of mortgage lender Countrywide Financial (January 2008); JPMorgan’s acquisition of Bear Stearns with US Federal Reserve support (March 2008); and the US government’s takeover of mortgage giants Fannie Mae and Freddie Mac (September 2008).

examined output performance after an earlier set of financial crises during 1970–2002. The current paper builds on that by zeroing in on the aftermath of the 2008 crisis.

An important consideration when comparing pre- and postcrisis output patterns is the extent to which precrisis growth was fueled by excessive credit growth and unsustainable investment which had to be worked off. A related issue is whether structural change unrelated to the crisis may have affected trend growth over time in some countries (specifically, whether some countries experienced temporarily elevated potential growth rates before the crisis that subsequently reverted to long-run average). As discussed in the next section, the analysis attempts to adjust precrisis trends for the influence of factors such as credit growth that may affect the path of output beyond the influence of typical demand fluctuations. Even with this correction, for some countries, the output deviations from precrisis trends may still capture the effect of slow-moving structural changes in trend growth rates over time. Nonetheless, the paper’s cross-country analysis—comparing countries that experienced banking crises in 2007–08 with those that did not, as well as across income levels—can help identify precrisis drivers of postcrisis output deviations.

The next section quantifies the losses in output and discusses the channels through which they occurred. The subsequent section examines the policy and structural attributes that in part account for variation in postcrisis output.

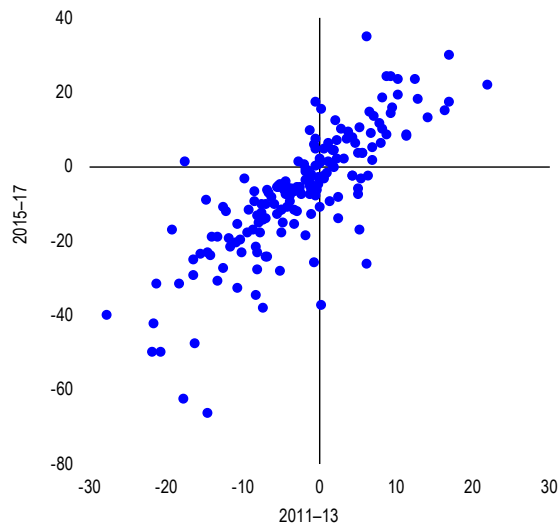
## II. QUANTIFYING LOSSES

### A. Quantifying Post-Crisis Deviations in Output from Pre-Crisis Trends

Following the global financial meltdown in late 2008, 91 economies representing two-thirds of global GDP in purchasing-power-parity terms experienced a decline in output in 2009. By way of comparison, during the 1982 global recession 48 economies accounting for 46 percent of world GDP registered output declines compared with the previous year.

To get a sense of the long-lasting changes in output after the 2008 crisis, this paper measures postcrisis deviations of output from the level that would have prevailed had output followed its pre-2009 trend growth rate (Ball 2014).

Figure 1 Correlation of GDP Deviations between Periods (Percent)



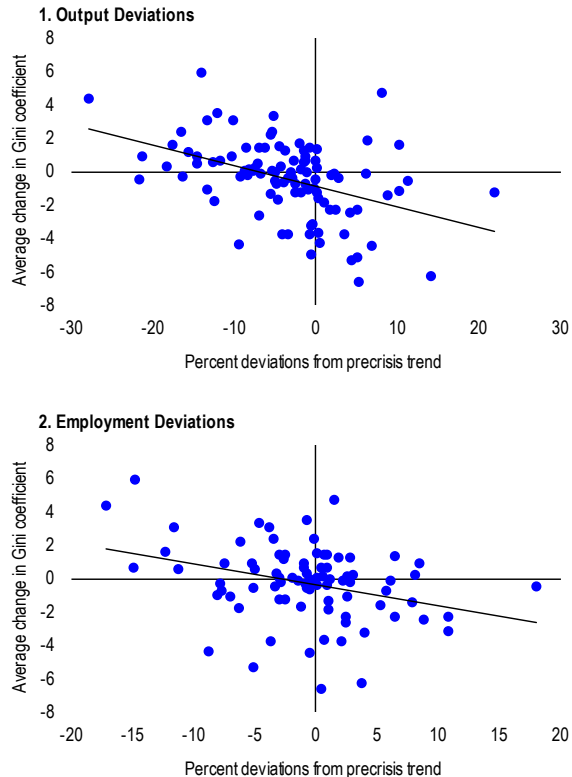
Source: IMF staff calculations

Note: GDP deviations are average percent deviations from precrisis trend.

Considering that generally accommodative financial conditions likely contributed to unsustainable growth in many countries prior to 2008, it is important to adjust for these influences when estimating an underlying trend path for output as the benchmark for comparison. Nevertheless, despite this adjustment, in some cases the measured output deviations may include country-specific changes in trend growth rates that are unrelated to the crisis. Consider the world's two largest economies, for example. In the United States, a slowdown in total productivity growth that predates the 2008 crisis has contributed to lower potential growth over time (Fernald 2015; Adler and others 2017). China's economy has experienced major structural shifts that span the 2008 crisis and an associated transition to slower, albeit still-robust, growth—an illustration of a more general phenomenon of changes in trend growth rates documented by Pritchett and Summers (2013). Given these developments (and possibly similar underlying shifts over this period in trend growth rates in other countries), comparisons of current global GDP with precrisis outcomes have to be careful to avoid attributing all of the observed changes to the 2008 crisis.

The post-2008 output deviations exhibit strong persistence over time (Figure 1).<sup>3</sup> A second, noteworthy aspect is that economies with larger output and employment losses in the initial aftermath of the crisis registered greater increases in income inequality compared with their precrisis average (Figure 2).<sup>4</sup> These developments help shed light on the lingering sense of subpar economic performance in many economies and concerns about a “new mediocre”

**Figure 2 Postcrisis Change in Inequality**



Sources: Standardized World Income Inequality Database (Solt 2016); and IMF staff calculations.

Note: The Gini coefficient is based on income before taxes and transfers and ranges from 0 to 100. The change in Gini coefficient is calculated as the difference between the averages during 2005–08 and 2014–15. Movement from left to right on the x-axis indicates less negative/more positive average deviations from precrisis trend in 2011–13.

<sup>3</sup> The correlation coefficient between GDP deviations for 2011–13 and 2015–17 is about 0.90. As shown in Annex Figure 3, the output deviations close to a decade after the 2008 crisis are more skewed toward losses than those registered at a similar interval after the 1982 global recession.

<sup>4</sup> Employment losses are measured as the gap between the number of employed workers and the number consistent with employment growing at the same rate during the postcrisis period as the economically active cohort between the ages of 15 and 65 (Schanzenbach and others 2017; see Annex).



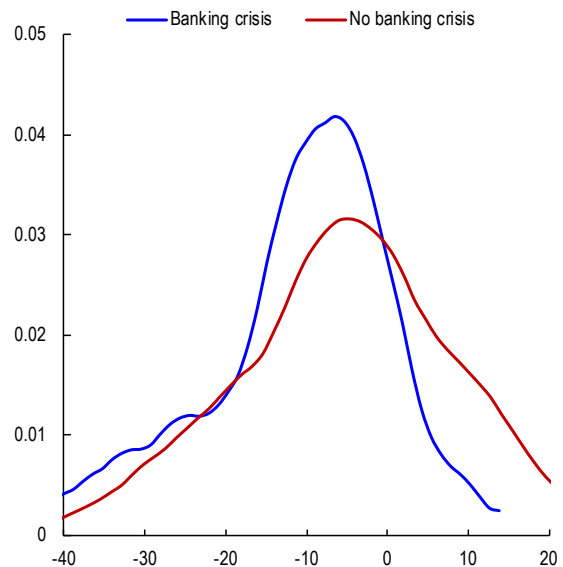
(Lagarde 2014, 2016). They may also hold clues to the disenchantment with existing institutions and establishment political parties, and the growing appeal of protectionism (Lipton 2018).

### B. Persistent losses: output remains below pre-crisis trend in more than 60 percent of economies

The deviations from pre-2009 trends are estimated for two broad samples of economies: those that experienced banking crises in 2007–08 (as defined in Laeven and Valencia 2013) and all other economies.<sup>5</sup> According to the Laeven-Valencia definition, there were banking crises in 24 countries during 2007–08, 18 of those in advanced economies (see Annex for the list). Figure 3 summarizes the distribution of postcrisis output deviations from precrisis trends when deviations are averaged over 2015–17.

