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## Research Summaries

### A New Look at Bank Capital

Jihad Dagher, Giovanni Dell’Ariccia, Luc Laeven, Lev Ratnovski, and Hui Tong



*This study suggests that bank capital in the range of 15–23 percent of risk-weighted assets would have prevented most of the past banking crises in advanced economies. The benefits of even higher bank capital are small. Transition costs to higher capital standards can be substantial, so any new minimal standards should be imposed gradually and in favorable economic circumstances.*

The global financial crisis and its aftermath highlighted how distressed banks can undermine the real economy. Bank capital prior to the crisis was in retrospect too low to withstand plausible shocks. A large part of the policy response, accordingly, focused on increasing bank capital ratios and other forms of loss absorption.

*Read more on page 2*

### Does Growth Create Jobs? Evidence for Advanced and Developing Economies

Zidong An, Nathalie Gonzalez Prieto, Prakash Loungani and Saurabh Mishra



*Global job creation remains sluggish, prompting calls for policy*

*actions to raise economic growth. Will growth create jobs? Recent IMF research documents a striking variation among countries in the extent to which employment responds to GDP growth over the course of a year. In some countries, labor markets are quite responsive: when growth picks up, employment goes up and unemployment falls; in other countries the response is quite muted. Thus, a pick-up in growth—through aggregate demand stimulus for instance—will result in more jobs, but the extent of job creation in the short run could vary sharply across countries. Some structural measures can thus serve as useful complementary policies, as also discussed in IMF research.*

The global unemployment rate increased sharply during the Great Recession to a peak of 6.2 percent in 2009 (Figure 1a). The increase in unemployment in

*Read more on page 5*

## A New Look at Bank Capital

A critical question at this juncture is: how large should bank capital buffers be?

- Proponents of higher capital emphasize the risks of high bank leverage and the exorbitant costs of the crisis. And they argue that higher equity requirements would have little social costs (Admati and Hellwig 2014).
- Opponents of higher capital believe that it would increase the cost of credit and hinder economic activity (IIF 2015). Also, higher capital might push intermediation into unregulated entities, increasing systemic risk.

In a recent [IMF discussion note](#) (Dagher and others 2016) we study past banking crises and ask how much capital it would have taken to:

- Absorb bank losses entirely through bank equity; and
- Avoid public recapitalization of banks.

### How Much Capital to Absorb Bank Losses?

To answer this question, we compile data on non-performing loan ratios (NPLs) in past banking crises from Laeven and Valencia (2013). We convert NPLs into loan losses using U.S. historic loss given default (LGD) ratio of about 50 percent (Schuermann 2004; Shibut and Singer 2014). Then, we deduct the portion of these losses that can be absorbed by provisions which, based on U.S. and international data, we take to be about 1.5 percent. And we add a 1 percent margin of safety to obtain the leverage ratio consistent with absorbing all losses through equity. Finally, we use the U.S. average ratio of total assets to risk weighted assets (RWA) of 1.75 (La Lesle and Avramova 2012) to convert our leverage ratio into a risk-weighted capital ratio. The overall formula that converts past NPLs into bank capital ratios that can fully absorb them is:

$$\text{Bank capital} = (\text{NPL} * \text{LGD} - \text{Provisions} + 1 \text{ percent}) * (\text{Total assets} / \text{RWA})$$

Figure 1a reports the distribution of NPLs in historic banking crises in OECD economies. Figure 1b depicts the share of banking crises for which banks could have absorbed all losses through equity, as a function of hypothetical pre-crisis bank risk-weighted bank capital ratios.

In Figure 1b, the baseline (blue) suggests that the marginal benefit of bank capital is high until 15 percent risk-weighted capital ratio. But it declines rapidly after that, because more extreme crises are rare and have substantially higher NPLs. The red line is a robustness test with a higher LGD of 75

percent. A similar line can be drawn for a higher ratio of total assets to RWA. In these cases, the point at which marginal benefits of capital decline moves to 23 percent of risk-weighted bank capital.

Figure 1a: Distribution of Non-Performing Loan Ratios in Past Banking Crises in OECD Countries

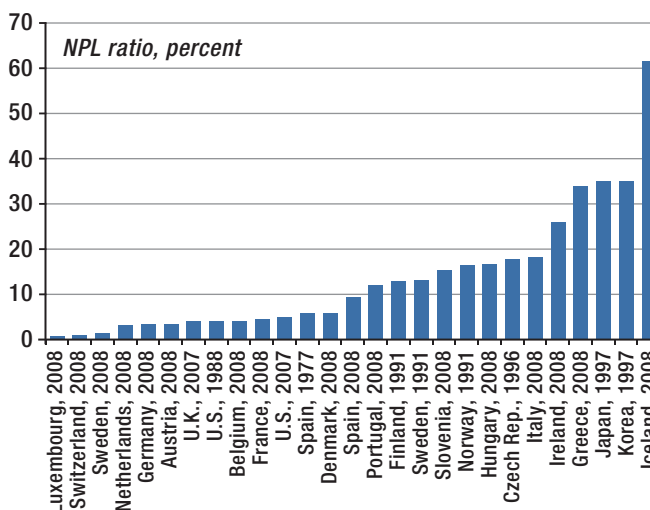
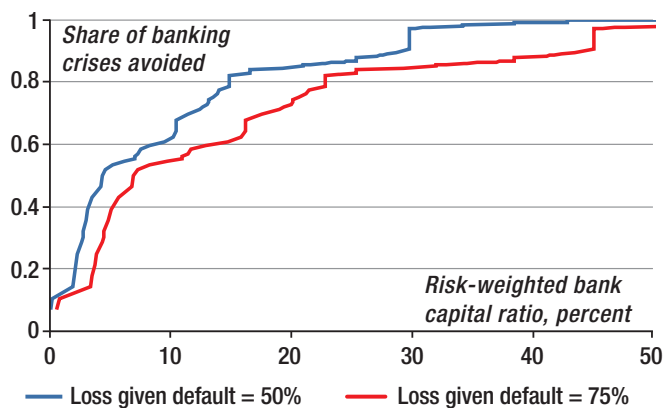


