

This chapter 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.

Introduction

Over the weekend of September 13–14, 2008, two large US financial institutions teetered close to failure while a third urgently sought a buyer to avoid that same fate. By Sunday night that weekend, Merrill Lynch was acquired by Bank of America. Insurance giant AIG still desperately pursued credit lines, just days away from a ratings downgrade that looked likely to push it over the edge. And in the early hours of Monday, September 15, 2008, the investment bank Lehman Brothers filed for bankruptcy, brought down largely by its exposure to a US housing market in deep decline.

The post-Lehman scramble for liquidity in global markets heralded the most acute phase of the financial turmoil that, by then, had been brewing in the United States and Europe close to 18 months.¹ The ensu-

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¹Identifying a precise starting point for the timeline—the “patient zero” of the epidemic—is difficult. This chapter 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

ing 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.

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 52 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 chapter takes stock of the global economic recovery 10 years after the financial meltdown of 2008 and the policy lessons that can help prepare for the next downturn. Specifically, the chapter 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 (TFP)—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 chapter uses a sample of 180 countries—covering advanced, emerging market, and low-income

mortgage-related hedge funds associated with Bear Stearns (June 2007) and BNP Paribas (August 2007); the United Kingdom'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).

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) examines output performance after an earlier set of financial crises during 1970–2002. The current chapter 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 that 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 the long-term 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 chapter’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.

Among the main findings of the analysis are that output losses appear to be persistent and not restricted to countries that suffered a banking crisis in 2007–08. Sluggish investment appears to be a key channel through which these losses registered, with associated long-lasting capital and TFP shortfalls relative to their precrisis trends. Consistent with these TFP shortfalls, research and development expenditure and technology adoption appear to have increased more slowly in countries that suffered larger output losses. The findings are similar to those of recent papers showing that output tends to stay below previous trends after crises and recessions (for example Cerra and Saxena 2008, 2017; Blanchard, Cerutti, and Summers 2015; and Aslam and others, forthcoming).

The analysis finds that policy choices leading up to the crisis and in its immediate aftermath influenced postcrisis variations in output performance. These can be grouped into three categories.

- *Financial:* Underscoring the importance of macroprudential policies and effective supervision, the analysis finds that countries in which financial vulnerabilities had accumulated to a larger degree in the precrisis years suffered greater output losses after the crisis. In the years running up to the crisis, countries with larger excess current account deficits and those with more rapid credit growth found that constraints bound relatively more strongly when financial conditions tightened after the crisis. Stricter banking regulation (proxied by an index of restrictions on certain aspects of bank activity) in the precrisis years is associated with a lower probability of a banking crisis in 2007–08.
- *Policy constraints and frameworks:* The evidence suggests that countries with stronger precrisis fiscal positions experienced smaller output losses in the aftermath. The analysis also finds that flexible exchange rate regimes helped lessen GDP damages.
- *Postcrisis actions:* Several countries took unprecedented and exceptional policy actions to support their economies after the 2008 financial meltdown. The chapter finds that these actions (specifically, quasi-fiscal measures to support the financial sector, including guarantees and capital injections) helped temper postcrisis output losses.

Some of these factors appear to be particularly relevant for the euro area. The 2008 financial crisis exposed thin buffers in some member economies and gaps in the architecture of the currency union. The interaction of domestic and area-level factors exacerbated adjustment difficulties in the euro area following the 2008 shock and gave rise to an intensifying sovereign debt crisis during 2010–12, which spurred efforts to strengthen the architecture of the currency union (IMF 2012, 2013a; Allard and others 2013; Goyal and others 2013; Berger, Dell’Ariccia, and Obstfeld 2018). In contrast to the 2009 shock, euro area countries hit by the sovereign crisis were not in a position to use expansionary fiscal policy to counter the “sudden stop.” Rather, they needed to reduce their fiscal deficits to regain creditors’ confidence and contain sovereign borrowing costs. In the event, the contractionary effect of this fiscal tightening was larger than anticipated at the time (Blanchard and Leigh 2013; IMF 2013b, 2015).

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. The main takeaways are summarized in the conclusion.

Persistent Post–Global Financial Crisis Deviations in Output

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 chapter measures postcrisis deviations of output from the level that would have prevailed had output followed its pre-2009 trend growth rate (Ball 2014). 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 (Online Annex 2.2.B).^{2,3} 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 example 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 GDP with precrisis outcomes must be careful to avoid attributing all of the observed changes to the 2008 crisis.⁴

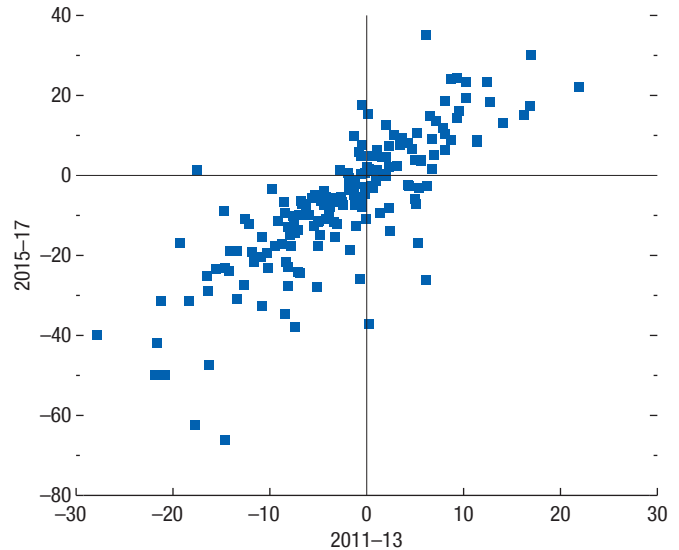
²All annexes are available online at www.imf.org/en/Publications/WEO.

³Online Annex 2.2.B discusses the differences between the chapter's approach and the standard filtering approach used for separating output into trend and business cycle components.

⁴For the United States, for example, there is a range of estimates regarding the postcrisis output loss due to the 2008 financial crisis versus those related to changes in potential output growth already underway prior to the crisis (see CBO 2014; Hall 2014; and Barnichon, Matthes, and Ziegenbein 2018).

Figure 2.1. Correlation of GDP Deviations between Periods (Percent)

Postcrisis performance is persistent, with a correlation coefficient between GDP deviations for 2011–13 and 2015–17 of about 0.90.



Source: IMF staff calculations.

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

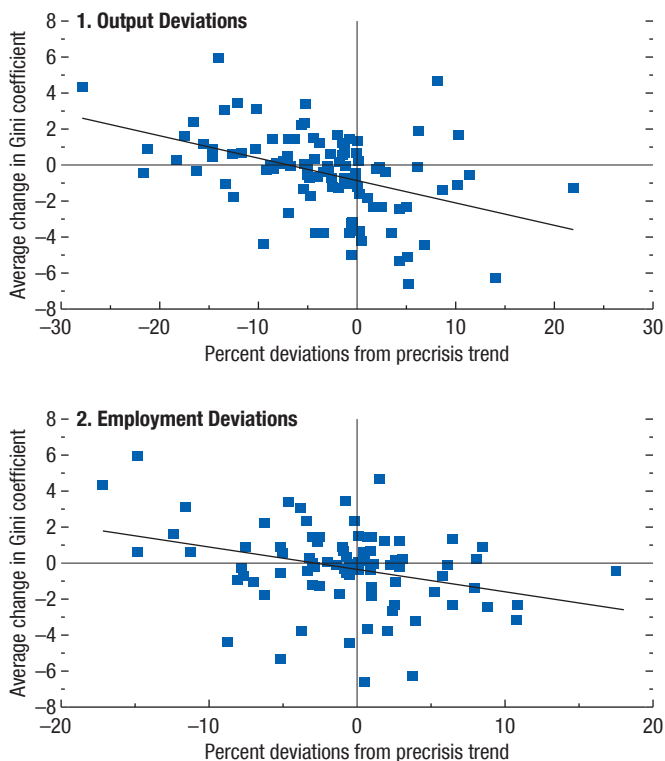
The post-2008 output deviations exhibit strong persistence over time (Figure 2.1).⁵ A second noteworthy aspect is that economies with larger output and employment losses in the initial aftermath of the crisis registered greater increases in income inequality compared with their precrisis average (Figure 2.2).⁶ These developments help shed light on the lingering sense of subpar economic performance in many economies and concerns about a “new mediocre” (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).

⁵The correlation coefficient between GDP deviations for 2011–13 and 2015–17 is about 0.90. As shown in Online Annex Figure 2.2.4, 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.

⁶Employment 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 Online Annex 2.2.B).

Figure 2.2. Postcrisis Change in Inequality

Economies with larger output and employment losses in the initial aftermath of the crisis registered greater increases in income inequality compared with the precrisis average.



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.

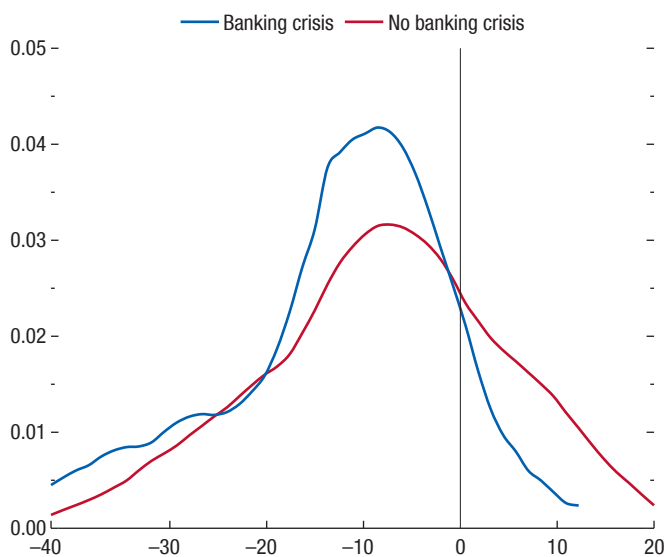
Output Remains below Precrisis Trend in More than 60 Percent of Economies

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.⁷ According to the Laeven-Valencia definition, there were banking crises in 24 countries during 2007–08, 18 of which were in advanced economies (see Online Annex 2.2.A

⁷The 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).