Among the 24 economies in the banking crisis group, about 85 percent still show negative deviations from the pre-2009 trend a decade after the 2008 meltdown. In light of earlier evidence (see for example Abiad and others 2009; Chapter 4 of the April 2009 WEO; Blanchard, Cerutti, and Summers 2015), it is not surprising that economies in the banking crisis group suffered persistent losses thereafter. As Blanchard, Cerutti, and Summers (2015) show, recessions associated with financial crises are more likely to lead to persistent shortfalls in output relative to precrisis trends. Less credit intermediation—from a combination of supply and demand factors—is a significant channel (Bernanke 2018). On the supply side, impaired financial systems cannot intermediate credit to the same extent as before the crash, and postcrisis regulatory tightening can also affect loan origination. In parallel with the supply disruptions, several factors may have held back credit demand. These include weak growth expectations, impaired corporate and household balance sheets weighing on collateral quality, and an imperative to rebuild net wealth.

**Figure 3 Postcrisis Output Deviations from Precrisis Trend, 2015–17**  
(Kernel density)



Sources: Laeven and Valencia (2013); and IMF staff calculations.

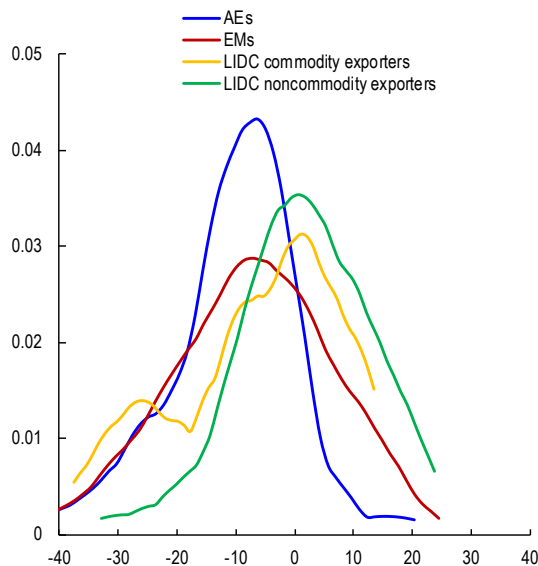
Note: Distribution of average percent deviations from precrisis trend, 2015–17. See Annex Table 1 for banking crises country list.

<sup>5</sup> The Laeven-Valencia (2013) definition of a banking crisis is based on two criteria: significant financial distress (including bank runs and liquidations) and significant government intervention in the banking system (including recapitalization, liability guarantees, and nationalization).

However, Figure 3 shows the persistence of output losses relative to precrisis trends for several economies, not just those that suffered a banking crisis in 2007–08 (consistent with Cerra and Saxena 2017 and Aslam and others, forthcoming, who find persistent losses associated with most recessions, not just those associated with financial crises). In this group, output remains below precrisis trends in about 60 percent of economies. A possible channel—discussed later in the paper—that affected this group is weaker external demand from trading partners that did suffer banking crises, which contributed to lower investment and associated capital shortfalls (also see Candelon and others, 2018).

Grouping the sample by advanced economies, emerging markets, and low-income developing countries shows that output deviations tend to be large across all groups (Figure 4). Output deviations are relatively more balanced across gains and losses for non-commodity-exporting (diversified) low-income developing countries and emerging market economies than for the other two groups. More generally, the greater variability in output deviations across emerging markets and low-income developing countries compared with advanced economies may reflect the variety of forces acting on their growth processes, including commodity price developments, export links to China, and receipt of outward investment from China (see also Aslam and others, forthcoming).

**Figure 4 Postcrisis Output Deviations from Precrisis Trend by Country Group, 2015–17**  
(Kernel density)



Source: IMF staff calculations.

Note: Distribution of average percent deviations from precrisis trend, 2015–17. AEs = advanced economies; EMs = emerging markets; LIDC = low-income developing country.

### III. CHANNELS

#### A. Proximate Causes— Sluggish Investment, Capital, and Total Factor Productivity Shortfalls

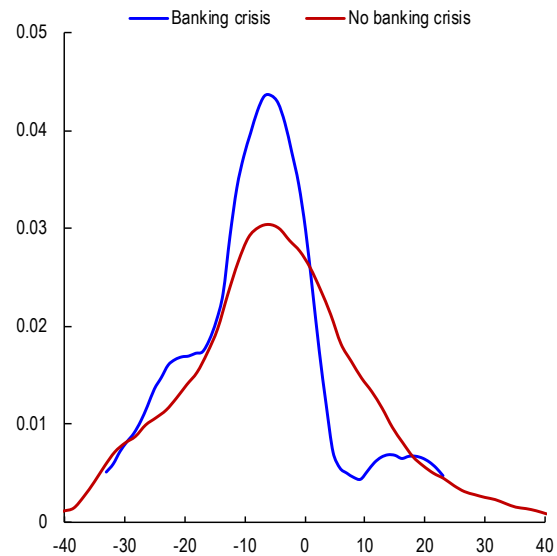
The persistence of output deviations suggests supply-side shifts in the factors of production. As shown in Figure 5, deviations in output per worker trace similar patterns to deviations in aggregate output, indicating that changes in labor input cannot account for the bulk of the observed output deviations. Most countries in the banking crisis group experienced negative deviations in labor productivity, with few countries situated to the right of vertical axis. The distribution of deviations in the non-crisis group, while still centered below zero, is considerably more symmetric with a higher mean.

The similarity with the aggregate output deviations discussed earlier suggests shifts in other factors of production associated, for instance, with weaker aggregate investment, as previously documented in Chapter 4 of the April 2015 WEO.<sup>6</sup>

Investment shortfalls may have resulted from a lack of access to credit after the crisis or from weak expectations of future growth and profitability (the latter view reprises the 1930s notion of secular stagnation—see Summers 2016 for a discussion; see also Kozłowski, Veldkamp and Venkateswaran 2018). A similar calculation for output, as described earlier in this paper, suggests shortfalls in investment relative to precrisis trends. Figure 6 shows the average of deviations relative to precrisis trends across all economies. By 2017, on average, investment was about 25 percent below precrisis trend.

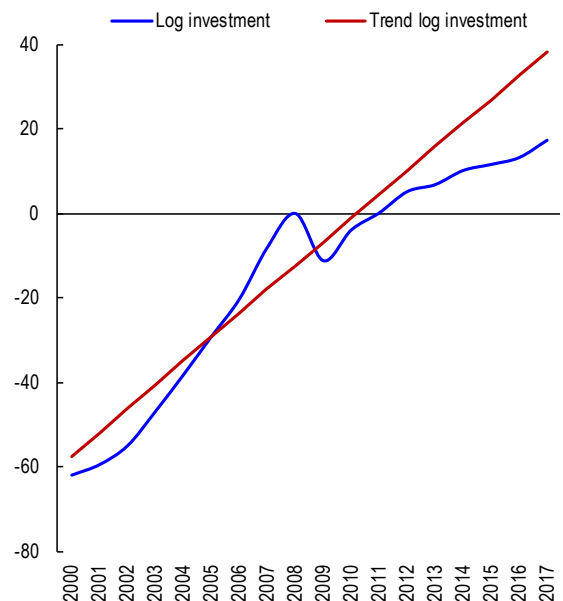
Two important consequences of sluggish investment, which may hold clues to why the recovery appears to have been so slow, are shortfalls in the capital stock and, to the extent technology is embedded in machinery, slower technology adoption. A useful way to see this is to decompose the deviations in output per worker from precrisis trends into deviations in capital stock per worker and residual total factor productivity (TFP) deviations. A caveat here is that even though TFP in principle reflects both technology and the efficiency of combining inputs, in practice, it also reflects measurement error in the factors of production and changes in capacity utilization. Evidence from standard growth

**Figure 5 Postcrisis Output per Worker Deviations from Precrisis Trend, 2015–17**  
(Kernel density)



Sources: Laeven and Valencia (2013); and IMF staff calculations.  
Note: Distribution of average percent deviations from precrisis trend, 2015–17. See Annex Table 1 for banking crises country list.

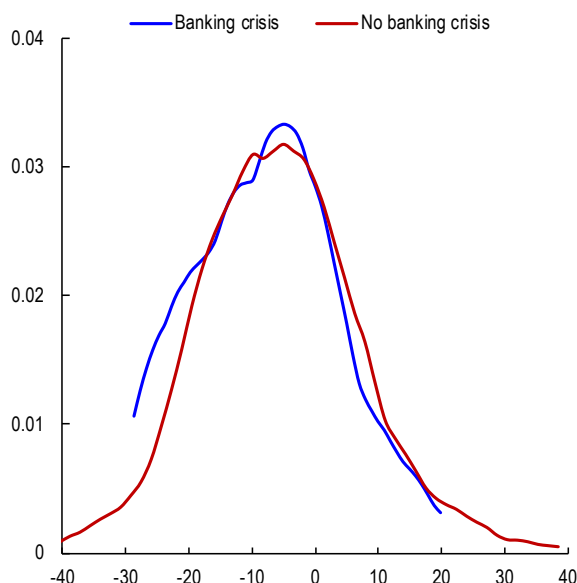
**Figure 6 Postcrisis Investment Deviations from Precrisis Trend: Mean Trajectory**  
(Percent)



Source: IMF staff calculations.  
Note: 2008 log investment normalized to zero.