Figure 1b: Risk-Weighted Bank Capital Ratios Sufficient to Absorb Loan Losses in Past Banking Crises in OECD Countries



Summarizing, bank capital in the range of 15–23 percent of risk-weighted assets would have been sufficient to absorb bank losses in the vast majority (85 percent) of past banking crises in OECD countries. Further increases in bank capital would have been relatively ineffective in preventing additional banking crises.

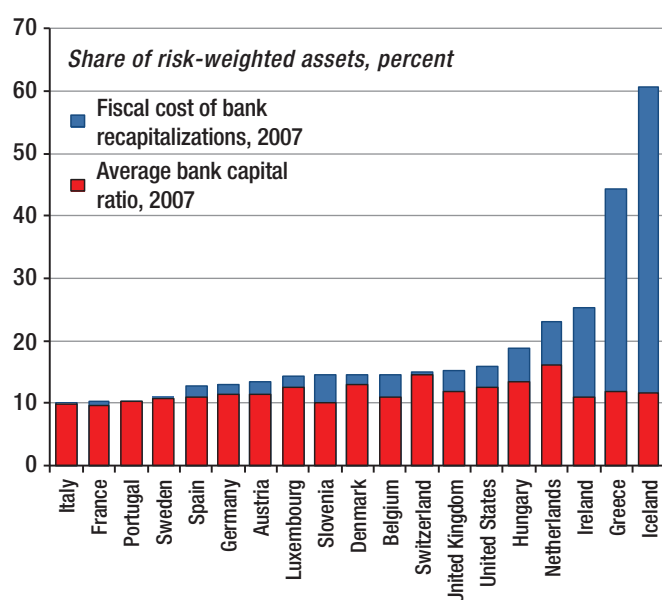
### How Much Capital to Avoid Public Recapitalizations?

To answer this question we assume that historic bank recapitalizations brought banks to the minimum level of capital needed to restore viability. Then, the level of pre-crisis bank capital that would have avoided the need for bank

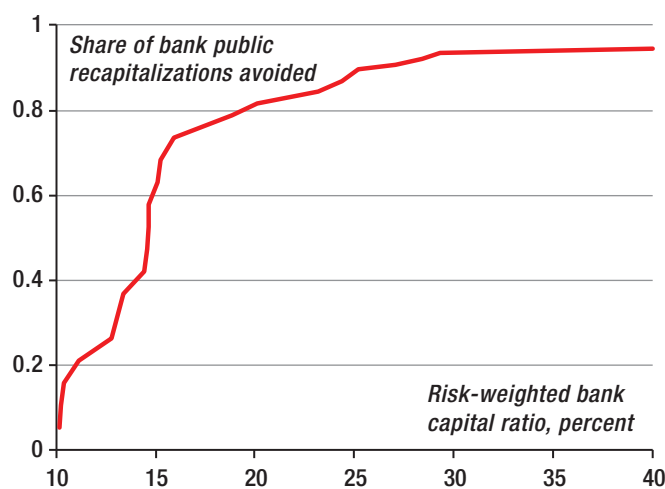
recapitalizations is the sum of actual pre-crisis capital and the post-crisis public capital injection (expressed in percentage points of bank capital ratios).

Figure 2a reports bank recapitalization expenditures in banking crises in OECD economies since 2007. Figure 2b depicts the share of banking crises for which bank recapitalizations could have been avoided, as a function of hypothetical pre-crisis bank risk-weighted capital ratios.

**Figure 2a: Pre-Crisis Bank Capital and Fiscal Cost of Bank Recapitalizations in OECD Countries, 2007–present**



**Figure 2b: Risk-Weighted Bank Capital Ratios Sufficient to Absorb Loan Losses in Past Banking Crises in OECD Countries**



Consistent with our previous findings we find that the marginal benefit of bank capital in terms of avoiding

public recapitalizations is relatively high until the 15–17 percent risk-weighted bank capital ratio (which help avoid recapitalizations in 75 percent of banking crises), and declines after that.

### What About Emerging and Developing Economies?

Emerging markets have, on average, suffered greater bank losses (relative to bank assets) during past banking crises. This is not surprising because in those countries macroeconomic shocks tend to be larger, credit less diversified, and institutional factors lead to higher NPL and LGD ratios.

On the one hand, higher bank losses, all else equal, call for higher levels of capital to absorb them. On the other hand, non-OECD countries tend to have much smaller banking systems relative to GDP. So when bank losses exceed the banks’ absorption capacity, the impact on the economy (and thus the fiscal accounts) is likely also smaller. We find that had non-OECD countries imposed bank capital ratios in the 15–23 percent range, losses exceeding the absorption capacity of capital would have been within 3 percent of GDP in 80 percent of banking crises.