Figure 2.3. Postcrisis Output Deviations from Precrisis Trend, 2015–17
 (Kernel density)

Output losses are persistent for a variety of economies, not just those that suffered a systemic banking crisis in 2007–08.



Sources: Laeven and Valencia (2013); and IMF staff calculations.
 Note: Distribution of average percent deviations from precrisis trend, 2015–17. See Online Annex Table 2.2.1 for banking crises country list.

for the list). Figure 2.3 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; and 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 worth.

However, Figure 2.3 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 the group without a banking crisis in 2007–08, output remains below precrisis trends in about 60 percent of economies. A possible channel—discussed later in the chapter—that affected this group is weaker external demand from trading partners that suffered 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 2.4). Output deviations are relatively more balanced across gains and losses for noncommodity-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).

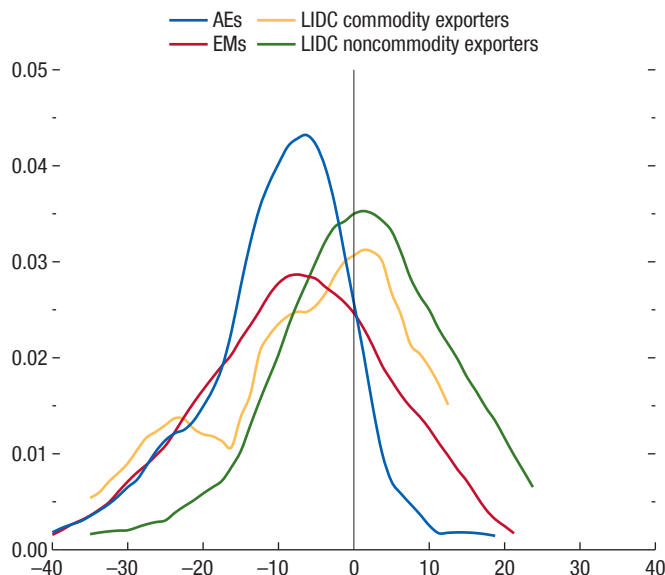
Proximate Causes: Sluggish Investment, Capital, and Total Factor Productivity Shortfalls

The persistence of output deviations suggests supply-side shifts in the factors of production. As shown in Online Annex Figure 2.2.3, 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.⁸ This similarity suggests shifts in other factors of production associated, for instance,

⁸Nevertheless, as noted in Box 2.1, postcrisis economic performance appears to have had an impact on migration and fertility decisions, with attendant implications for future labor input.

Figure 2.4. Postcrisis Output Deviations from Precrisis Trend by Country Group, 2015–17
(Kernel density)

Postcrisis output deviations tend to be large across advanced economies, emerging markets, and low-income developing countries, with relatively more balanced gains and losses for noncommodity-exporting low-income developing countries and emerging markets than for the other two groups.



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. See Online Annex 2.1 for country groupings.

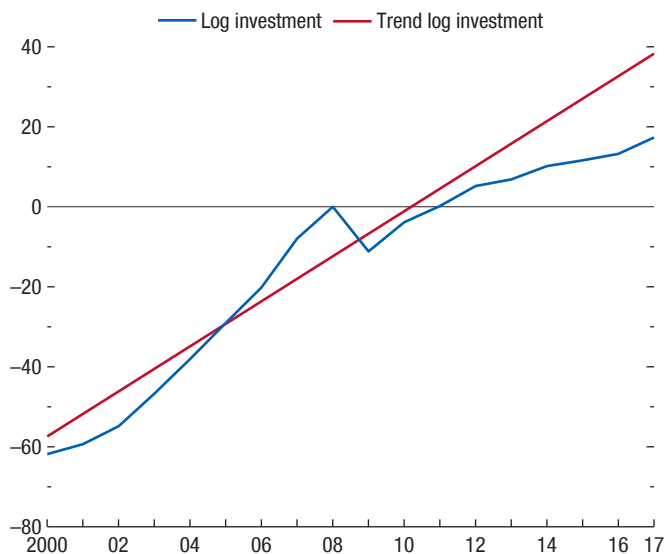
with weaker aggregate investment, as documented in Chapter 4 of the April 2015 WEO.⁹

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 2017). A similar calculation for output, as described earlier in this chapter, suggests shortfalls in investment relative to precrisis trends. Figure 2.5 shows the average across all economies of deviations relative to precrisis trends. By 2017, on average, investment was about 25 percent below precrisis trend.

⁹An important exception is China, where the 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 2.5. Postcrisis Investment Deviations from Precrisis Trend: Mean Trajectory
(Percent)

Investment dropped below precrisis trend during the crisis and deviated further in 2012. By 2017, on average, investment was about 25 percent below precrisis trend.

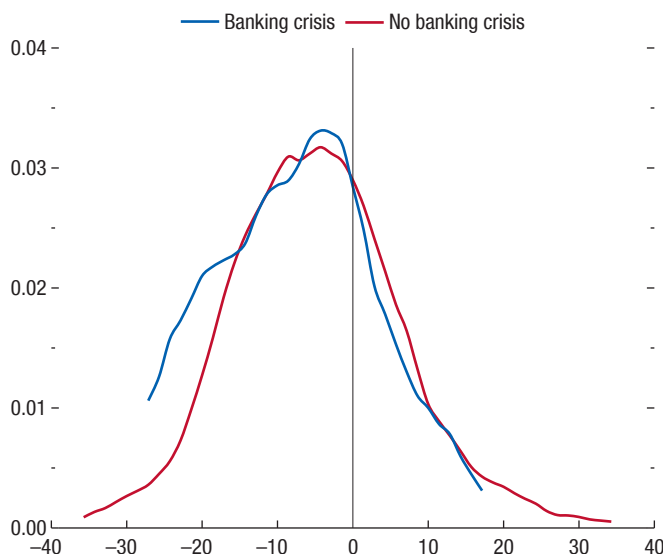


Source: IMF staff calculations.
Note: 2008 log investment normalized to zero.

Two important consequences of sluggish investment that 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 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 accounting techniques (described in Online Annex 2.2.B and summarized in Figure 2.6) suggests that there are large capital shortfalls relative to precrisis trends. 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

Figure 2.6. Postcrisis Capital Stock Deviations from Precrisis Trend, 2015–17
(Kernel density)

Close to 80 percent of economies that suffered a banking crisis in 2007–08 experienced shortfalls in capital relative to precrisis trend. Among economies that did not suffer a banking crisis in 2007–08, about 65 percent appear to be operating with capital stocks below precrisis trend.



Sources: Laeven and Valencia (2013); and IMF staff calculations.
Note: Distribution of average percent deviations from precrisis trend, 2015–17. See Online Annex Table 2.2.1 for banking crises country list.

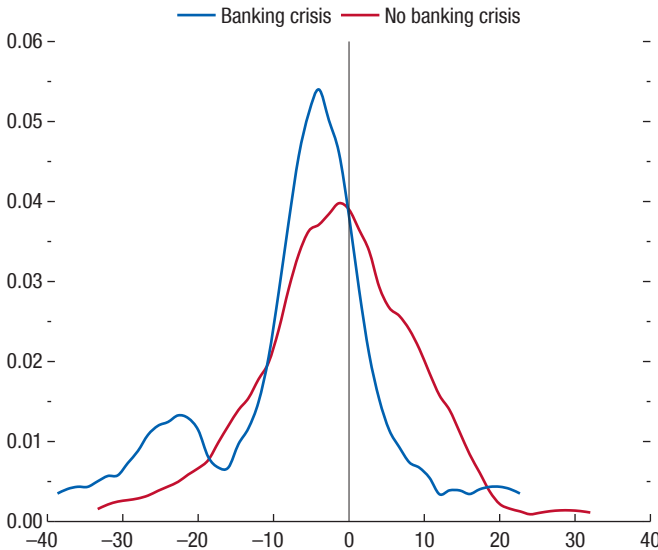
path.¹⁰ At the sectoral level, these capital shortfalls are widespread, extending beyond the construction sector, which underwent a needed correction after the precrisis boom (Online Annex Figure 2.2.5).

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 2.7). These estimated deviations in TFP from precrisis trends are consistent with evidence of widespread postcrisis deceleration in TFP growth discussed in Adler and others (2017). As reported in Table 2.1, 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

¹⁰Online Annex 2.2.B shows that the distributions of capital stock deviations are not distinguishable across the two groups in a statistical sense, while those of output and TFP are.

Figure 2.7. Postcrisis Total Factor Productivity Deviations from Precrisis Trend, 2015–17
(Kernel density)

Estimated deviations in TFP from precrisis trend are consistent with the evidence of a widespread postcrisis deceleration in TFP growth. These TFP deviations account for close to 80 percent of output per worker deviations for both groups of economies, that is, those that suffered banking crises in 2007–08 and those that did not.



Sources: Laeven and Valencia (2013); and IMF staff calculations.
Note: Distribution of average percent deviations from precrisis trend, 2015–17. TFP = total factor productivity. See Online Annex Table 2.2.1 for banking crises country list.

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

Slower Technology Adoption

The estimates of TFP deviation suggest that the pace of technology adoption (and associated pace of upgrading of capital stock with embodied technology) may have slowed following the crisis. However, as noted above, TFP is an imperfect proxy for the pace of technology adoption. A clearer picture emerges from examining variables directly associated with innovation and technology adoption. Cross-country evidence on a key innovation input—research and development spending—suggests that countries with above-median output losses registered slower increases in research and development shares of GDP. This is especially evident among advanced economies (Figure 2.8).