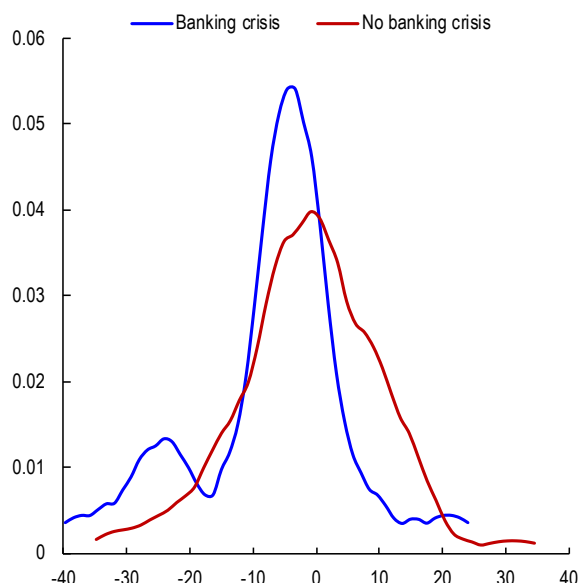
<sup>6</sup> An important exception is China. Its investment share of GDP rose from below 40 percent in precrisis years to almost 50 percent after the crisis, driven by credit-fueled expansion of infrastructure, residential and commercial real estate, and corporate capital expenditure.

**Figure 7 Postcrisis Capital Stock Deviations from Precrisis Trend, 2015–17**  
(Kernel density)



Sources: Laeven and Valencia (2013); and IMF staff calculations.  
Note: Distribution of average percent deviations from precrisis trend, 2015–17. See Annex Table 1 for banking crises country list.

**Figure 8 Postcrisis Total Factor Productivity Deviations from Precrisis Trend, 2015–17**  
(Kernel density)



Sources: Laeven and Valencia (2013); and IMF staff calculations.  
Note: Distribution of average percent deviations from precrisis trend, 2015–17. See Annex Table 1 for banking crises country list.

accounting techniques suggests there are large capital shortfalls relative to precrisis trends (Figure 7). Close to 80 percent of economies that suffered a banking crisis in 2007–08 experienced shortfalls in capital relative to precrisis trends. Among economies without a banking crisis in 2007–08, capital stocks of about 65 percent appear to be lower than they would be if capital accumulation had followed the extrapolated precrisis trend path.<sup>7</sup> As discussed in Chapter 2 of the October 2018 WEO, at the sectoral level these capital shortfalls are widespread, extending beyond the construction sector, which underwent a needed correction after the precrisis boom.

A second possible consequence of sluggish investment is slow technology adoption—to the extent that new technologies are embodied in equipment. The growth accounting approach attributes a significant role to the residual (TFP) component of deviations from precrisis trend in output per worker once the influence of deviations in capital per worker is taken into account (Figure 8). These estimated TFP deviations from precrisis trends are consistent with evidence of widespread postcrisis deceleration in TFP growth discussed in Adler and others (2017). As reported in Table 1, the median share of output per worker deviation accounted for by TFP deviation is close to 80 percent for both groups of economies. While the evidence points to the importance of TFP deviations in accounting for output per worker deviations, the cross-country data do not permit a further separation of TFP deviations into those due to

<sup>7</sup> The Annex shows that the distributions of capital stock deviations are not distinguishable across the two groups in a statistical sense, while those of output and total factor productivity are.

sluggish investment from those related to worsening efficiency or other factors unrelated to investment.

**Table 1 Total Factor Productivity Deviations Account for a Large Share of GDP per Worker Deviations**  
(Percent)

Median Share of GDP Deviation Accounted for by Deviation in GDP per Worker, 2015–17	
Countries without banking crisis in 2007–08	70.4
2007–08 banking crisis countries	80.5
Median Share of GDP per Worker Deviation Accounted for by Total Factor Productivity, 2015–17	
Countries without banking crisis in 2007–08	79.3
2007–08 banking crisis countries	78.2

Source: IMF staff calculations.

#### IV. Variation in Postcrisis Performance -- Correlates

As discussed in the preceding section, a large number of economies registered output losses relative to precrisis trends, but the postcrisis experience varied by individual country. In part, this variation may reflect differences in the nature of the shock at the level of individual countries. Some suffered severe banking crises as part of the global financial panic, while others were affected mostly through their trade and financial links to the first set of countries. But initial conditions in the buildup to the meltdown of 2008, policy choices in the immediate aftermath of the crisis, and structural aspects may have also helped shape postcrisis variation in output performance—in the first instance, by influencing countries' vulnerability to the disruptive forces the financial meltdown of 2008 unleashed, and subsequently by affecting the damage they experienced and their ability to recover. Identifying why economies' responses differed can provide important lessons for the most effective policy responses. The exercise can also help shed light on actions that may help limit damage and facilitate recovery in future downturns.

##### A. Empirical Approach

The previous section noted the persistence of output losses, with a strong correlation between GDP deviations for 2011–13 and 2015–17. Understanding the sources of variation in output performance during 2011–13 can therefore provide insight into output patterns observed during 2015–17.

The empirical approach estimates cross-sectional regressions similar to those of other papers that have examined various aspects of cross-country variation in the impact of the global financial crisis (Claessens and others 2010; Lane and Milesi-Ferretti 2010, 2014; Blanchard, Faruqee, and Das 2010; Giannone, Lenza, and Reichlin 2011; Berkmen and others 2012; Tsangarides 2012; Cerra, Panizza, and Saxena 2013). The baseline OLS specification

$$\Delta y_i = \alpha + \beta * \text{controls}_i + \varepsilon_i$$

builds on previous analysis in the WEO (Chapter 4 of the October 2009 WEO; see also Abiad and others 2009), which studied the determinants of medium-term output losses following financial crises in advanced, emerging market, and developing economies during 1970–2002. Here,  $\Delta y_i$  represents output deviations during 2011–13 (and in some specifications, during 2015–17) while the set of controls includes measures averaged over 2005–2008 that proxy for macrofinancial vulnerabilities, policy space, and structural rigidities, as well as a dummy variable for banking crisis during 2007–08. These are described in detail below. Table 2 summarizes the direction of impacts for the various drivers, while detailed regression results are presented in Tables 3–5.

**Table 2 Impact of Precrisis Conditions on 2011–13 GDP Deviations from Precrisis Trend**

	(1)	(2)	(3)	(4)	(5)	(6)
	All Countries		AEs		EMs	
Domestic Credit Growth	– **	– ***	– ***	– ***	– ***	– **
Demand Exposure to Advanced Economies	– ***	–	+	+	–	–
Demand Exposure to China	+	+	+	+ *	+ **	+
Financial Openness	– *	–	–	–	–	–
CA Balance	+		+ ***		–	
CA Gap		+ ***		+ ***		+
Share of Manufacturing in GDP	+		+		+	
Difficulty of Dismissal	– **		– *		– **	
Precrisis GG Debt Change	– ***		– ***		– ***	
De Facto Peg Dummy	– **		– ***		–	
Banking Crisis	– **	–				

Source: IMF staff calculations.

Note: + denotes positive impact, – denotes negative impact. Precrisis conditions are averaged over 2005–08. Results in columns (1) and (2) are reported in Table 3. Results in columns (3) through (6) are reported in Table 5. AEs = advanced economies; CA = current account; CA Gap = excess external balance, Lee and others (2008); EMs = emerging markets; GG = general government.

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

## B. The Nature of the Shock Matters

Although the 2008 financial crisis originated in the United States and Europe, it had a global macroeconomic impact. The origins of the crisis are by now well documented.<sup>8</sup> Four aspects are common to most accounts.