And, a complementary strategy for non-OECD countries is to reduce potential bank losses through institutional improvements (in regulation, supervision, and resolution).

### Results Are Robust, but Some Caveats

Our results are robust to a number of extensions: We consider losses on securities during recent crises and find that they were similar to loan losses, validating our results based on bank losses. We also use data from Fratianni and Marchionne (2013) on capital injections in *individual* banks during the 2007 crisis, and find that a 23 percent capital ratio would have avoided almost all public recapitalizations of individual banks. This supports our previous results based on system averages.

Some caveats on the interpretation of our results for policy purposes. First, we discuss actual bank capital rather than minimum capital requirements. Second, we focus on bank capital, whereas some loss absorption capacity might be provided by junior debt instruments (as in recent FSB’s TLAC proposals). Third, banks have recently been strengthened by regulatory reforms other than higher capital (such as Basel III liquidity ratios). And finally, we do not consider the positive incentives effects of higher bank capital.

Taken together, these caveats suggest that desirable minimum capital requirements are likely lower than the 15–23 percent RWA range identified in our analysis.



### Costs of Bank Capital

The literature suggests that the steady-state cost of additional bank capital is low. A 1 percentage point in capital requirements leads to a modest increase in lending rates in the range of 5–15 basis points in most studies.

However the costs of transition to higher capital can be very high. A 1 percentage increase in capital requirements is associated with a 2–5 percent reduction in lending growth. In principle, these transition costs could be mitigated if banks can adjust their balance sheets gradually.

High transition costs call for a gradual approach to any increases in bank capital. New requirements should be imposed over a relatively long period of time. Yet, markets may pressure banks to comply with new standards faster than required by regulators. Then, whenever possible, new standards should be introduced during favorable macroeconomic conditions. Also, supervisors should encourage banks to increase loss absorption by raising equity (through new issuance or retained earnings) rather than shrinking assets, so as to avoid reduced credit availability.

### Conclusion: 15–23 Percent and Gradual

With all the aforementioned caveats in mind, our study suggests that risk-weighted bank capital in the range of 15–23 percent of risk-weighted assets would have prevented a majority of past banking crises in advanced economies. The additional benefits of bank capital above that rate are small. Transition to higher bank capital is a challenge. Regulators should balance improved bank stability with negative

short-term effects on lending and growth, which might be substantial. A possible solution is to link the implementation of higher bank-capital ratios to better economic conditions.

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## Does Growth Create Jobs? Evidence for Advanced and Developing Economies

(continued from page 1)

emerging markets and developing countries was modest. In contrast, the unemployment rate in advanced countries shot up to nearly 8.5 percent and has returned very sluggishly in subsequent years toward its pre-crisis level. Even by 2017, the forecast is that unemployment in advanced economies will still be higher than it was a decade earlier (Figure 1b).

Figure 1a: Global Unemployment Rates

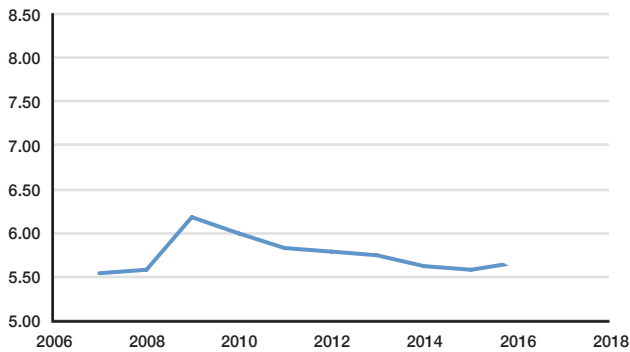
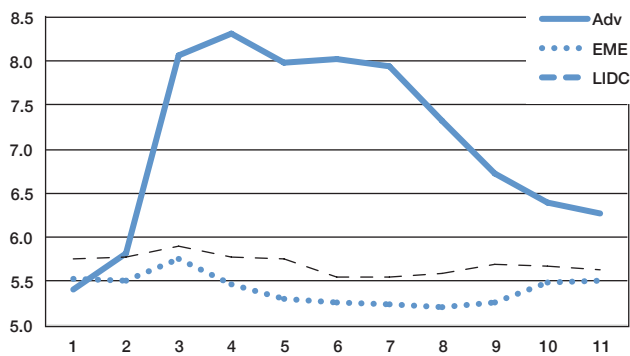


Figure 1b: Global Unemployment Rates



Notes: The vertical scale shows unemployment rates in percent. Figure 1a shows the global unemployment rate, Figure 1b the rates for sub-groups: advanced, emerging markets and low-income developing countries (LIDC). Source: International Jobs Report, April 2016, OCP Policy Center.

Some observers argue that the sluggish recovery of unemployment in advanced economies is to be expected given that output remains below trend in many of these countries; they argue further that the way to reduce unemployment faster would be through macroeconomic policies (e.g., Krugman 2011, Kocherlakota 2014). Others suggest that the job losses are not well explained by developments in output (e.g., McKinsey

2011, Cazes and others 2011). Recent IMF research provides evidence on this debate by documenting the short-run relationship between labor market developments and real GDP movements for a large group of countries. Such a relationship is often referred to as Okun’s Law, following Okun’s (1962) documentation of it for the United States.