Table 2.1. 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.
Note: See Online Annex Table 2.2.1 for banking crises country list.

Further confirmation of slower innovation and technology adoption among countries hit harder by the crisis is seen through the example of industrial robots—an observable and much-discussed class of automation technology expected to replace human labor in an increasing range of tasks. (Box 2.2 examines the postcrisis employment impact of industrial robots.)¹¹

An inspection of the industrial robot data (Figure 2.9) indicates that the average change in density—measured as robot shipments per thousand hours worked—during the postcrisis period was higher in countries that had smaller postcrisis losses in output.

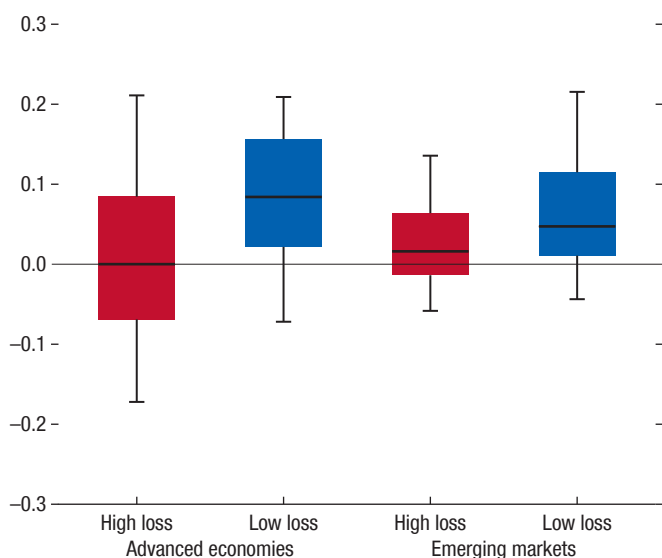
As with the general measure of innovation (research and development expenditure), the gap in changes in robot density between high- and low-output-loss countries is higher among advanced economies than among emerging markets. As part of the generalized slower investment in the postcrisis period, robot adoption may have been affected more negatively in countries hit harder by the crisis.¹² This “suppressed-investment”

¹¹As described in Online Annex 2.3.A, data from the International Federation of Robotics, which compiles information on worldwide shipment of robots, are used to examine the postcrisis diffusion of automation technology. The data are reported at the level of industries for 75 countries extending back to 2004 (for some countries, data are available going back to 1993).

¹²While there is possibly an element of reverse causality in these correlations (lower robot investment contributed to higher output loss), empirically, the magnitude of robot investment compared with manufacturing output in the United States, for example, suggests that the effect of robot investment on manufacturing—as well as aggregate—output is small. Based on US Bureau of Economic Analysis data, the International Federation of Robotics (the data source for robots used in the analysis) reports that the value of industrial robot shipments to the United States as a share of US gross manufacturing output ranged between 0.016 percent in 2002 and 0.027 percent in 2016.

Figure 2.8. Changes in Research and Development Expenditure, by Output Losses and Country Groups
(Percent of GDP)

Countries with above-median output losses registered slower increases in research and development expenditure shares of GDP. This was especially evident among advanced economies.



Sources: World Bank, World Development Indicators database; and IMF staff calculations.
Note: The bars depict the difference in averages between 2014–16 and 2011–13. The bar chart shows the interquartile range, and lines display lesser of the maximum (minimum) and ± 1.5 times the upper (lower) quartile range. High (low) loss indicates above (below) median losses in output relative to precrisis trend as calculated in Online Annex 2.2.B.

effect likely more than offset any tendency to automate rather than rehire unemployed workers.¹³

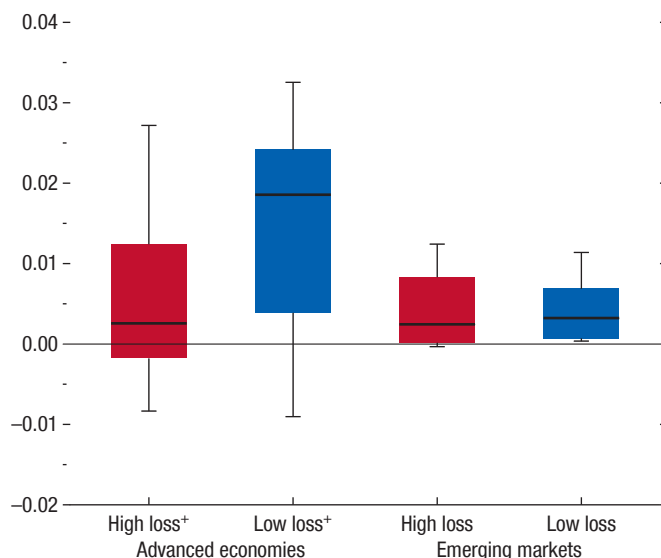
Policy Frameworks, Measures, and Postcrisis Output Performance

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

¹³Analysis at the industry-country level (Online Annex 2.3.B) corroborates this finding. Industries in advanced economies that suffered relatively bigger investment and TFP losses during the crisis experienced slower robot diffusion.

Figure 2.9. Average Change in Robot Density, by Output Losses and Country Groups, 2010–14
(Robot shipment per 1,000 hours worked)

The gap in changes in robot density between high and low loss countries is higher among advanced economies than among emerging markets.



Sources: International Federation of Robotics; World Input-Output Database; and IMF staff calculations.
Note: Robot density is defined as robot shipment/1,000 hours worked. The bar chart shows the interquartile range, and lines display lesser of the maximum (minimum) and ± 1.5 times the upper (lower) quartile range. High (low) loss indicates above (below) median losses in output relative to precrisis trend as calculated in Online Annex 2.2.B.
*denotes differences in medians between high- and low-output loss samples among advanced economies statistically significant at 10 percent. See Online Annex 2.3 and Online Annex Table 2.3.2 for further details on data and estimation.

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.

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.

As explained in Online Annex 2.2.C, the empirical approach estimates cross-sectional regressions similar to those of other studies that have examined various aspects of cross-country variation in the impact of the global financial crisis (Blanchard, Faruqee, and Das 2010; Claessens and others 2010; Lane and Milesi-Ferretti 2010, 2014; Giannone, Lenza, and Reichlin 2011; Berkmen and others 2012; Tsangarides 2012; Cerra, Panizza, and Saxena 2013). The approach builds on Chapter 4 of the October 2009 WEO, which studies the determinants of medium-term output losses following financial crises in advanced, emerging market, and developing economies during 1970–2002 (see also Abiad and others 2009).

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.¹⁴ Four aspects are common to most accounts. First, abundant global liquidity enabled a lending boom in the United States, United Kingdom, euro area, 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, 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, United Kingdom,

and 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.¹⁵ The analysis suggests that, on average, countries that experienced banking crises suffered a 4 percentage point higher output loss during 2011–13 relative to the precrisis trend than those that did not experience banking crises in 2007–08. (Online Annex Table 2.2.5; Table 2.2 summarizes the direction of impacts for the various drivers.)

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. It is also seen in the role played by specific factors, 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. This gap can be thought of as a real-time estimate of imbalances resulting from private

¹⁴See, 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.

¹⁵Gertler 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.

Table 2.2. 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 Online Annex Table 2.2.5. Results in columns (3) through (6) are reported in Online Annex Table 2.2.7. AEs = advanced economies; CA = current account; CA Gap = excess external balance, Lee and others (2008); EMs = emerging markets; GG = general government.

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

and public saving–investment disparities (see Lee and others 2008; and 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 (Online Annex Table 2.2.5; Table 2.2). 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.

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 [CBR] at Cambridge University) suffered larger postcrisis losses in output relative to precrisis trends (Table 2.2).¹⁶ This

¹⁶The 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 because it has broader country coverage than the Organisation for Economic

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.

Spillovers

The results in Table 2.2 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.

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.¹⁷ This may reflect, in part, retrenchment in global banking after the crisis.

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), as described in Online Annex 2.2.C.

¹⁷This is consistent with Perri and Quadrini (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 Chapter 4 of

There is a similar pattern for postcrisis investment deviations among countries that did not experience a banking crisis in 2007–08 (Online Annex Table 2.2.6). 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 2.6) 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 Online Annex Table 2.2.7 (summarized in Table 2.2), grouped according to advanced and emerging market economies, indicate that economies whose 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.

Precrisis Policies and Policy Frameworks

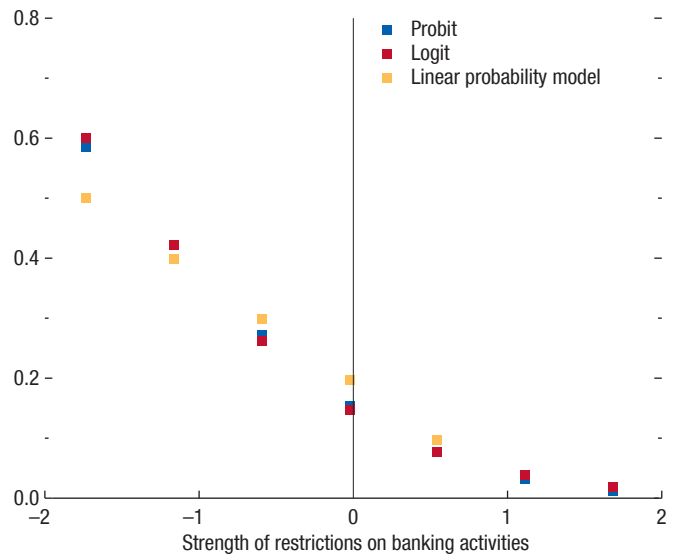
The incidence of bank crises in 2007–08 was a key driver of subsequent losses. Regulatory and supervisory structures may thus have played a preemptive role in influencing subsequent damage. The bank regulation index constructed by Barth, Caprio, and Levine (2013) illustrates this link. Specifically, 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 2.10).¹⁸ However, 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;

the April 2009 WEO, which documents the role of international links in transmitting financial stress across borders.