- First, abundant global liquidity enabled a lending boom in the United States, United Kingdom, euro area periphery, and Central and Eastern Europe before 2008. As discussed in Chapter 2 of the October 2018 *Global Financial Stability Report* (GFSR), the credit expansion was intermediated through complex links between traditional banks and nonbank financial institutions beyond the regulatory perimeter.
- Second, as a wave of US adjustable rate mortgages began to reset in 2006–07 and subprime borrowers found it difficult to stay current on their loans or refinance them,

<sup>8</sup> See for example Obstfeld and Rogoff 2009; Sorkin 2009; Lewis 2010; Lowenstein 2010; Rajan 2010; Blinder 2013; Paulson 2013; Geithner 2014; Bernanke 2015; Bayoumi 2017; and Toloui 2018.

the US housing market began to turn in an unprecedented, synchronized manner across many states.

- Third, unlike the late-1990s US subprime mortgage collapse, which affected mostly loan originators, the financial losses were amplified in 2007–08 by the poorly monitored practice of securitizing subprime loans into complex financial products that became impossible to price in a declining market.
- Fourth, tightening global financial conditions during 2007–08 hastened the end of the lending boom in the euro area periphery, United Kingdom, central and eastern Europe, triggering a wave of defaults by overextended property developers and households unable to roll over their loans, which further strained the balance sheets of European banks already caught in the web of losses on US subprime mortgage exposures. In the euro area, a debilitating nexus soon emerged between banks and sovereigns: taxpayer bailouts and guarantees of distressed banks severely undermined public debt sustainability in some countries; in others, weak fiscal positions and widening government spreads critically compromised banks with large holdings of sovereign securities.

For economies that experienced banking crises in 2007–08, the loss of intermediation services and diminished credit volumes, not surprisingly, had a far-reaching impact on activity. The associated corporate failures and employment losses undermined the ability of borrowers to service their loans, spiraled back to sap bank balance sheets, forced banks to retrench credit further, and amplified the output decline.<sup>9</sup> The analysis suggests (Table 3) that, on average, countries that experienced banking crises suffered a 4 percentage point

**Table 3 Impact on 2011–13 GDP Deviations from One Standard Deviation Increase in Drivers**

	(1)	(2)	(3)	(4)
Banking Crisis in 2007–08	-4.32 **	-2.01	-6.53 ***	-4.21 **
Domestic Credit Growth	-2.70 **	-5.37 ***		
Demand Exposure to Advanced Economies	-13.35 ***	-6.19		
Demand Exposure to China	1.07	3.04		
Financial Openness	-3.35 *	-3.04		
CA Balance	0.65			
Precrisis GDP Growth	-0.55	3.31 ***	-0.57	-0.94
CA Gap		2.10 ***		
Share of Manufacturing in GDP			0.15	
Difficulty of Dismissal			-1.56 **	
Precrisis GG Debt Change				-8.33 ***
De Facto Peg Dummy				-1.79 **
Constant	-3.49 ***	-4.04 ***	-2.00 **	-0.95
Observations	163	64	107	83
R <sup>2</sup>	0.18	0.58	0.16	0.29

Source: IMF staff calculations.

Note: Banking crisis in 2007–08 is dummy variable, based on Laeven and Valencia (2013). CA = current account; CA Gap = the excess external balance, Lee and others (2008); GG = general government.

\*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1.

**Table 4 Impact on 2011–13 Investment Deviations from One Standard Deviation Increase in Drivers**

	All Countries		Countries without Banking Crisis in 2007–08	
Banking Crisis in 2007–08	-11.59 ***	-3.52		
Domestic Credit Growth	-6.81 **	-12.05 ***	-6.04 *	-8.31
Demand Exposure to Advanced Economies	-24.81 *	-14.94	-25.17 *	-19.91
Demand Exposure to China	3.87	20.80 ***	4.19	22.70 ***
Financial Openness	-0.50	2.47	-2.81	-1.73
CA Balance	5.46 **		4.43 *	
Precrisis GDP Growth	-5.17 *	6.88 **	-5.36 *	7.48 **
CA Gap		10.62 ***		12.79 ***
Constant	-9.16 ***	-9.22 ***	-9.37 ***	-9.59 ***
Observations	135	62	114	42
R <sup>2</sup>	0.23	0.70	0.16	0.64

Source: IMF staff calculations.

Note: Banking crisis in 2007–08 is dummy variable, based on Laeven and Valencia (2013). CA = current account; CA Gap = the excess external balance, Lee and others (2008); GG = general government.

\*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1.

<sup>9</sup> Gertler and Gilchrist (2018) examine the relative contributions of banking disruption and household balance sheets to the contraction of US employment during the Great Recession. They find that banking disruption is key to the aggregate decline in US employment, while household balance sheet strength is relatively more important for explaining regional variation.

higher output loss during 2011–13 relative to the precrisis trend than those that did not experience banking crises in 2007–08.



### **C. Macroeconomic Imbalances and Financial Factors**

Regardless of whether a country suffered a banking crisis in 2007–08, tighter financial conditions after the crisis brought out the central role of precrisis financial vulnerabilities in influencing postcrisis output performance. This influence is reflected at a general level in the variation of output performance as a function of initial macroeconomic and financial imbalances, and along more specific dimensions, such as the pace of precrisis credit growth.

A useful summary statistic of macroeconomic imbalances is the gap between the actual current account balance and its level consistent with medium-term fundamentals (which can be thought of as a real-time estimate of imbalances resulting from private and public saving-investment disparities—see Lee and others 2008; Lane and Milesi-Ferretti 2010). The results suggest that countries with current account balances weaker than the level consistent with fundamentals entering the crisis suffered bigger output losses relative to precrisis trends (Table 3). This may in part reflect the more severe adjustment forced on countries with higher precrisis excess deficits.

In addition, countries more dependent on credit (those with faster credit growth in the buildup to the crisis) suffered larger losses in an environment of tighter financial conditions.

### **D. Labor Market Structure**

Some economies are more flexible than others when it comes to relocating workers in the face of shocks. The strength of employment protection legislation—the balance it provides between security for workers and flexibility for firms—is a key influence on firms’ decisions to hire new workers. The evidence suggests that economies in which it was more difficult for firms to terminate labor contracts (proxied by an index of ease of dismissal compiled by the Centre for Business Research at Cambridge University) suffered larger postcrisis losses in output relative to precrisis trends (Table 3).<sup>10</sup> This may indicate reluctance on the part of firms during the postcrisis recovery phase to expand operations and lock themselves into costly contracts in economies where subsequent exit would be more difficult.

### **E. Spillovers**

The results in Table 3 are also consistent with spillover effects through trade. Controlling for the effect of banking crises, economies relatively more exposed to demand from advanced economies suffered larger output losses in the aftermath.

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<sup>10</sup> The Cambridge University CBR index (Adams, Bishop, and Deakin 2016) is based on an average of nine detailed indicators of dismissal procedures constructed using leximetric coding methodology on country-level labor legislation. The index is used here since it has broader country coverage than the Organisation for Economic Co-operation and Development’s (OECD’s) strength of employment protection indices. The index correlates well with the OECD measures for countries covered by the OECD’s indices, as well as with a typical measure of labor market churn and dynamism (the probability of entering and exiting employment), which can be constructed for a limited set of countries along the lines of Elsby, Hobijn, and Sahin (2013).

(continued...)

The size of gross external financial exposure acted as another key channel through which financial distress from the crippled core of advanced economies transmitted to the rest of the global economy. Countries more integrated into global financial markets (represented by larger fractions of external assets and liabilities relative to GDP) experienced bigger deviations from the precrisis trend.<sup>11</sup> This may reflect, in part, retrenchment in global banking after the crisis.

There is a similar pattern for postcrisis investment deviations among countries that did not experience a banking crisis in 2007–08 (Table 4). In particular, countries with stronger trade ties to advanced economies going into the crisis experienced larger deviations in investment during 2011–13 relative to precrisis trends. This finding is consistent with the earlier observation (Figure 7) that persistent capital shortfalls were observed also in countries that did not experience a banking crisis in 2007–08.