## Jobs and Growth in Advanced Economies

Figure 2a shows the relationship between unemployment changes and GDP growth for the United States. The relationship documented by Okun holds up very well even with the addition of over 50 years of data, cementing its claim to be called a “Law.” The relationship also holds well for most U.S. states, with the strength of the relationship dependent in part on the state’s industrial structure. In the so-called Rust Belt states, unemployment is very responsive to cyclical fluctuations in the economy, but the relationship is weaker in states where agriculture or oil production are dominant (Figure 2b).

Figure 2a: Does Growth Lower Unemployment? U.S. Evidence

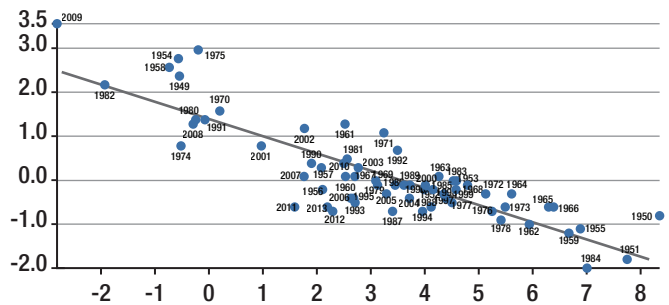
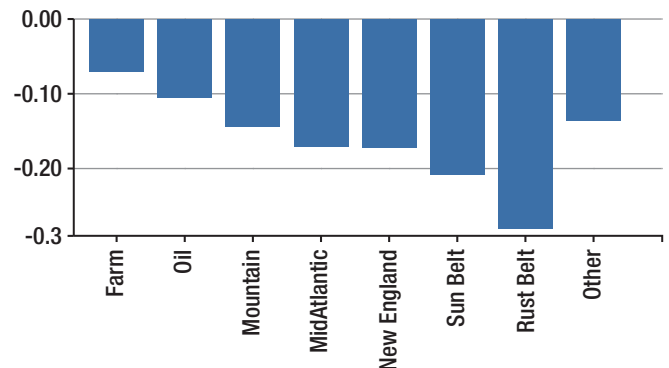


Figure 2b: Does Growth Lower Unemployment? U.S. Evidence



Notes: In Figure 2a, the horizontal axis shows real GDP growth in percent; the vertical axis shows the change in the unemployment rate in percentage points. Figure 2b shows the change in unemployment in response to real GDP growth in various groups of U.S. states.

Sources: Figure 2a: Ball, Leigh, and Loungani 2013; Figure 2b: Gonzalez Prieto, Loungani, and Mishra 2016.

While Okun’s Law holds well overall for the United States, the behavior of unemployment since 2011 did deviate from the historical relationship because of an unusual fall in labor force participation (Schindler and others 2014). Erceg and Levin (2013) emphasize the unusual depth and duration of the Great Recession as a reason: in their view, participation normally does not respond much to output fluctuations given the costs of entering and exiting the labor force, but a protracted recession eventually leads workers to exit.

Another reason for the sluggish decline in U.S. unemployment is adverse shocks to particular sectors, particularly construction and finance. There is evidence that these shocks, and the uncertainty generated about sectoral fortunes, were particularly important in accounting for long-duration unemployment (see Chehal, Loungani, and Trehan 2010; IMF 2010; and Choi and Loungani 2015). Though the U.S. unemployment rate has now dipped below 5 percent, there are still some structural issues in the labor market. Mobility across states in response to adverse shocks has been declining—and indeed may not have been as high in the first place as suggested in previous studies (Dao, Furceri, and Loungani 2016).

Cyclical unemployment in most European economies can also be explained well by Okun’s Law (Arpaia, Kiss, and Turrini 2014; and Bakker 2016), as can a large part of the increase in youth unemployment seen during the Great Recession (Banerji, Saksonovs, Lin, and Blavy 2014).

### Evidence for Emerging Markets and Low-Income Countries

When looking across a broad group of economies, employment may be a better labor market indicator than unemployment. It is more likely to be measured in a comparable way across countries and the data may be of better quality; moreover, in low-income countries, unemployment may not be an option for many people. Figure 3a shows the so-called Okun coefficient—how much employment increases when growth picks—for the G20 economies, which together account for the lion’s share of global GDP and employment.

Figure 3a: Does Growth Create Jobs? Evidence for Country Groups

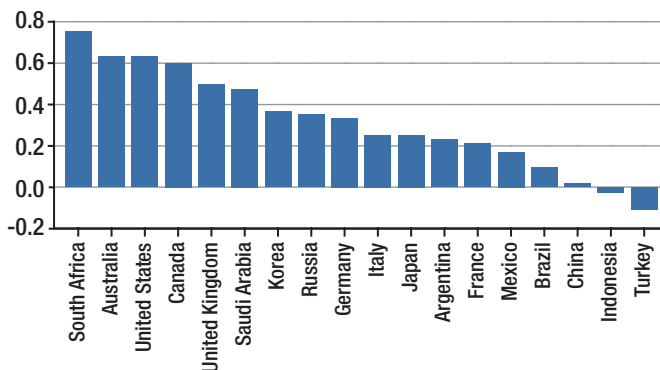
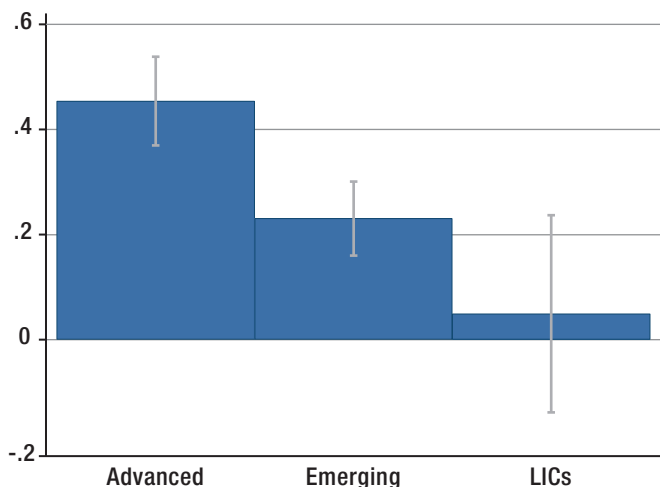