¹⁸The association shown here is robust to controlling for some other influences on the likelihood of a bank crisis (Online Annex Table 2.2.4).

Figure 2.10. Probability of Banking Crisis (Probability)

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 banking crisis in 2007–08.



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. Figure is based on Online Annex Table 2.2.3.

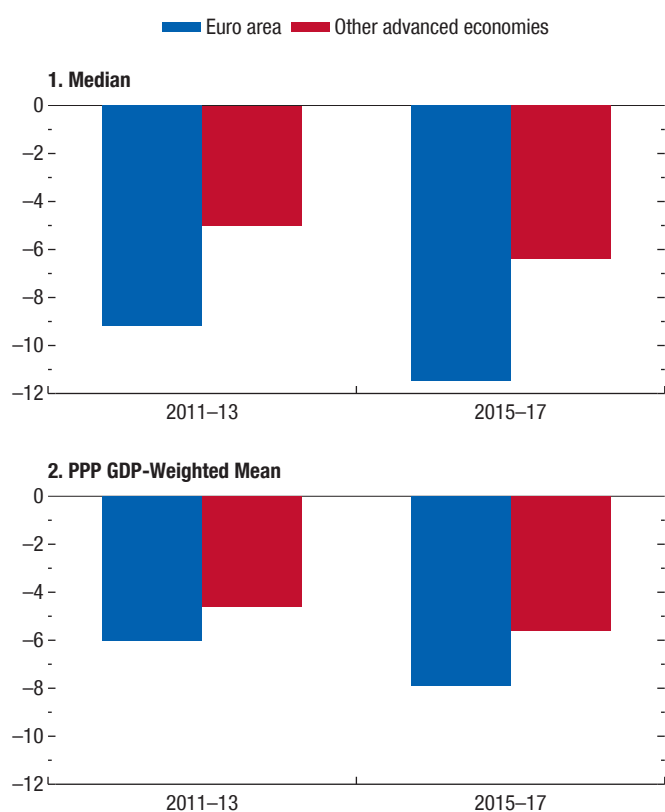
overall intensity of financial sector monitoring activity; the porosity of the regulatory perimeter and opportunities for regulatory arbitrage) likely also played a role.

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; Jordà, 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 (Table 2.2). 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 (Table 2.2). This finding may, in part, reflect the difficulties experienced by some euro area economies. In these countries, the absence of an independent nominal exchange rate, together with fiscal stress and the lack of a common area-wide

Figure 2.11. Postcrisis Deviations of Euro Area and Other Advanced Economies
(Percent)

The median and PPP GDP-weighted mean of output loss for euro area economies are higher than for other advanced economies.



Source: IMF staff calculations.

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

banking union and fiscal 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 2.11), covering an intense phase of the sovereign debt crisis, deposit flight from stressed euro area 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 (as discussed in

Box 2.3), 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.¹⁹

Extraordinary Actions Taken in the Aftermath of the Crisis

Several countries took 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 comprised (1) central bank monetary policy actions—unconventional monetary policy support through asset purchases as policy rates approached their effective lower bounds, and liquidity support to specific segments of credit markets through targeted central bank facilities; (2) discretionary fiscal stimulus; and (3) financial sector operations—bank balance sheet stress tests, government guarantees of banking sector liabilities, purchases of toxic assets from banks, and capital injections. Central banks also established ad hoc bilateral swap lines to support foreign exchange liquidity in jurisdictions beyond home markets.

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

¹⁹Thomsen (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.

Table 2.3. 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-weighted)	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); IMF 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 are based on Schwartz and Tan (2016). In panel 1, G20 calculations do not include Mexico and South Africa. G20 = Group of Twenty.

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 chapter 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 2.3). 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.)²⁰ 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 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.

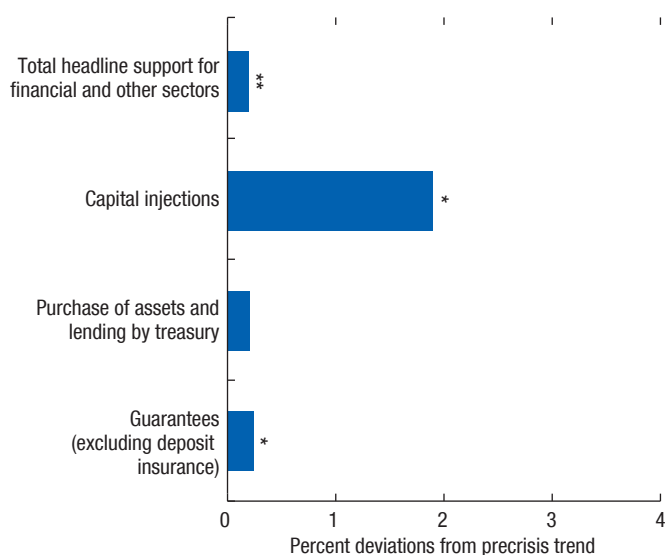
As shown in Figure 2.12, conditional on the size of initial losses during 2011–13, quasi-fiscal actions taken to stabilize the financial sector helped limit damage during 2015–17. Overall headline support for the financial sector has a statistically significant positive correlation with subsequent output deviations from trend; among the specific actions, capital injections and guarantees appear to have helped limit subsequent output losses. These 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 pro-

²⁰During 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>). For 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>.

Figure 2.12. Impact on 2015–17 GDP Deviations from One Standard Deviation Increase in Drivers (Percent)

Actions taken to stabilize the financial sector helped limit damages during 2015–17. Overall headline support for the financial sector has a statistically significant positive correlation with subsequent output deviations from precrisis trend. Among specific actions, capital injections and guarantees have helped limit subsequent output losses.



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. Coefficient bars correspond to estimates in Online Annex Table 2.2.8.

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

viding unconditional financial resources to its members through a general allocation of SDR 204 billion (\$316 billion) during August–September 2009.²¹ 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.²²

²¹The 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>).

²²The gross figure includes precautionary arrangements. See IMF (2015) for details.

Summary

The 2008 financial crisis had its roots in the US housing boom of the preceding half-decade. Its impact was seen worldwide from shuttered maquiladora factories in Mexico to the restructuring of regional savings and loan *cajas* in Spain and extended joblessness for migrant workers in China's Pearl River Delta. Output losses following the 2008 financial meltdown were persistent and experienced by 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 pre-crisis trends, and slower technology adoption among countries hit harder by the crisis.

The crisis prompted a still-ongoing rethink of the nature of economic fluctuations, as well as of the role of policy frameworks and measures to combat downturns. The policy lessons of the crisis discussed in this chapter follow from the lens adopted to view its aftermath and to understand why the recovery appeared so slow in many countries. Other important developments covered in previous WEO reports, such as the declining share of labor income (Chapter 3 of the April 2017 WEO), subdued wage growth, and the rise of part-time work (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.

The evidence documented in this chapter 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), Auerbach (2017),

Blanchard and Summers (2017), and Furman (2018) 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 on 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. After faltering at times over the past 10 years, the global economic recovery experienced a long-awaited synchronized growth upswing in 2017–18. Nevertheless, large challenges loom for the global economy. The extraordinary policy actions to prevent a second Great Depression have had important side effects. The extended period of ultralow interest rates in advanced economies has contributed to the

buildup of financial vulnerabilities, as discussed in the April and October 2018 GFSRs. The large accumulation of public debt and the erosion of fiscal buffers in many economies following the crisis point to the urgency of rebuilding those defenses to prepare for the next downturn. Moreover, some of the crisis management tools deployed in 2008–09 are no longer available (the Federal Reserve's bailouts of individual institutions, for example), suggesting financial rescues in the future may not be able to follow the same playbook.

Beyond these aspects, more fundamental challenges relate to long-lasting legacies of the crisis. There are already signs of possible long-term consequences of the crisis on potential growth through its impacts on migration, fertility, and future labor input (Box 2.1). And societal support for openness and global economic integration appears to have weakened in many countries after the crisis. The corollary of these developments is the rising appeal of protectionist nostrums and populism. A fuller reckoning of such long-lasting legacies of the 2008 financial crisis must necessarily await the broader perspective that will emerge with further passage of time.

Box 2.1. The Global Financial Crisis, Migration, and Fertility

Empirical and anecdotal evidence suggest that changes in economic performance affect migration flows and fertility rates. This box explores the relationships between postcrisis economic performance, policies, migration, and fertility. The main finding of the box is that postcrisis economic performance had a significant impact on both migration and fertility. Through these channels, the crisis has likely left long-lasting scars on future growth. The box also identifies several policies associated with significant impacts on migration and fertility.