An important offsetting influence on weak demand from advanced economies during this period was demand from China. China's 4 trillion yuan stimulus during 2008–11 (close to 10 percent of 2008 GDP) supported a large nationwide infrastructure expansion and construction of social housing, with associated favorable impacts on exporters of commodities and heavy equipment (Ahuja and Nabar 2012). The results in Table 5, grouped according to advanced and emerging market economies, indicate that economies whose

**Table 5 Impact on 2011–13 GDP Deviations from One Standard Deviation Increase in Drivers by Country Group**

	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	AEs	EMs	AEs	EMs	AEs	EMs	AEs	EMs	AEs	EMs	AEs	EMs	AEs	EMs	AEs	EMs
Domestic Credit Growth	-4.96 **	-4.79 ***	-5.43 ***	-5.71 **												
Demand Exposure to Advanced Economies	9.01	-7.20	4.40	-8.27												
Demand Exposure to China	3.88	7.33 **	6.56 *	4.98												
Financial Openness	-3.34	-3.68	-2.30	-21.43												
CA Balance	4.03 ***	-0.42														
Precrisis GDP Growth	-1.64	-0.27	2.77 *	3.11	-3.17	-1.55	-2.22	-0.45								
CA Gap			2.49 ***	1.23												
Share of Manufacturing in GDP					3.18	0.34										
Difficulty of Dismissal					-1.72 *	-2.27 **										
Precrisis GG Debt Change													-11.85 ***	-10.27 ***		
De Facto Peg Dummy													-2.50 ***	-1.27		
Constant	-6.99 ***	-4.46 ***	-6.28 ***	-6.91	-8.84 ***	-1.07	-2.58	-0.42								
Observations	33	83	32	32	34	52	34	48								
R <sup>2</sup>	0.63	0.21	0.69	0.44	0.17	0.10	0.31	0.15								

Source: IMF staff calculations.

Note: AEs = advanced economies; CA = current account; CA Gap = the excess external balance, Lee and others (2008); EMs = emerging markets; GG = general government.

\*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1.

export baskets were more exposed to China before the crisis benefited disproportionately in the aftermath from higher exposure to China's domestic demand (measured as the share of trading partner demand accounted for by China), especially among emerging market economies.

<sup>11</sup> This is consistent with Perri and Quadri (2018), who develop a model of global, synchronized recessions that follow from cross-border transmission of liquidity shortages in highly integrated capital markets. The extensive cross-border financial links—particularly among advanced economies—on the eve of the crisis was unprecedented and may have compounded countries' vulnerabilities. See also the analysis in Chapter 4 of the April 2009 WEO, which documents the role of international links in transmitting financial stress across borders.

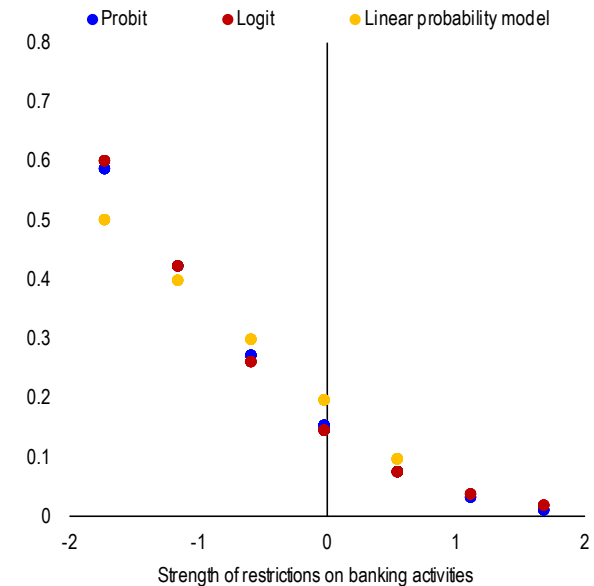
## F. Precrisis Policies and Policy Frameworks

The incidence of bank crises in 2007–08 was a key driver of subsequent losses. Regulatory and supervisory structures may thus have played a preemptive role in influencing subsequent damage. The bank regulation index constructed by Barth, Caprio, and Levine (2013) illustrates this link. Specifically, stronger restrictions in 2006 on banks' ability to underwrite, broker, and deal in securities; offer mutual fund products; and engage in insurance underwriting, real estate investment, development, and management are associated with a lower probability of a banking crisis during 2007–08 (Figure 9).<sup>12</sup> A caveat is that the index measures the strength of restrictions only on specific aspects of bank activity. Other dimensions (for instance, strength of capital, funding, and liquidity requirements; the accompanying supervisory approach to stress-testing balance sheets; overall intensity of financial sector monitoring activity; the porosity of the regulatory perimeter and opportunities for regulatory arbitrage) likely also played a role.

In general, the initial policy space available prior to a crisis can affect the extent of activity decline afterward (Blanchard, Dell'Ariccia, and Mauro 2010; Jorda, Schularick, and Taylor 2016; Romer and Romer 2018). For the 2008 episode specifically, countries with smaller increases in general government debt over 2005–08 experienced smaller losses relative to trends (Tables 3,5). Countries with lower public sector borrowing requirements going into the crisis appear to have had more room to deploy fiscal policy for demand support in the immediate aftermath.

Policy frameworks also appear to matter for postcrisis output outcomes. Exchange rate flexibility is associated with less damage, pointing to a buffering role of nominal exchange rates (Tables 3,5). This finding may in part reflect the difficulties experienced by euro area periphery economies. In these countries, the absence of an independent nominal exchange rate, together with fiscal stress and the lack of a common area-wide banking union and fiscal

**Figure 9 Probability of Banking Crisis**  
(Probability)



Sources: Barth, Caprio, and Levine (2013); and IMF staff calculations.

Note: Movement from left to right on the x-axis indicates stronger restrictions on banking activities.

<sup>12</sup> See Annex for details on the regression specification. The association shown here is robust to controlling for some other influences on the likelihood of a bank crisis (Annex Table 4).

backstop, meant the burden of adjustment after the crisis fell entirely on domestic prices and output.

The median output loss for euro area economies is notably higher than for other advanced economies in 2011–13 (Figure 10), covering an intense phase of the sovereign debt crisis, deposit flight from stressed euro area economies to core economies, and financial fragmentation within the euro area (see IMF 2012, 2013a). The difference in losses widened through 2015–17, pointing to a weaker recovery compared with other advanced economies. The divergence may in part reflect the limited policy levers available within a currency union for adjustment to asymmetric shocks, differences in the speed of financial sector repair, and—despite substantial progress toward a banking union and the creation of the European Stability Mechanism for crisis management—remaining gaps in the euro area architecture.<sup>13</sup>

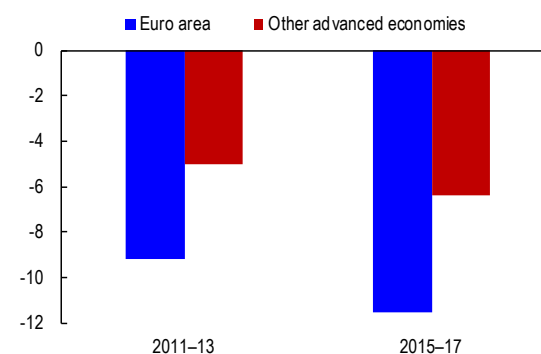
### G. Extraordinary Actions Taken in the Aftermath of the Crisis

Several countries undertook exceptional and unprecedented policy measures to support their economies after the 2008 financial crisis. In many cases, notably among the advanced economies most severely affected by the crisis, the measures combined central bank monetary policy actions (unconventional monetary policy support through asset purchases as policy rates approached their effective lower bounds; liquidity support to specific segments of credit markets through targeted central bank facilities), discretionary fiscal stimulus, and financial sector operations (bank balance sheet stress tests, government guarantees of banking sector liabilities, purchases of toxic assets from banks, capital injections). Central banks also established ad hoc bilateral swap lines to support foreign exchange liquidity in jurisdictions beyond home markets.

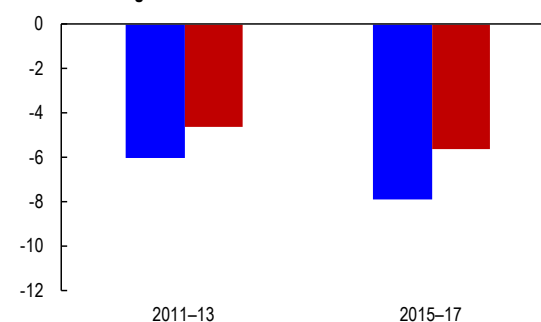
**Figure 10 Postcrisis Deviations of Euro Area and Other Advanced Economies**

(Percent)

1. Median



2. PPP GDP-Weighted Mean



Source: IMF staff calculations.

Note: Other advanced economies are advanced economies that are not in the euro area. PPP = purchasing power parity.

<sup>13</sup> Thomsen (2017); Arnold and others (2018); and Berger, Dell’Ariccia, and Obstfeld (2018) discuss the reforms implemented to strengthen the euro area architecture and the remaining steps to complete the banking and fiscal union.

Advanced economy monetary policy actions, in particular, represented a significant change in the approach to providing monetary accommodation—necessitated in some cases by central banks rapidly reducing policy rates to their effective lower bounds during the crisis (Bernanke 2017). The particular mix of tools varied across individual cases, but generally included a combination of quantitative easing (massive balance sheet expansion with purchases mainly of government bonds, mortgage-backed securities, and corporate bonds), state-dependent forward guidance (specifying particular levels of unemployment and inflation as conditions for rate hikes), negative interest rates (charging commercial banks a penalty on excess reserves held at the central bank), and yield-curve control (targeting the yields of longer-maturity government bonds through central bank purchases).