Figure 3b: Does Growth Create Jobs? Evidence for Country Groups

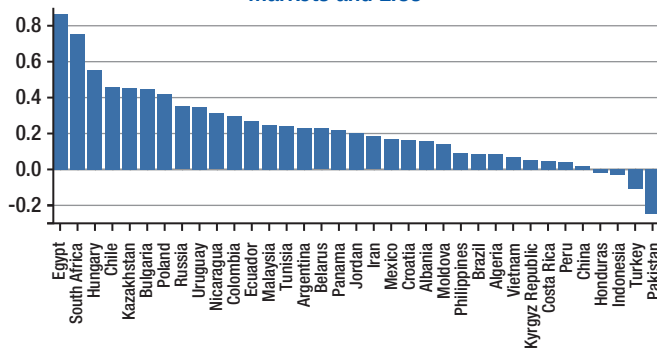


Notes: Both panels show the response of employment growth to real GDP growth. India is not shown in Figure 3a due to lack of data. In Figure 3b, LICs includes countries classified by the World Bank as low-income and lower-middle income countries. Sources: Figure 3a: Loungani and Mishra 2016; Figure 3b: Ball, Furceri, Leigh, and Loungani 2016.

In South Africa, Australia, and Canada, a 1 percent increase in GDP is matched by an increase in employment of 0.6 percent or higher. In contrast, there is virtually no response of employment to growth in China, Indonesia, and Turkey. The extent to which changes in growth account for changes in unemployment and employment also varies across countries. GDP growth accounts for over 70 percent of the variation in employment in Canada and the United States, about 40 percent in Russia, the United Kingdom, and Australia, and very little in many other countries.

Figure 3b shows the average value of the Okun coefficient for three groups of countries: advanced, emerging, and low-income (LICs). In addition to the average, the range of values for different countries within the group is shown. Among advanced economies on average, employment increases by 0.4 percent for a 1 percent in GDP growth and the variation across countries is small. In emerging markets, the average value is smaller, 0.2 percent, though again with some variation across countries. For LICs, the average coefficient is small—barely above zero—and with a very large variation across countries (Figure 4).

**Figure 4: Does Growth Create Jobs: Evidence for Emerging Markets and LICs**



Note: The bars show the response of employment growth to real GDP growth.

Source: Ball, Furceri, Leigh, and Loungani 2016.

## Summing up the Evidence

There is often a maintained assumption that labor market outcomes in many countries are largely determined by longer-term structural factors than by short-term cyclical fluctuations. Our results give an initial diagnostic check on the validity of this view. There are several countries in which Okun's Law holds poorly in the sense that the estimate of the Okun coefficient is low in absolute value and the overall fit of the equation is poor. In these countries the assumption of a dichotomy between output and labor market fluctuations may be fine as a starting point. But in any more cases, where Okun's Law holds well, the view is less tenable. At the IMF, a [template \(http://www.imf.org/external/pubs/ft/tnm/2012/tnm1201.pdf\)](http://www.imf.org/external/pubs/ft/tnm/2012/tnm1201.pdf) has been developed to provide estimates of Okun coefficients for countries using various methodologies and robustness checks (Chami and others 2012). This provides a means for ensuring that—as is the case with forecasts made by the private sector (Ball, Jalles, and Loungani 2015)—the relationship between IMF staff forecasts of output and unemployment for various countries is consistent with that which prevails in the data.

To sum up, for the majority of countries around the globe, taking account of growth is an important part of understanding short-run unemployment fluctuations. In the case of other countries, there are several possible explanations for the weakness of the jobs-growth link. In some cases, reported unemployment rates may not fully reflect the true unemployment rate. Some countries are going through rapid structural change and unemployment may be driven by this longer-run trend rather than short-run fluctuations. For instance, this is likely to be the case in Morocco, where the unemployment rate has fallen sharply over the past 20 years with the increase in trend GDP but the short-run responsiveness of unemployment to GDP growth is essentially zero. In countries with large rural sectors and a large degree of informality, the measured unemployment rate (which is more likely to reflect urban and formal sectors) may not be very responsive to growth.

## Policy Implications: A Two-Handed Approach

The evidence that extra growth will bring back jobs in many countries leads to the obvious question: what will deliver the extra growth? In Furceri and Loungani (2014), we advocate a two-handed approach: continued support to domestic aggregate demand and the adoption of policies and reforms that can boost aggregate supply. Without supportive demand policies, supply measures could have little impact in the short run. If companies do not see improved sales prospects, they will not increase capacity; hence, it is essential to ensure that the demand is there to sustain supply. But without supply measures, output gains based solely on a stimulus to demand will prove temporary. The range of supply measures varies, from removing bottlenecks in the power sector to reforms in labor and product markets (IMF 2016; Adhikari, Duval, Hu, and Loungani 2016). In many countries, there is a strong case for increasing public infrastructure investment, which would provide a much-needed boost to demand in the short term and would also help supply (i.e., potential output) over the longer term (Abiad and others 2014).