The Great Recession and Migration

The decades leading up to the global financial crisis saw large increases in net migration (immigration-emigration) rates between advanced economies.¹ This trend, however, reversed after the crisis. Meanwhile, net migration has been consistently neutral in emerging markets through both periods, while low-income developing countries have increased net migration rates in the postcrisis years, even as they are generally more prone to volatile net migration rates (Figure 2.1.1, panel 1). Motivated by this heterogeneity of net migration among country groups, the analysis examines the relationship between the changes in trends before and after the crisis, looking at per capita GDP and migration flows by using data on migration inflows from 143 source countries to 20 destination advanced economies.²

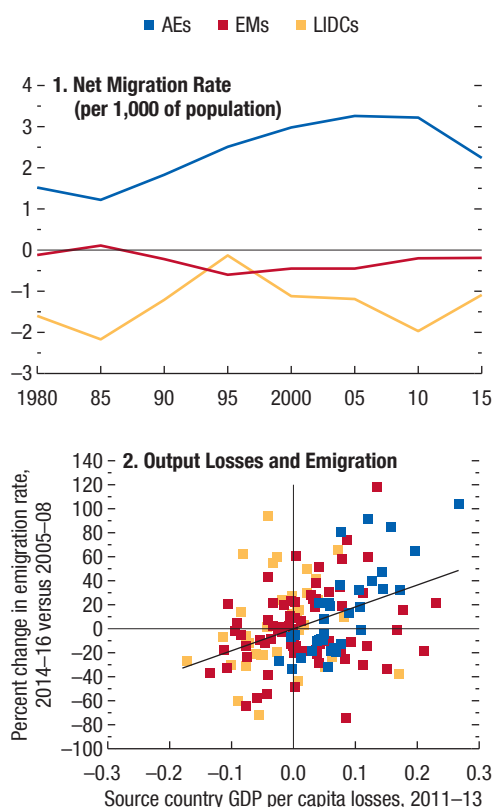
Immigrants are typically more vulnerable to economic shocks than natives. They are often over-represented in sectors most sensitive to the business cycle (OECD 2009) and may face discrimination in a tight labor market (Arai and Vilhelmsson 2004). Immigrants have also responded to changes in labor demand more strongly than natives (Kahanec and Guzi 2017). Simple correlations confirm the conjec-

The authors of this box are Christopher Johns, Mico Mrkaic, and Yuan Zeng.

¹Net migration rate is defined as the number of immigrants minus the number of emigrants over a period, divided by the person-years lived by the population of the destination country over that period. It is expressed as net number of migrants per 1,000 population.

²The analysis uses migration inflows, given that inflows are tracked more precisely and more frequently than bilateral migration outflows and migrant stocks. Data on bilateral migration inflows facilitates accurate analysis of the push and pull factors influencing international migration.

Figure 2.1.1. International Migration and the Global Financial Crisis



Sources: Organisation for Economic Co-operation and Development; United Nations Department of Economic and Social Affairs, *World Population Prospects: The 2017 Revision*; and IMF staff calculations.

Note: AEs = advanced economies; EMs = emerging market economies; LIDCs = low-income developing countries. Net migration rate by country group is population-weighted average. Losses are based on calculations in Online Annex 2.2.B.

ture that migrants respond to economic performance (Figure 2.1.1, panel 2), measured by the deviations of GDP per capita from precrisis trend (calculated as described in Online Annex 2.2.B).

Beyond the correlations, the analysis explores the links between economic performance and migration in a multivariate setting, controlling for the additional main drivers mentioned in the October 2016 *World Economic Outlook*—structural factors and immigration policies. While the box’s discussion centers on the role of economic factors in migration decisions, it should be mentioned that some

Box 2.1 (continued)

migration decisions are driven entirely by such factors as political instability and war in the source country or region. To avoid biasing results, migration flows data exclude flows of refugees and asylum seekers.³ Figure 2.1.2, panel 1 shows the impact of losses in GDP per capita on differences between emigration rates in 2011–13 and 2014–16 compared with years before the crisis (2005–08).⁴ Losses in GDP per capita significantly impact migration flows in the short and medium terms. In addition to economic performance, migration flows are affected by the strength of poverty constraints in source countries⁵ and the GDP per capita in the destination relative to the source country, education in destination and source countries, and the distance between destination country and source country.^{6,7}

Policies imposed in the wake of the crisis to limit migration and reduce competition in labor markets also affect migration (Figure 2.1.2, panel 2). The analysis examines restrictions on legal entry, stay, and quotas (an increase in each variable denotes greater restrictiveness). Increased postcrisis restrictions significantly reduced migration flows, mostly in the medium term, over and above the impact of economic losses.

The Great Recession and Fertility

During a recession, relatively elevated unemployment rates may lead to deferred decisions on marriage, having children, or both. In nearly all recent recessions in advanced economies, the impact on fertility has been mainly to postpone births, which contributes to a short-run reduction in the number of births in the aftermath (long-run effects tend to be

³Inflows of foreign population data are from the Organisation for Economic Co-Operation and Development (OECD). Refugees and asylum seekers are excluded from the data for all countries except: Germany, Netherlands, and Norway—included if living in private households (as opposed to reception centers or hostels for immigrants); and United Kingdom—included if stayed in country longer than one year.

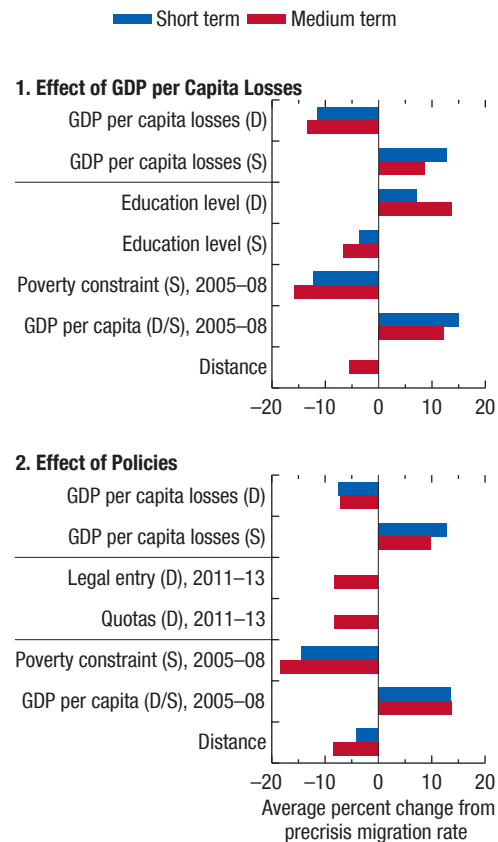
⁴Emigration rate is defined as inflows to destination country from source country over a period, divided by 1,000 population in source country.

⁵Defined as the disposable income Gini coefficient divided by the square of PPP GDP per capita.

⁶Distance is defined as great-circle distance between most populated cities in destination country and source country.

⁷Controls based on measures used in Borjas (1987); Hatton and Williamson (2002); and Clark, Hatton, and Williamson (2007).

Figure 2.1.2. Impact on Emigration Rate from One Standard Deviation Increase in Drivers at Different Horizons
(Percentage points)



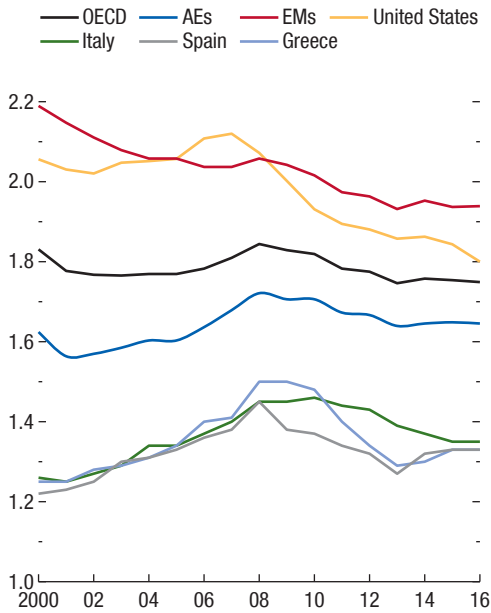
Sources: International Migration Institute; Organisation for Economic Co-operation and Development; Standardized World Income Inequality Database (Solt 2016); World Bank, World Development Indicators database; and IMF staff calculations. Note: Explanatory variables are contemporaneous with dependent variable unless noted otherwise. All postcrisis variables except GDP per capita losses are average changes from precrisis (2005–08) levels. Losses are based on calculations in Online Annex 2.2.B. All coefficients are statistically significant at 5 percent. Increases in policy variables correspond to increases in restrictiveness. S = source country; D = destination country. Short term = 2011–13 average; Medium term = 2014–16 average.

less pronounced).⁸ Although immigration may be a partial solution for low fertility and an aging population in the short term, in the long term, immigrants’

⁸Neels (2010); Cherlin, Cumberworth, and Morgan (2013).

Box 2.1 (continued)

Figure 2.1.3. Total Fertility Rate
(Number of births per woman)



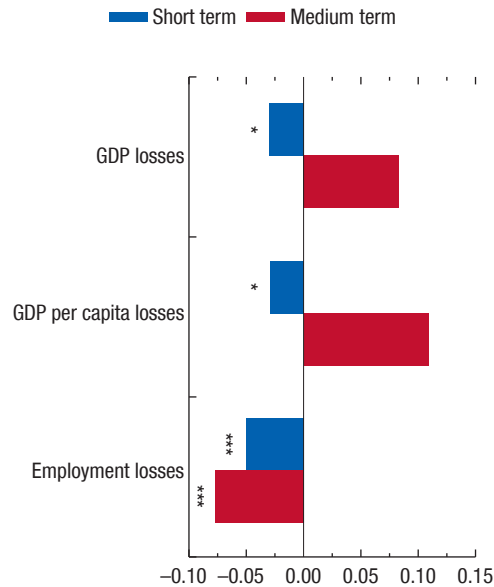
Sources: Organisation for Economic Co-operation and Development (OECD); World Bank, World Development Indicators database; and IMF staff calculations.
Note: OECD is the average fertility rate for OECD and partner countries. AEs = OECD and partner advanced economies; EMs = OECD and partner emerging market economies. See Online Annex 2.1 for country list.

fertility rates generally converge to that of natives (Espenshade 1994).