Estimates of the impact of advanced economy central banks' quantitative easing on interest rates and financial conditions vary (Gagnon 2016). In general, the positive effect of the actions on domestic output in advanced economies and imports from trading partners is believed to have outweighed negative effects as a result of elevated capital inflows and currency appreciation pressure elsewhere (IMF 2014). More broadly, quantitative easing may have also helped stabilize activity by reducing the tail risk of debilitating asset price declines. Nevertheless, the actions were the subject of controversy, with policymakers in emerging market and developing economies, at times raising concern about adverse spillovers from advanced economy central banks' unconventional monetary policy approaches (Mantega 2010; Zhou 2010; Rajan 2014).

The analysis in this paper focuses on the impact of fiscal and quasi-fiscal measures in support of the financial sector undertaken by some economies in the aftermath of the crisis (Table 6). The Group of Twenty (G20) economies, for example, on average injected discretionary fiscal stimulus of just over 2 percent of GDP in 2009 and 2010. (The IMF was among the early advocates of the effort in the days leading up to the November 2008 G20 Summit.)<sup>14</sup> The number of such actions is larger than the instances of asset purchase programs by advanced economy central banks and therefore more easily studied in a regression framework to assess their impact on output deviations.

Estimating the immediate effect of the actions is difficult. In the case of discretionary fiscal stimulus, for example, causality runs in both directions, with larger output collapses likely to

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<sup>14</sup> During 2008 and 2009, the G20 forum (Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, United Kingdom, United States, European Union) was pivotal in forging international consensus on fiscal expansion, augmenting the lending resources of the IMF and multilateral development banks, and the need to strengthen financial regulation. See <https://www.g20.org/en/g20/timeline>. On the IMF's November 2008 call for fiscal stimulus by the G20 economies, see <http://www.imf.org/en/News/Articles/2015/09/14/01/49/pr08278>.

**Table 6 Financial Sector Support and Discretionary Fiscal Stimulus in Group of Twenty Economies**  
(Percent of GDP)

1. Headline Support for the Financial Sector (as of February 2009)

	Capital Injection	Purchase of Assets, Lending by Treasury	Central Bank Support with Treasury Backing	Central Bank Liquidity Support	Guarantees	Total
	(A)	(B)	(C)	(D)	(E)	(A+B+C+D+E)
G20 Average (PPP GDP weights)	2.0	3.3	1.0	9.2	14.3	29.8
Advanced Economies	2.9	5.0	1.2	12.9	21.3	43.3
Advanced Europe	2.4	3.6	2.1	1.0	19.5	28.6
Emerging Markets	0.3	0.1	0.3	1.8	0.2	2.7

2. Crisis-Related Discretionary Fiscal Stimulus in G20 Economies (as of October 2010)

	2009	2010	2011
G20 Average	2.1	2.1	1.1
Advanced Economies	1.9	2.1	1.2
Emerging Markets	2.4	2.0	0.9

Sources: IMF (2009), Fiscal Affairs and Monetary and Capital Markets departments database on public interventions; Chapter 1 of the November 2010 *Fiscal Monitor*.

Note: Panel 1 is calculated based on country statistics originally published in IMF (2009). The data on guarantees for Australia is based on Schwartz and Tan (2016). In panel 1, G20 calculations do not include Mexico and South Africa. G20 = Group of Twenty.

prompt larger policy responses, all else equal. It is nonetheless possible to detect lagged effects of the measures on output deviations from precrisis trends averaged over 2015–17.

As shown in Table 7 and Figure 11, conditional on the size of initial losses during 2011–13, quasi-fiscal actions taken to stabilize the financial sector helped limit damage during 2015–17. Overall headline support for the financial sector has a statistically significant positive correlation with subsequent output deviations from trend; among the specific actions, capital injections and guarantees appear to have helped limit subsequent output losses. These

**Table 7 Impact on 2015–17 GDP Deviations from One Standard Deviation Increase in Drivers**

Total Headline Support for Financial and Other Sectors	0.20 **							
Capital Injections	1.90 *							
Purchase of Assets and Lending by Treasury	0.21							
Central Bank Support with Treasury Backing	-14.35							
Central Bank Liquidity Support	-0.25							
Guarantees (excluding Deposit Insurance)	0.24 *							
Upfront Government Financing	0.31							
Crisis-Related Discretionary Fiscal Stimulus	-0.78							
Banking Crisis in 2007–08	-0.17	-1.74	2.88	3.54 *	3.06	-1.35	1.71	2.25
GDP Deviation 2011–13	1.12 ***	1.05 ***	1.10 ***	1.08 ***	1.10 ***	1.06 ***	1.09 ***	1.33 ***
Constant	-5.95 ***	-5.08 ***	-4.79 **	-4.04 **	-2.04	-5.12 **	-4.72 **	-1.33
Observations	29	29	29	29	29	28	29	19
R <sup>2</sup>	0.62	0.60	0.53	0.54	0.54	0.60	0.53	0.50

Source: IMF staff calculations.

Note: Banking crisis in 2007–08 is dummy variable, based on Laeven and Valencia (2013).

\*\*\* p < 0.01, \*\* p < 0.05, \* p < 0.1.

interventions may have helped thaw credit markets, and resumption of credit services subsequently contributed to raising output.

Beyond action at the national level, as discussed in Chapter 2 of the October 2018 GFSR, there were extensive multilateral efforts to strengthen financial regulatory standards (aimed at expanding the regulatory perimeter, containing the buildup of systemic risk, strengthening resilience to shocks, and developing resolution frameworks). Multilateral cooperation also helped craft an important component of the monetary response to the crisis, with the IMF providing unconditional financial resources to its members through a general allocation of SDR 204 billion (\$316 billion) during August–September 2009.<sup>15</sup> In addition, several economies relied on the global financial safety net to ease their adjustment to the funding shock after the crisis. The IMF, for example, approved SDR 420 billion in support to its members during 2008–13, of which SDR 119 billion was drawn during that interval.<sup>16</sup>

## V. SUMMARY

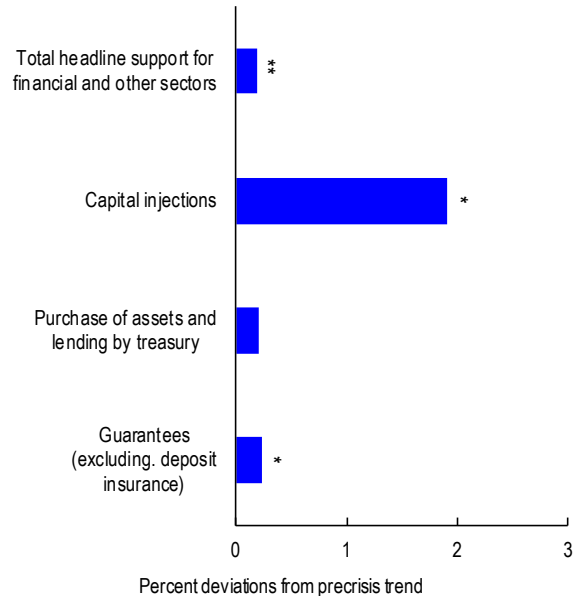
This paper has documented persistent output losses following the 2008 financial meltdown in a broad set of countries, not just the group afflicted by banking crises at the time. Protracted weak investment after the crisis was a major contributing factor, associated with persistent shortfalls in capital and total factor productivity relative to precrisis trends as well as slower technology adoption among countries hit harder by the crisis.

The policy lessons of the crisis discussed in this paper follow from the lens adopted to view its aftermath and to understand why the recovery appeared so slow in many countries. Other important developments, such as the declining share of labor income (see Chapter 3 of the April 2017 WEO), subdued wage growth, and the rise of part-time work (discussed in Chapter 2 of the October 2017 WEO), pose additional policy challenges for ensuring the income security and welfare of those who rely mostly on their labor income.

<sup>15</sup> The IMF's special drawing right (SDR), an international reserve asset based on a basket comprising the US dollar, Chinese renminbi, Japanese yen, euro, and British pound, is a claim on freely usable currencies of IMF members. The 2009 general SDR allocation augmented IMF members' international reserves, with the aim of easing postcrisis liquidity constraints. <https://www.imf.org/en/News/Articles/2015/09/14/01/49/pr09283>.

<sup>16</sup> The gross figure includes precautionary arrangements. See IMF (2015) for details.