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## Seven Questions on Rethinking the Oil Market in the Aftermath of the 2014–16 Price Slump

Rabah Arezki

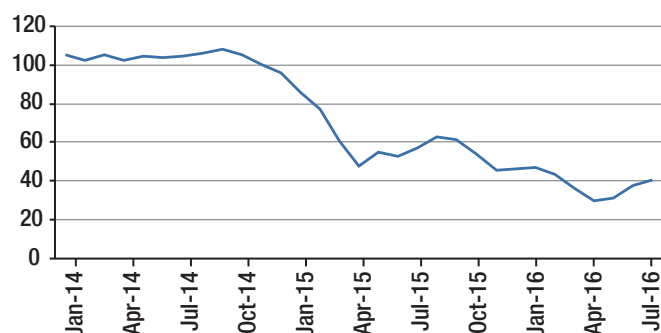


*Oil prices have decreased by about 65 percent since their recent peak in June 2014 (see chart). This dramatic and largely unexpected collapse in prices has sparked intense debate over the causes and consequences. Arguably, the dynamic adjustment has changed the oil market structurally, leaving it quite different from the past. In addition, the manner in which falling oil prices affect the global economy has changed in important ways.*

*A broader energy perspective is therefore now needed to comprehend oil's long-term outlook. To this end, this article briefly answers seven questions about the oil market in the global economy.*

### Crude Oil Price (APSP)

U.S. dollars a barrel



Source: IMF, Primary Commodity Price System.

Note: APSP = average petroleum spot price—average of U.K. Brent, Dubai, and West Texas Intermediate, equally weighted.

### Question 1. Is the Slump Attributable to a “Supply Glut” or to “Peak Demand”?

The evidence suggests that supply factors better explain the initial collapse in oil prices in 2014 than do demand factors. A host of issues are involved, including the rapid increase in shale production in the United States; a change in strategy in Saudi Arabia, the largest member of the Organization of the Petroleum Exporting Countries (OPEC); higher-than-expected output in countries such as Libya and Iraq despite ongoing conflicts; the return of Iranian oil to international markets; and the United States’ removal of the oil export

ban (Arezki and Blanchard 2014). These factors have persisted. The dynamic adjustment of investment in the oil sector to lower prices will continue to shape the speed and extent of any market recovery (IMF 2015).

Demand factors have also played an important role (Baumeister and Hamilton 2015). Yet oil demand has grown unabated since 2011, when growth in emerging markets first slowed. Of course, changes in expectations about future oil demand may also explain this delayed market response. Specifically, the realization has been gradual that the slowdown in emerging markets is structural, not cyclical. In addition, several episodes of market fright, when oil prices further collapsed before rebounding—at the end of August 2015 and January to February 2016—suggest that financial factors are also relevant (see Arezki and Matsumoto 2015a).

### Question 2. Does OPEC (still) matter?

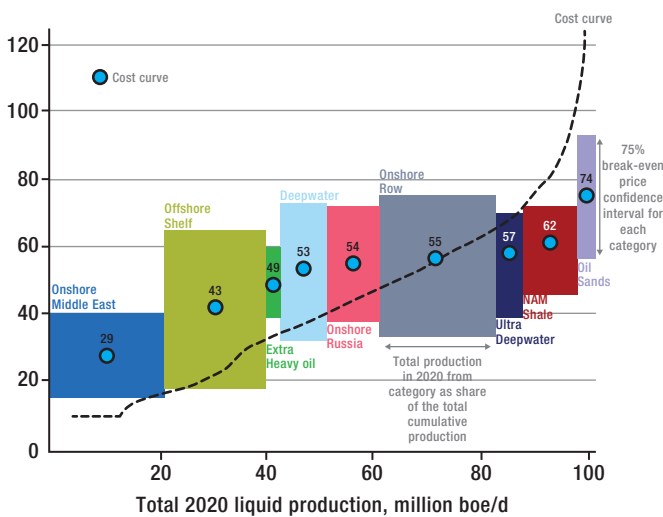
In theory, the effectiveness of a cartel and its compact depend on the strength of demand and supply outside the cartel. In the 2000s, strong demand and a relatively strong OPEC enticed investment and production in high-cost areas (such as oil sands in Canada and ultra-deep-water oil off Brazil). Considering the delay between investment and production for (conventional) oil, production in non-OPEC countries peaked about the same time as emerging market economies began slowing and expectations for future demand began faltering.

In response, OPEC-dominant and lowest-cost producers changed strategies. In the past, Saudi Arabia would stabilize prices by cutting production when prices fell too much and raising it when they rose too high relative to a stated price target.

In 1986, Saudi Arabia attempted to cut production by an unprecedented margin to support prices even as non-OPEC production rose rapidly, and the cut failed in its goals. Perhaps learning from the episode, this time around the country instead announced it would step up production, effectively crowding out high-cost producers. Observers expect the change in strategy to last to allow time for it to succeed.