In the decade before the crisis, the total fertility rate rose in several advanced economies, only to decline afterward (Figure 2.1.3).⁹ In the United States, the rate fell from a peak of 2.12 in 2007 to 1.8 in 2016. Similarly, the birth rate of foreign-born women (ages 15–50) in the United States declined by 16 births per thousand women from its peak of 76 in 2008 to its 2016 level. For European countries, such as Greece and Spain that suffered a double-dip recession, the fertility rate decreased from 1.5 to about 1.3 over the

⁹Total fertility rate in a specific year is defined as the total number of children that would be born to each woman if she were to live to the end of her child-bearing years and give birth to children in alignment with the prevailing age-specific fertility rates. It is calculated by aggregating age-specific fertility rates as defined over five-year intervals.

Figure 2.1.4. Impact of Crisis Exposure on Fertility Rate at Different Horizons
(Average change in fertility rate on x-axis; postcrisis minus precrisis)



Sources: Organisation for Economic Co-operation and Development; and IMF staff calculations.
Note: Explanatory variables are contemporaneous with dependent variable. Average changes in fertility rate are the difference between postcrisis term and precrisis (2005–08) level. Losses are based on calculations in Online Annex 2.2.B. Short term = 2011–13 average; Medium term = 2015–16 average. * p < .10; ** p < .05; *** p < .01.

same time span. These persistently low fertility rates over the past decade may weigh on future labor input and thus weaken potential growth in the long run.

Evidence from OECD and partner countries shows that average changes in the fertility rate for the post-crisis period relative to the precrisis period (2005–08) have been negatively impacted by the crisis through several channels, of which employment losses were the most significant (Figure 2.1.4). Further evidence in the literature (Sobotka, Skirbekk, and Philipov 2011) shows that other complex social changes (higher female labor participation rate, smaller desired family size, and so on) and burdened welfare systems could affect women’s reproductive decisions.

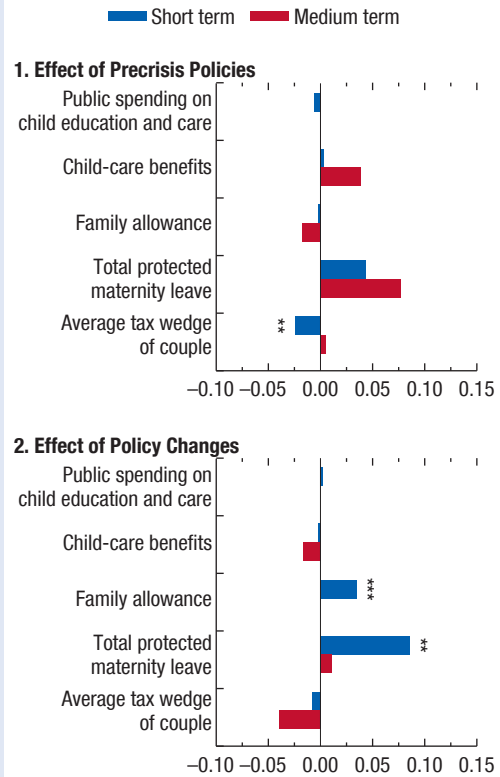
The fertility rate can be affected by labor market policies as well. Figure 2.1.5 shows how policies

Box 2.1 (continued)

affected fertility after the crisis. On one hand, the result in panel 1 demonstrates that a higher precrisis tax wedge on couples reduces fertility in the short term. On the other hand, panel 2 suggests that postcrisis increases in family allowances and improvements in job protection during maternity are associated with higher fertility rates. These findings are in line with evidence and case studies from European Union countries.¹⁰

Figure 2.1.5. Impact on Fertility from One Standard Deviation Increase in Drivers at Different Horizons

(Average change in fertility rate on x-axis; postcrisis minus precrisis)



Sources: Organisation for Economic Co-operation and Development; and IMF staff calculations.

Note: Explanatory variables are contemporaneous with dependent variable. Precrisis policy variables are average of period 2005–08. Policy changes are average postcrisis changes from precrisis (2005–08) levels. Average changes in fertility rate are of difference between postcrisis term and precrisis (2005–08) level. Short term = 2011–13 average; Medium term = 2015–16 average.

* p < .10; ** p < .05; *** p < .01.

¹⁰See, for example, Hoem (2008), Kalwij (2010), and Thévenon (2011).

Box 2.2. The Employment Impact of Automation Following the Global Financial Crisis: The Case of Industrial Robots

As discussed in the chapter, an important change in the production process after the global financial crisis appears to be the pace of technology adoption. This box addresses the following questions related to technology adoption, using the example of industrial robots: How did the diffusion of robots affect employment in the aftermath of the crisis? What type of workers were particularly affected? Did certain labor market policies alter the impact of robot adoption on employment?

Forces of automation were at work prior to the crisis (Autor, Levy, and Murnane 2003; Goos and Manning 2007; Acemoglu and Autor 2011; Autor and Dorn 2013), and one much-discussed aspect of the transformation of the workplace is the diffusion of industrial robots. Yet, existing work has mostly focused on exploring precrisis diffusion of automation in the United States (Autor, Levy, and Murnane 2003; Acemoglu and Autor 2011; Autor and Dorn 2013; Acemoglu and Restrepo 2017), and in a few European countries (Graetz and Michaels forthcoming; Chiacchio, Petropoulos, and Pichler 2018). Thus, less is known about postcrisis robot diffusion in and beyond these countries. Exploring these recent developments may provide some perspective on possible future workplace dynamics and labor market outcomes, where artificial-intelligence-powered equipment is expected to replace human input in an expanding range of nonroutine tasks (Berg, Buffie, and Zanna 2017; Frey and Osborne 2017; Acemoglu and Restrepo, 2018 and forthcoming).

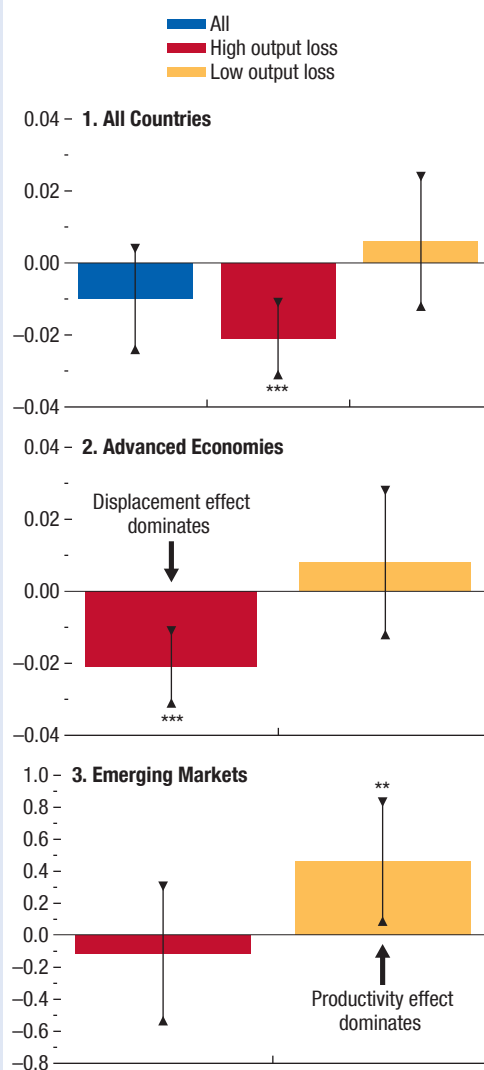
Effect of Robot Diffusion on Employment

As noted in Acemoglu and Restrepo (2017), robot diffusion can affect employment in different ways. Greater diffusion of robots can affect employment negatively through displacement (by directly replacing workers performing certain tasks), but also positively, through productivity gains, as robots can free up human labor for other tasks, incentivize investment, and create employment.

Estimation results show that increased robot diffusion in industries located in countries with more negative output losses during the crisis is associated with lower employment growth (Figure 2.2.1) in the

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Figure 2.2.1. Effect of Robot Diffusion on Employment Growth (Percent)



Sources: IFR (2017); World Input-Output Database; and IMF staff calculations.

Note: Robot diffusion is defined as average change in robot shipments/1,000 hours worked 2010–14. Error bars around coefficient estimate are two standard errors. Losses are based on calculations in Online Annex 2.2.B. Figure is based on coefficients in Online Annex Table 2.3.4.

* p < .10; ** p < .05; *** p < .01.

Box 2.2 (continued)

aftermath of the crisis. This is particularly driven by industries in advanced economies with relatively bigger output deviations relative to precrisis trend. In emerging markets with relatively lower output deviations relative to precrisis trend, increased robot diffusion is associated with higher employment growth.

Hollowing Out of the Employment-Skills Distribution

The negative association between labor and robot diffusion appears to be more pronounced in industries initially more reliant on medium-skilled workers. The effect is largely seen in advanced economies (Figure 2.2.2). This finding is consistent with the hollowing-out effects documented by Autor, Levy, and Murnane (2003), and Goos, Manning, and Salomons (2014).