**Figure 11 Impact on 2015–17 GDP Deviations from One Standard Deviation Increase in Drivers (Percent)**



Source: IMF staff calculations.

Note: Movement from left to right on the x-axis indicates less negative/more positive deviations from precrisis trend. Extraordinary measures were taken during 2008–09.

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

The evidence documented in this paper suggests that policy choices in the run-up to the crisis and in its immediate aftermath influenced postcrisis output performance in multiple ways. Stronger banking regulation—proxied by restrictions on certain aspects of bank activity—appears to have played a preventive role by lowering the probability of a banking crisis in 2007–08. The finding is relevant for ongoing debates on rolling back the regulatory standards adopted following the crisis.

Countries with stronger fiscal positions entering the crisis suffered smaller losses, suggesting that greater room for policy maneuver may have helped defend against harm. Extraordinary fiscal and quasi-fiscal actions to support the financial sector after the crisis appear to have helped lessen output losses over the medium term. Economies that moved quickly to assess the health of their banking systems and recapitalize banks appeared to have suffered smaller output losses subsequently. As IMF (2013c), Furman (2016), Auerbach (2017), and Blanchard and Summers (2017) note, there is renewed recognition of discretionary fiscal policy as a countercyclical demand management tool. Moreover, as the analysis shows, China's large fiscal stimulus during 2008–11 appears to have had favorable spillovers to trading partners. Altogether, the evidence presented here suggests some confirmation of the efficacy of fiscal measures in limiting persistent losses after a recession. And as noted in earlier IMF research (IMF 2014), unconventional monetary policy actions by advanced economy central banks helped limit output declines and employment losses at home while supporting imports from abroad.

The policy efforts of the past decade helped forestall an even worse outcome with deeper output and employment losses. But they have had important side effects. The extended period of ultralow interest rates in advanced economies have contributed to the buildup of financial vulnerabilities. The large accumulation of public debt has eroded fiscal buffers in many economies and left them with limited defenses against the next downturn. A fuller analysis of the extraordinary policy efforts and their side effects must necessarily await the broader perspective that will emerge with further passage of time.



## VI. ANNEX: DEFINITIONS AND DATA CONSTRUCTION

### A. Definition of Banking Crises

Annex Table 1 lists the banking crises used in the analysis. The definition of a banking crisis is from Laeven and Valencia (2013). It is based on two criteria: significant financial distress (including bank runs and liquidations) and significant government intervention in the banking system (including recapitalization, liability guarantees, and nationalization). The sample includes all banking crises that started between 2007–08.

### B. Definitions of Main Data Categories

#### *Deviations from Pre-Crisis Trends*

Deviations of GDP and other variables from the pre-crisis trend are calculated as follows:

- First, the transitory pre-crisis components are removed by means of low pass filters.<sup>17</sup> While no method of removing transitory components can accommodate the specificities of every country in the sample, the filtering approach by Gourinchas and Obstfeld (2012), where the two-sided Hodrick-Prescott (HP) lowpass filter is used to eliminate transitory components, offers a general method of isolating low frequency (log) GDP movements from the data.<sup>18</sup> The smoothing parameter is set at a higher value (100) than in standard business cycle detrending (6.25 with annual data). With the higher parameter, the estimated trend is less sensitive to short-run business cycle fluctuations and filters out relatively more medium-term influences, such as those of credit cycles.<sup>19</sup> Annex Figure 1 shows how removing transitory components affects estimation of the pre-crisis trend in

**Annex Table 1 Banking Crises, 2007–08**

Country	Start of Crisis
<b>Systemic Cases</b>	
Austria	2008
Belgium	2008
Denmark	2008
Germany	2008
Greece	2008
Iceland	2008
Ireland	2008
Kazakhstan	2008
Latvia	2008
Luxembourg	2008
Mongolia	2008
Netherlands	2008
Spain	2008
Ukraine	2008
United Kingdom	2007
United States	2007
<b>Borderline Cases</b>	
France	2008
Hungary	2008
Italy	2008
Portugal	2008
Russia	2008
Slovenia	2008
Sweden	2008
Switzerland	2008

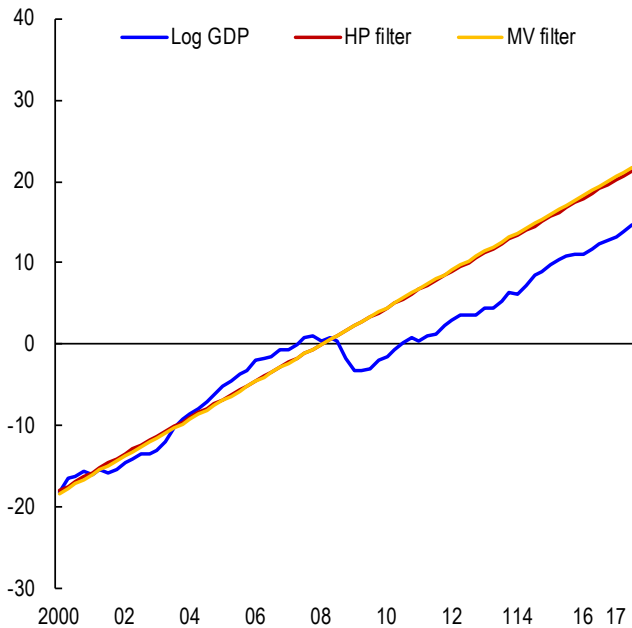
Source: Laeven and Valencia (2013).

<sup>17</sup> An alternative approach is to fit a linear trend to the log-GDP series that has been truncated a few years before the peak of the cycle. This approach produces estimates that are highly sensitive to the length of the truncation period. Furthermore, its cutoff frequency cannot be controlled.

<sup>18</sup> Estimating the trends with a multivariate filter (as in Berger and others 2015) that accounts for macrofinancial imbalances could in principle provide more accurate estimates of underlying trend. In practice, the HP filter with the smoothing parameter set to 100 works equally well. In addition, the limited availability of data on asset prices precludes a wide application of multivariate filtering.

<sup>19</sup> The “standard” value  $\lambda=6.25$  has the cutoff frequency of only 8 years.

**Annex Figure 1 Estimates of Precrisis Trends for the United States (Percent)**



Source: IMF staff calculations.

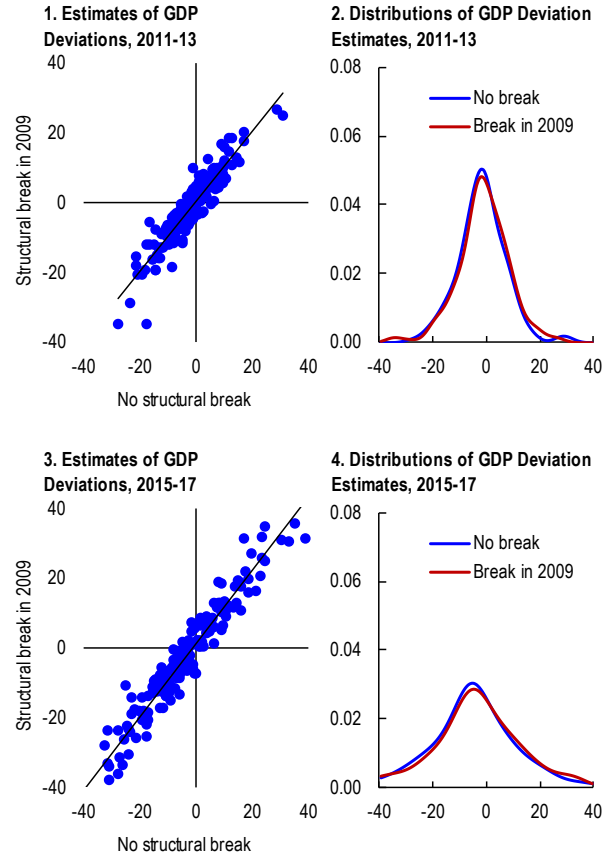
Note: 2008 log GDP normalized to zero. Trend log GDP denotes extrapolated trend of potential GDP during 2000-08. HP=Hodrick-Prescott, MV=multivariate. Potential GDP estimated with HP filter, lambda=100. MV filter regressors are headline consumer price index, housing price index, stock prices, credit growth, and capacity utilization.

the case of the US. The multivariate filter

yields estimates of output deviations that are in agreement with those obtained by applying the HP filter as described above.

- The underlying filtered time series run from 1995 to 2017. While GDP series could have experienced a structural break at the time of the GFC, an analysis shows that the estimated deviations are robust to the presence of a structural break.<sup>20</sup> Annex Figure 2 shows the relationships between 2011–13 and 2015–17 GDP deviations estimated with and without allowing for a post-GFC structural break. The closeness of both sets of estimated deviations demonstrates the robustness of estimated GDP deviations to the presence of a structural break.