**Question 3. Is the shift in cost structure permanent or temporary?**

The short answer is the shift is temporary. An important fact about the slump in prices is the significant downward shift in the cost structure associated with oil production. A commonly held belief is that the cost structure, which is often proxied by breakeven prices (the price at which it is economical to produce a barrel of oil) is constant and driven by immutable factors such as the nature of the oil extracted and the associated geology (see chart). In practice, the cost structure depends on a host of factors, including technological improvements and the extent of “learning by doing.” In instances such as the recent dramatic drop in prices, breakeven prices have moved downward in sync with oil prices. That shift is explained by the operational efficiency gains stemming from the service industry’s significant reduction in margins to support the upstream sector. In shale oil specifically, the extraordinary resilience to the drop in oil prices can be explained by important efficiency gains compounded by the fact that shale was at the onset of an investment cycle in which learning by doing was important. Going forward, the shale cost structure is likely to shift back up somewhat because some of the efficiency gains cannot be sustained and the cost of capital is high.



Source: Rystad Energy research and analysis.  
 Note: boe/d = barrel of oil equivalent per day, NAM = North American.

**Question 4. Do futures markets (truly) reflect market sentiments?**

Futures have not helped predict market “breakdown.” Market expectations for the trajectory of oil prices, as captured by longer-term futures (only), changed after the OPEC meeting of late November 2014, adding to evidence that suggests that futures markets appear to “learn” only gradually (Leduc, Moran, and Vigfusson 2013). While oil futures curves gradually ratcheted up throughout the 2000s until reaching a peak just before they abruptly ratcheted down at the end of 2014.

The limitations associated with futures are at least twofold. First, while they are large in absolute size they are in fact relatively thin after 12–18 months when considering the volume traded relative to the volume actually consumed. As such, futures do not necessarily reflect volume traded over the counter. Second, as in other commodities, futures markets it is subject to the imbalance between longs and shorts. In other words, there is a higher demand for short-term hedging, say, by oil producers than long-term hedging by manufacturers. The former are typically willing to accept relatively lower prices to hedge price risks since they cannot easily pass on the price change to the consumer, contrary to oil and gas intensive manufacturers attempting to protect their cost structure even if oil is relatively small relative to their overall cost base.

**Question 5. Why have low oil prices not (yet) boosted the global economy?**

While a drop in oil prices amounts to a transfer from exporters to importers, the expected net plus stems from the higher propensity to save of the former. Also, it is important to distinguish between supply-driven oil price shocks relative to demand-driven ones, as the former should lead to a net plus to the global economy and the latter is symptomatic of a slowing global economy (Husain and others 2015).

Several reasons explain the limited effects of lower oil prices on the global economy (see Obstfeld, Arezki and Milesi-Ferretti 2016). A bigger-than-expected fall in capital expenditure in the oil sector, especially in North America, has been a drag on the world economy and trade. Oil exporters have experienced greater-than-expected reductions in (government) expenditures across the board. This has led to lower energy subsidies, social services,

infrastructure investment, and, in turn, imports from advanced and emerging markets.

Pressure has also increased to draw down sovereign wealth fund assets, with potential consequences for financial markets against the background of concern about market liquidity (Arezki, Mazarei, and Prasad 2015).

In advanced economies, consumers seem to have saved a large share of the reduction in the net oil import bill. And in emerging markets, limited pass-through from international to domestic prices meant that the windfall was not spent, although it led to improvement in government balance sheets. The appreciation of the U.S. dollar has limited the reduction in domestic currency oil prices somewhat. Importantly, interest rate policies are constrained by a zero lower bound environment.

### Question 6. What to make of a (two-way) relationship between the “energy transition” and oil prices?

The energy transition refers to the shift toward lower-carbon or carbon-free energy, such as renewables. The expected “lower-for-longer” oil price environment will likely delay the transition (Arezki and Obstfeld 2015). The transition also faces a host of challenges that will likely take decades to overcome (Arezki and Matsumoto 2015b). The future of oil will depend on the complex interplay between demography, technology, and public policy, affecting both supply and demand. In thinking about the future therefore one should think more broadly about energy.

On the supply side, oil will increasingly face competition from other sources of energy, such as natural gas and renewables. Oil is for the most part used for transportation as products such as gasoline, diesel, and jet fuel. As energy-using technology evolves in the transportation sector toward wider use of hybrid and electric cars, compartmentalization of the transport and electricity sectors is bound to disappear. That trend will likely further displace oil, to the benefit of natural gas first and then renewables (IMF 2016).

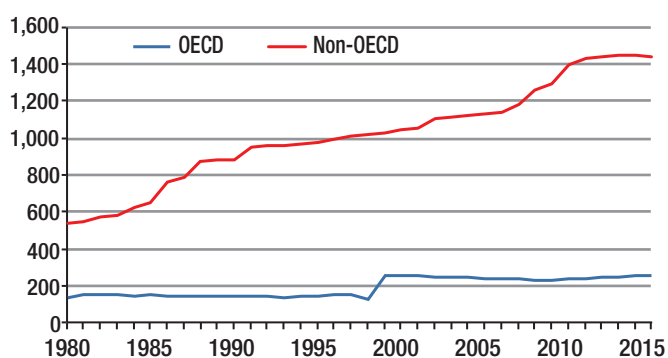
In demand, countervailing forces are at work. On one hand, rapid urbanization and growing middle classes in emerging markets, especially in Asia, will tend to push up demand for transportation and hence for oil. On the other, expected slower growth in emerging markets and public policies geared toward reducing emissions will improve oil efficiency and reduce oil demand.

### Question 7. Is it the End of Peak-Oil?

The peak-oil hypothesis posited that oil supply would top out in the mid-2000s, precisely the moment when the shale “revolution” started to take off. In many respects, this revolution can be viewed as an endogenous supply response to high prices in the 2000s, hence challenging the overly pessimistic view that geological factors were to limit supply (Arezki, Laxton, Nurbekyan, and Wang 2015).