Labor Market Policies

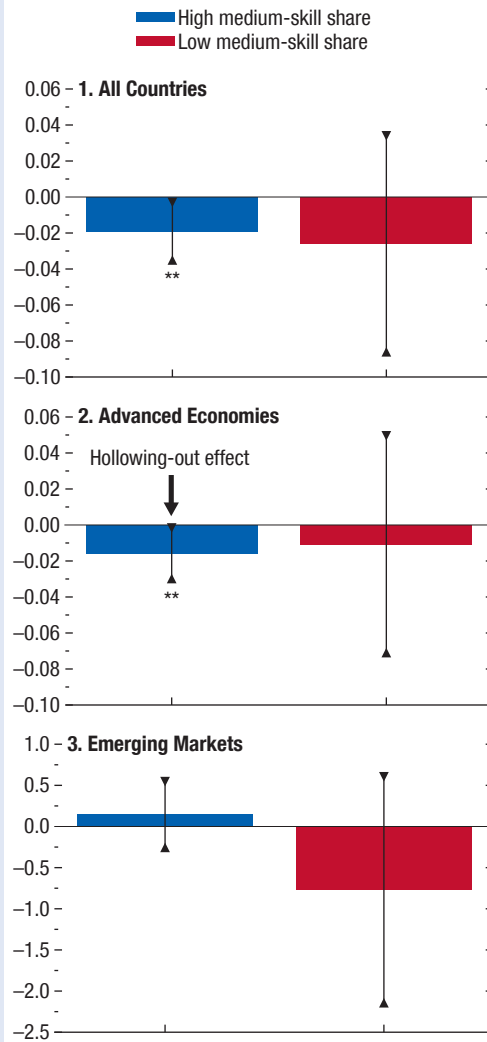
To explore whether labor market policies can mitigate the impact of robot diffusion on employment, regression analysis is conducted on samples divided by the severity of crisis exposure.¹

A consistent picture emerges (Figure 2.2.3): the postcrisis displacement effect of robots on employment was more pronounced in countries with more rigid labor market policies and less labor market dynamism (churn) prior to the crisis.² More specifically, lower active labor market spending as a share of GDP, stricter dismissal policies, less churn in the labor market, and more stringent employment protection legislation are associated with higher displacement effects of robot diffusion in countries that experienced relatively high output losses.

¹Four specific measures of labor market policy are under consideration: (1) active labor market policy (ALMP) spending as share of GDP, (2) ease of dismissal index by Cambridge University’s Center for Business Research, (3) labor churn as calculated in Online Annex 2.2.B, and (4) employment protection legislation index compiled by the Organisation for Economic Co-operation and Development. All measures are calculated as precrisis averages to capture the initial extent of labor market rigidities.

²Labor market dynamism, also referred to as job churn, is measured as described in Online Annex 2.2.B, following Elsby, Hobijn, and Sahin (2013).

Figure 2.2.2. Hollowing-Out Effect of Robot Diffusion on Employment Growth (Percent)



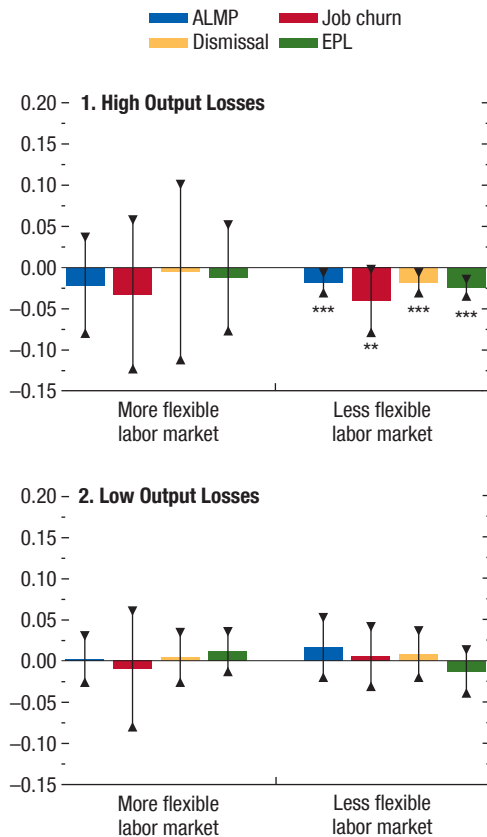
Sources: IFR (2017); World Input-Output Database (WIOD); and IMF staff calculations.

Note: Robot diffusion is defined as robot shipment/1,000 hours worked. Level of worker skills is based on education attainment from WIOD. Medium-skilled workers have attained secondary and/or postsecondary nontertiary education in 2009. Error bars around coefficient estimate are two standard errors. Figure is based on coefficients in Online Annex Table 2.3.5.

* p < .10; ** p < .05; *** p < .01.

Box 2.2 (continued)

Figure 2.2.3. Labor Market Policies and Effect of Robot Diffusion on Employment Growth
(Average change in employment growth, 2010–14)



Sources: Cambridge University Center for Business Research (CBR); IFR (2017); Organisation for Economic Co-operation and Development; World Input-Output Database; and IMF staff calculations.

Note: More flexible labor market comprises countries that have above-median ALMP spending (percent of GDP), above-median job churn rates, below-median dismissal regulations as measured by CBR, and below-median EPL. Error bars around coefficient estimate are two standard errors. Losses are based on calculations in Online Annex 2.2.B. Figure is based on coefficients in Online Annex Table 2.3.6. ALMP = active labor market policy; EPL = employment protection legislation.

* p < .10; ** p < .05; *** p < .01.

In sum, industries in advanced economies with relatively bigger output losses experienced displacement effects from robot diffusion in the aftermath of the crisis. This negative effect on employment growth was particularly severe in industries in advanced economies with relatively large shares of medium-skilled workers. At the same time, in countries with more rigid labor market policies and less churn, the labor displacement effect of robot diffusion was more pronounced, suggesting that policies supportive of creating more flexible labor markets can help absorb employment displacement associated with automation.

Box 2.3. The Role of Financial Sector Repair in the Speed of the Recovery

As the financial crisis started rattling markets, policymakers broadly followed the crisis management rulebook: step one—stop panic from spreading (containment phase), step two—repair the damage (resolution phase). The principal forms of intervention were (1) liquidity provision through collateralized lending and other arrangements; (2) support for short-term wholesale funding markets; (3) (more extensive) guarantees of retail deposits and other liabilities; (4) purchases or exchanges of nonperforming or illiquid assets; and (5) capital injections to banks. Interventions often started with liquidity support to relieve the immediate pressure and then moved to identifying and meeting recapitalization needs.

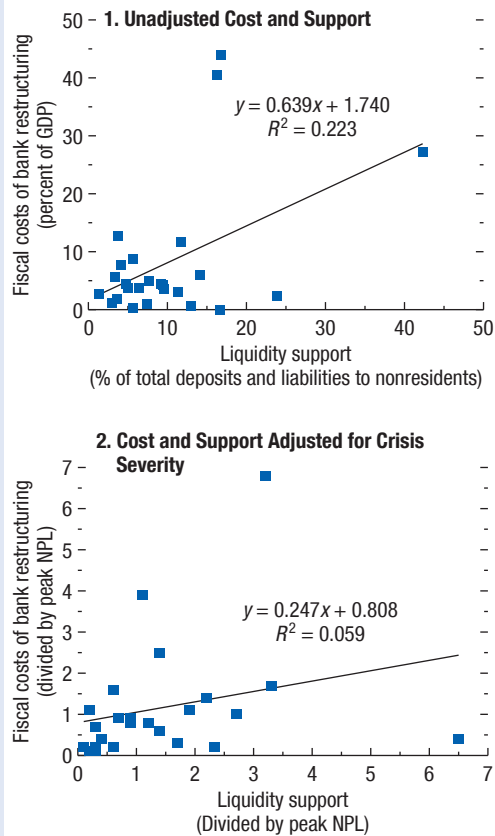
Yet the timing and strength of the response varied across countries, especially when it came to the challenge of repairing the damage (Figure 2.3.1). Part of the variation certainly reflected when and how severely a country was affected, plus how large the banking sector was relative to GDP, but there are differences even after controlling for crisis severity. Specific forms of intervention also differed. Some governments acquired minority stakes in distressed banks while others chose to close or nationalize them. Stress tests were introduced to restore confidence, with different approaches in design and governance. Sometimes, but not always, measures aiming to reduce debt overhang in the nonfinancial sector accompanied the interventions targeted at the financial institutions. Last but not least, cross-country differences in structural features, such as resolution frameworks, bankruptcy regimes, and the degree to which the system depended on bank- versus market-based financing, came into focus.

Drawing on this variation, several insights can be gained from comparing crisis management in the United States and in Europe:

- The containment phases were fairly similar. The major central banks were quick to offer liquidity support through traditional facilities and established unconventional facilities to ensure that pressure in funding markets subsided. They also established swap lines as early as December 2007 and extended these to other central banks as the crisis spread. In many respects, the response in the containment phase was better coordinated internationally during the recent crisis than in past crises (Laeven and Valencia 2013).

The author of this box is Deniz Igan.

Figure 2.3.1. Containment and Resolution

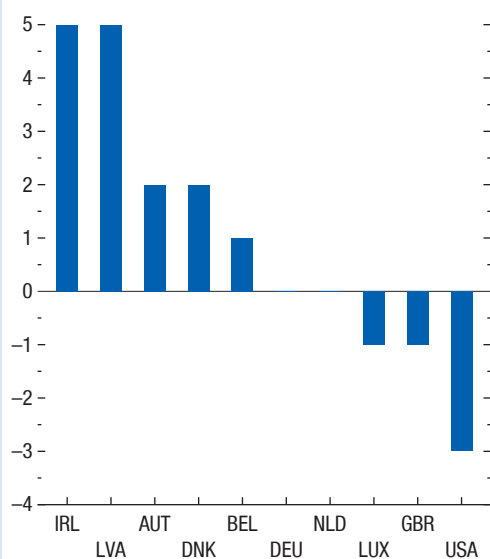


Sources: Laeven and Valencia (2013); and IMF staff calculations.
 Note: To adjust for crisis severity, fiscal costs of bank restructuring and liquidity support are divided by the peak NPL. NPL = nonperforming loan ratio.