**Annex Figure 2 Structural Break (Percent)**



Sources: IMF Staff Calculations.

Note: Distribution of average percent deviations from precrisis trend.

<sup>20</sup> The structural break is modelled as 5- $\sigma$  shock to potential GDP in 2009, calibrated to correspond to the 5- $\sigma$  shock to headline real GDP.

(continued...)

- Second, the trend of the filtered series is calculated over 2000–08. The 2000–08 period is chosen because it is long enough to minimize the influence of shocks in individual years.<sup>21</sup>
- Finally, the deviations of post-crisis GDP from its pre-crisis trend are calculated as the average differences for 2011–13 and 2015–17.

### Comparing GDP Deviations with Previous Recessions

Annex Figure 3 compares the aftermaths of the 2008 and 1982 global recessions. While in the shorter run, both recessions induced similar deviations from the pre-crisis trends, the impact of the 2008 recession has been felt much longer. In addition, the 2008 recession affected a larger share of global output, as seen by comparing the distributions of weighted and unweighted output deviations.

### Employment Deviations

Employment deviations are calculated using the approach by Schanzenbach and others (2017) who track the evolution of the employment ratio and compare it to the “benchmark” value from 2007 as follows:

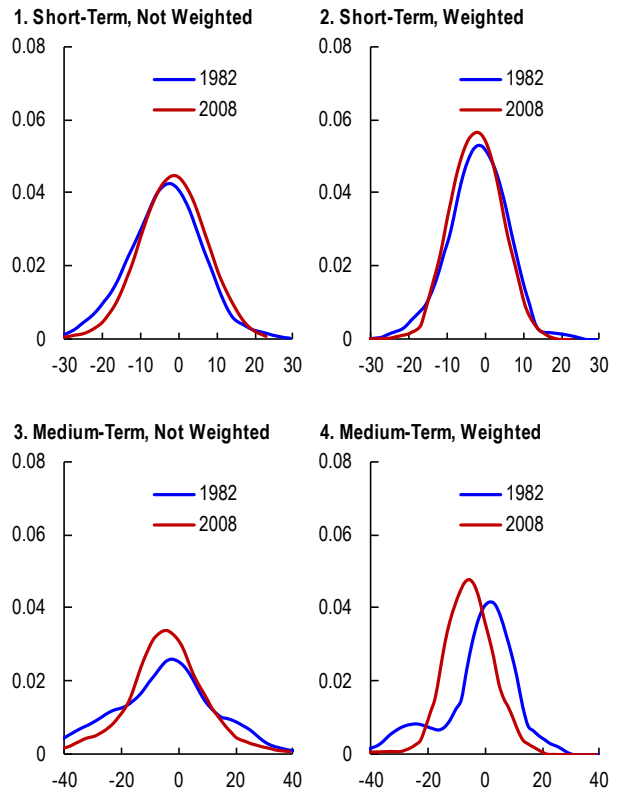
$$\text{employment gap}_t = \frac{\text{employment}_t}{\text{population}_t^{15-65}} / \frac{\text{employment}_{2007}}{\text{population}_{2007}^{15-65}} \quad (1)$$

While Schanzenbach and others (2017) estimate employment deviations only for the US, the paper extends their analysis to 102 countries.

### Deviations of Total Factor Productivity

Post-crisis deviations of total factor productivity (TFP) from its pre-crisis trend are calculated using the standard Cobb-Douglas production function for output per worker and comparing the observed post-crisis values in labor productivity and output per worker with their pre-crisis trends—starred variables in the following equation:

Annex Figure 3 Distributions of GDP Deviations after Recessions



Sources: IMF Staff Calculations.

Note: Distribution of GDP percent deviations from pre-crisis trend. Country weights proportional to purchasing power parity GDP. Short-term = 3-5 years after the recession. Medium-term = 7-9 years after the recession.

<sup>21</sup> In the case of the US, Fernald (2015) shows that labor productivity accelerated in the 1990s and that it returned to its long-run trend of approximately 1.5 percent per annum around 2003—well before the 2008 recession. For this reason, calculating post-GFC losses based on periods of faster productivity growth before 2000 could overstate post-GFC output losses. In this paper’s analysis, the trend growth of US labor productivity, calculated as described above, amounts to 1.54 percent per annum. This estimate is in close agreement with the estimate by Fernald.

$$\ln\left(\frac{A^*}{A}\right) = \ln\left(\frac{y^*}{y}\right) - \alpha \cdot \ln\left(\frac{k^*}{k}\right). \quad (2)$$

### ***Treatment of Explanatory Variables***

Explanatory variables used in the regression exercises are constructed as follows:

- First, all explanatory variables are averaged over the period 2005-08 to attenuate the effect of idiosyncratic shocks.
- Second, all regressors (except for the banking crisis dummy) are standardized to have zero means and standard deviations of unity.
- Finally, the regressors are winsorized to alleviate the influence of outliers.<sup>22</sup>

### ***Tests of Equality of Distributions***

Figures 3, 7, and 8 show the distributions of deviations of output, capital stock and total factor productivity respectively. The results of statistical tests of equality of these distributions between countries with and without banking crisis are presented in Annex Table 2. The table shows the rejection of the null hypothesis of equality of distributions in the cases of output and total factor productivity deviations. However, the distributions of capital stock deviations were not found to be significantly different between the crisis and non-crisis countries.

**Annex Table 2 Tests of Equality of Distributions of 2015–17 Deviations**

	Average Percentile	Expected Percentile	P-Value
GDP	39.4	50.3	0.052
Capital Stock	47.7	50.3	0.630
Total Factor Productivity	41.5	50.5	0.079

Source: IMF staff calculations.

Note: Two-sample Wilcoxon rank-sum (Mann-Whitney) test.

### **C. Additional Details of Regression Analysis on Probability of a Banking Crisis**

The probability of a banking crisis occurring in 2007–08 is given by the following model:

$$\Pr(\text{banking crisis}) = f(\text{regulation}, \theta), \quad (3)$$

where *regulation* is a measure of various aspects of banking regulation and  $\theta$  is the set of parameters to be estimated. The index of banking regulation is drawn from Barth, Caprio, and Levine (2013). Results in Annex Table 3 show that the strength of restriction on banking activities (specifically, stronger restrictions on banks' ability to underwrite, broker, and deal in securities; offer mutual fund products; and engage in insurance underwriting, real estate investment, development, and management) in 2006 is associated with a lower probability of

<sup>22</sup> The analysis omits countries with large output deviations that were caused by war or political strife.

the occurrence of banking crisis in 2007–08 and the coefficient is statistically significant. Robustness tests on the probit regression are presented in Annex Table 4.

### Annex Table 3 Probability of Banking Crisis and the Strength of Restrictions on Banking Activities

	Probit	Logit	LPM
Strength of Restrictions on Banking Activities	-0.72 ***	-1.27 ***	-0.18 ***
Constant	-1.04 ***	-1.79 ***	0.19 ***
Observations	116	116	116
$R^2$			0.17

Source: Barth, Caprio and Levine (2013); IMF staff calculations.

Note: LPM = linear probability model.

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

### Annex Table 4 Banking Crisis and Regulations: Probit Regression

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	
Strength of Restrictions on Banking Activities	-0.72 ***					-0.71 ***	-0.61 ***	-0.60 ***					-0.60 **	-0.65 **	-0.43	-0.46 *
Fraction of Bank Application Denied		-1.50 ***							-1.55 ***	-1.60 *	-1.07 ***	-1.13 ***	-1.32 **	-0.90 **	-1.25 *	
Bank Concentration			0.05													
Supervisory Power				-0.10												
Capital Regulation					-0.16											
Share of Interest Borrowing from G5						-0.01			0.27				0.35			
Financial Openness							1.21 **			2.48 **						1.94 *
Demand Exposure to Advanced Economies								3.13 **			4.89 **				3.36	
Constant	-1.04 ***	-1.14 ***	-0.74 ***	-0.83 ***	-0.88 ***	-1.01 ***	-0.98 ***	-0.90 ***	-1.15 ***	-1.17 **	-0.81 ***	-1.11 ***	-1.20 ***	-0.87 ***	-1.10 ***	
Observations	116	54	52	98	98	111	116	115	53	54	54	51	50	51	51	

Source: Barth, Caprio, Levine (2013); and IMF staff calculations.

Note: Group of Five (France, Germany, Netherlands, United Kingdom, and United States). G5 = Group of Five.

\*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

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