#### Oil Proved Reserves

Thousand million barrels



Source: BP Statistical Review of World Energy June 2016.

Beyond the response of technology to oil prices, the resource base (what is known about geology as opposed to true geology) depends on exploration. The evidence suggests that discoveries of oil (as well as other commodities) have occurred mostly in developing countries, including in Latin America and sub-Saharan Africa that only saw exploration once they become more friendly to such activities (see chart).<sup>1</sup> That increase in discoveries in the southern hemisphere is likely to continue to support supply in spite of depletion of reserves in the northern and low prices (Arezki, van der Ploeg, and Toscani forthcoming). That said, the risks that fossil fuel assets will be stranded (in other words, obsolete) are likely to leave many countries vulnerable to financial stability and bankruptcy risks (van der Ploeg 2016; Venables 2016).

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<sup>1</sup> These discoveries may have important macroeconomic consequences (Arezki, Ramey, and Sheng forthcoming; Eastwood and Venables 1982).

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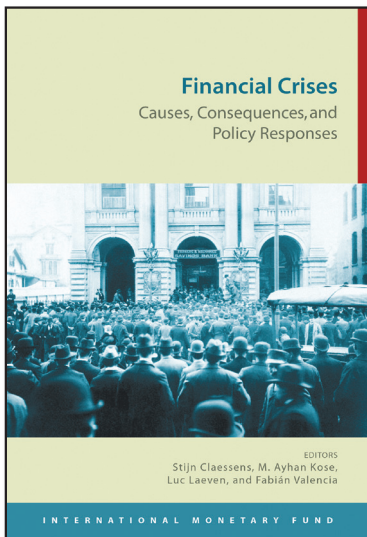
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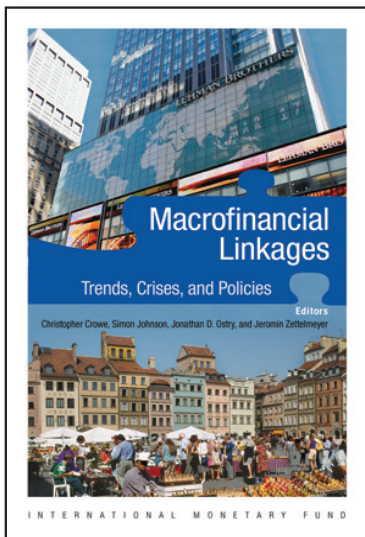
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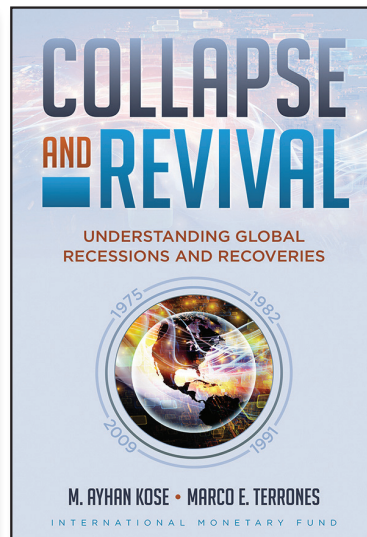
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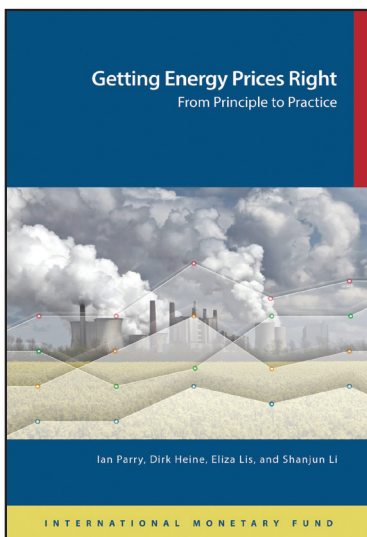
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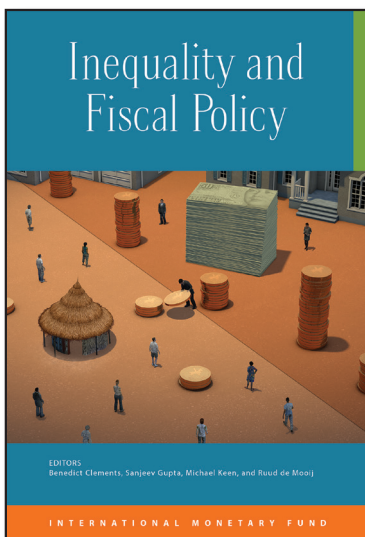
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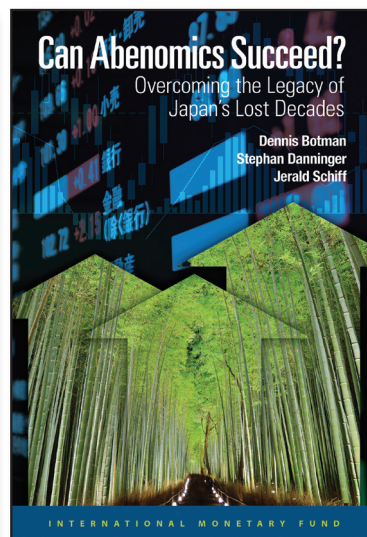
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