- The resolution phases diverged more, laying bare stark differences in regulatory and supervisory architecture across the two regions.
- The United States mobilized recapitalization plans faster than did countries in the European Union (EU) (Figure 2.3.2).
- In addition to speed, the actions taken in the United States were more decisive. Banks replenished their eroded capital base by issuing new equity early in the crisis, whereas, in the EU, there was no matching effort (Figure 2.3.3). At least in part, this was driven by the supervisory approach: US banks were compelled to raise fresh capital (and were able to do so because of support from the

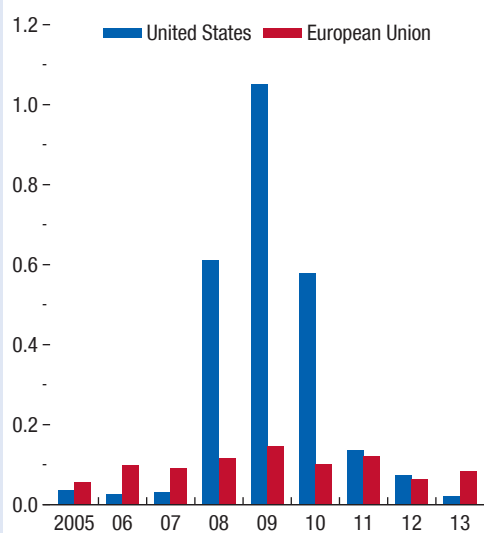
Box 2.3 (continued)

Figure 2.3.2. Timing of Recapitalization (Months)



Sources: Laeven and Valencia (2013); and IMF staff calculations.
 Note: Timing is measured by the months between moments when liquidity support became extensive and implementation of recapitalization. Data labels use International Organization for Standardization (ISO) country codes.

Figure 2.3.3. New Share Issuance by Banks (Percent)



Sources: Homar and van Wijnbergen (2015); and IMF staff calculations.
 Note: New share issuance by banks is measured by the volume in percent of the consolidated balance sheet.

Federal Reserve and other agencies); EU banks were instructed to improve their risk-weighted capital ratios, but options were left open on how to do that. Faced with tight funding conditions and broader uncertainty, banks chose to cut lending and increase their sovereign debt holdings—which carry a zero risk weight under Basel III.

- Further, while stress tests were conducted on both sides of the Atlantic, market perceptions of what they accomplished differed. In the United States, the Supervisory Capital Assessment Program aimed to address uncertainty about the solvency of systemic institutions (Bernanke 2009). Moreover, the Treasury Department committed to making capital available to eligible banks. Test results were publicly available on a bank-by-bank basis, providing the needed information to nervous markets (Fernandes, Igan, and Pinheiro 2015). In the European Union, the Committee of European Banking Supervisors conducted two rounds of tests. Individual results were kept confidential in the 2009 round, though

released in the 2010 exercise. The scenarios were criticized for being too benign and not capturing the risk of sovereign default—a major concern at the time (Abramovich 2011).¹ Moreover, the newly created European Financial Stability Facility (EFSF)—tasked with potential capital assistance—could offer funding to member states by selling bonds rather than investing directly in banks.² Finally, despite the seal of approval gained by passing the stress tests, many banks continued to struggle. Taken together, these led markets to label the exercise a “nonevent” with no useful information content (Shah 2010).³ The EU experience under-

¹Regulators reportedly chose not to include a default scenario “partly because they said that a sovereign default was unlikely and partly due to worries that it would send the wrong political message” (Enrich 2010).

²The EFSF was succeeded by the European Stability Mechanism, which, under some conditions, can provide funding directly to recapitalize banks.

³Regulators will prefer to fully reveal banks’ capital shortfall at times of crisis if they are able to recapitalize them, but will hold onto some information if they cannot recapitalize (Spargoli 2012).

Box 2.3 (continued)

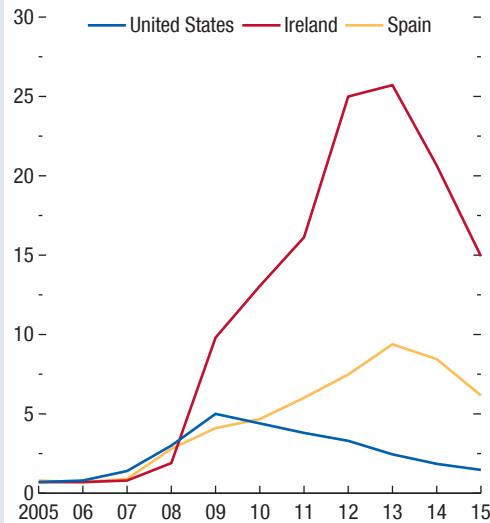
scored the importance of credibility—established through independent governance, the requisite technical expertise, and clearly communicated plans for any backstop needs (Ong and Pazarbasioglu 2013).

- Because the epicenter of the crisis in many countries was housing markets, mortgage defaults became endemic. In the United States, the Making Home Affordable (MHA) program was introduced in 2009 to help struggling homeowners (Chapter 3 of the April 2012 *World Economic Outlook*). The refinancing program under the MHA program, in particular, provided substantial welfare gains to highly indebted households (Mitman 2016) and boosted consumption (Agarwal and others 2015). In European countries caught up in their own credit-fueled housing boom-bust, there were no corresponding widespread programs at the outset of the crisis. Nonperforming loan ratios increased more than in the United States and remain high (Figure 2.3.4).⁴
- More generally, many European countries continue to grapple with large stocks of impaired assets a decade after the onset of the crisis. A large confluence of factors—the global financial crisis hit many hard and particularly hurt those with their own homegrown bubbles (Claessens and others 2010)—exposed the monetary union’s incomplete architecture and triggered a sovereign debt crisis, subjecting banks to a second round of shocks. The deep and prolonged economic downturn that followed further weakened borrowers’ debt service capacity, leading to an increase in loan defaults and large corporate and household debt overhangs. The nonperforming loans are concentrated most notably in small and medium-sized enterprises, which contribute almost two-thirds of Europe’s output and employment and tend to rely more on bank financing than large firms. In addition, many European countries have bank-based financial systems.⁵ Together with

⁴Ireland and Spain were chosen for illustrative purposes as they both had housing booms and busts and significant banking distress. Other EU countries that could be used for direct comparison (for example, Greece, Italy, Portugal) either did not have a similar precrisis boom-bust pattern in housing markets, or their experience was dominated by the sovereign debt crisis that followed the global financial crisis.

⁵Market-based economies experience significantly and durably stronger rebounds than those that are bank-based; in particular, the more bank-based economies of continental Europe (Allard and Blavy 2011).

Figure 2.3.4. Nonperforming Loan Ratio (Percent)



Source: World Bank, Global Financial Development Database.

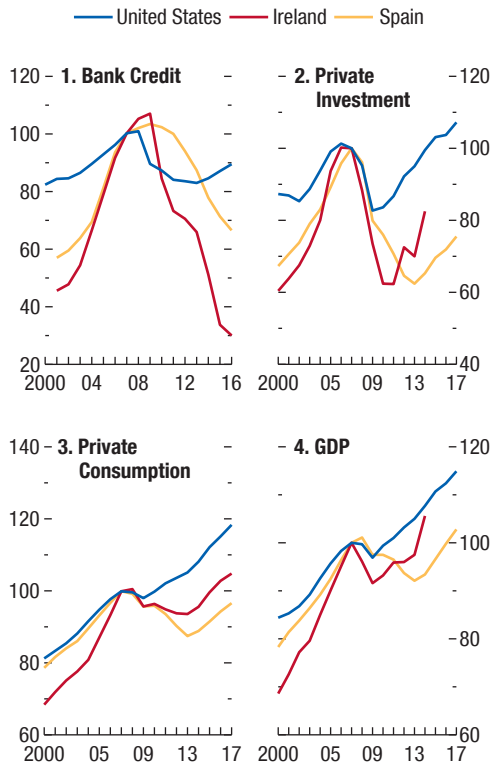
the concentration of debt overhang in small and medium-sized enterprises, this further amplified the impact of the banks’ problems and debt overhang on investment and consumption. Inadequate capital buffers, prudential problems with collateral valuation and treatment of nonperforming loans, legal obstacles to debt enforcement, loan restructuring and foreclosure, and a lack of distressed debt markets have been identified as primary obstacles to nonperforming loan resolution (Aiyar and others 2015).

- A related point of comparison between the US and EU experiences involves the resolution framework for banks themselves. In the former, having an established resolution authority that can act independently on the best option to resolve distressed banks (across state borders)—the Federal Deposit Insurance Corporation—helped ensure swift resolution of failing banks (although dealing with systemic financial institutions required further action). In the latter, the troubles of the banking system started a search for new mechanisms that culminated in the creation of a single supervisor and a unified resolution framework (Goyal and others 2013).

The postcrisis paths for credit, investment, consumption, and growth differed accordingly (Figure 2.3.5). The United States recovered faster and more strongly.

Box 2.3 (continued)

Figure 2.3.5. Postcrisis Paths
(Percent; 2007 = 100)



Sources: Organisation for Economic Co-operation and Development; World Bank, World Development Indicators database; and IMF staff calculations.

The deleveraging phase, notably, has been shorter and more shallow—consistent with the importance of repairing bank balance sheets in restoring growth.⁶

Summing up, comparison of the US and European experiences and cross-country studies highlights the following:

- *Swift and decisive action*: Recapitalizing or resolving banks shortly after the containment phase is key. The alternative leads to zombification, with significant macroeconomic costs. From a structural point of view, resolution frameworks should aim to ensure that such swift and decisive action is possible.
- *Appropriate backstops*: In extreme circumstances, establishing credibility and preventing panic and contagion may require use of public funds. In this context, having enough fiscal room and mitigating the sovereign-bank nexus become crucial. Any actual use of these backstops, however, should be a last-resort measure accompanied by appropriate burden sharing and clear exit strategies to minimize moral hazard, as well as the potential costs associated with direct government involvement in financial markets (for example, efficiency concerns).

⁶Other evidence corroborates this insight: early and decisive recapitalization of distressed banks helps corporate investment recover (Sun and Tong 2015) and can take several years off the duration of a recession (Homar and van Wijnbergen 2015).

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