THE EFFECT OF THE GLOBAL FINANCIAL CRISIS ON OECD POTENTIAL OUTPUT

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1. Introduction and summary

1. The global financial crisis has been extremely costly in terms of lost output and jobs. A crucial judgement for macroeconomic policy is how much of this loss will remain once cyclical recovery is complete, in terms of permanently lower medium-term output relative to the trajectory that would have been expected in the absence of the crisis.\(^1\) The extent of such losses is a particularly important consideration for fiscal policy given the large increase in government deficits and debt experienced by many OECD countries; the greater the loss, the less that fiscal balances will improve with any recovery and so the greater the need for discretionary action to correct remaining fiscal imbalances. The extent of the loss in capacity to produce output without generating unsustainable macroeconomic imbalances is also relevant for monetary policy; the greater the loss, the sooner any recovery will run into capacity constraints and so the sooner the need to normalise policy rates and end unconventional monetary easing. An understanding of which countries have been most severely impacted by the crisis is also of relevance to policy, as it may cast light on which pre-crisis conditions and policies make economies vulnerable to such shocks and so suggest ways of improving resilience in the future.

2. Evaluating the effect of the crisis on medium-term output prospects is inherently problematic, given the impossibility of knowing what the counter-factual is and because of the difficulties of disentangling the effect of the crisis from other effects, including policy changes. Moreover, even nearly six years after the crisis, with many economies judged to be operating well below capacity, any assessment can only be preliminary. The approach in the current paper is based on OECD published estimates of potential output, which is that estimated trend level of output which can be sustained without generating inflationary pressures. Losses related to the crisis are evaluated relative to a counter-factual assuming a continuation of pre-crisis productivity trends, but with alternative assumptions regarding the trend employment rate.

3. The main findings of the paper are as follows:

- The crisis is estimated to have reduced potential output for the median OECD country by about 4 per cent in 2014, which is in line with previous OECD estimates of the effect of major banking crises. The loss to aggregate OECD potential output is estimated to be about 2¼ per cent because larger countries are estimated to have been less affected.

- These effects are smaller than other widely-quoted estimates in the literature relating to the medium-term output effects of past financial crises, but it is argued that this is because other studies tend to over-estimate the pre-crisis trend growth rate as a basis for the counter-factual against which output losses are evaluated.

- The estimated effects of the current crisis in this paper do, however, vary widely across countries. The most severely affected are overwhelmingly smaller European, mainly euro area, countries; the reduction in potential output in 2014 being more than 10% for the Czech Republic, Estonia, Greece, Hungary, Iceland, Ireland and Slovenia. Conversely, for a few OECD countries, including Germany and Japan, the crisis is not estimated to have had any adverse effect on potential output.

- The largest adverse effects come from lower productivity, which is a combination of both lower total factor productivity and lower capital per worker. The decline in capital per worker accounts

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\(^1\) Note that the paper here is concerned with estimating the permanent medium-term loss to the level of output once any cyclical recovery is complete. However, even if this loss turns out to be small, the cyclical loss in output (measured by a cumulative output gap) until output returns to a sustainable trend is, for many OECD countries, likely to be larger than for any other downturn experienced in the post-war period.
for more than 3 percentage points of the decline in potential output in 2014 for Estonia, Greece, Iceland, Hungary, Korea and Portugal, with these countries also being among those in which the pre-crisis growth of capital per worker was most rapid.

- The contribution of lower potential employment to the crisis hit is typically much smaller than from productivity, although this contribution is more than 5 percentage points for Iceland, Ireland, Greece, Portugal, and Spain, with most of this explained by higher structural unemployment (Iceland an exception). Adverse effects on labour force participation are modest and generally much less than might have been expected on the basis of previous severe downturns, which may partly reflect pension reforms and a tightening up of early retirement pathways. Conversely, the United States is one country where there has been a marked decline in trend participation, but this is attributed mostly to demographic effects and not the effect of the crisis.

- In terms of pre-crisis conditions, both higher inflation and positive output gaps (a measure of over-heating), are correlated with subsequent potential output losses. In addition, pre-crisis conditions relating to financial excesses, namely high investment, larger current account deficits, low real interest rates and high total economy indebtedness are also correlated with larger potential output losses. This provides support to arguments that macroeconomic policy should be concerned with financial developments over and above their immediate implications for inflation. Additionally, while the pre-crisis trend growth rate is not a useful predictor of subsequent output losses, faster growth in the capital-per-worker component is correlated with post-crisis potential output losses. These results therefore suggest that underlying the potential output losses was a substantial misallocation of resources, especially capital, in the pre-crisis boom period, with rapid growth in capital contributing to unsustainable pre-crisis productivity growth.

- More competition-friendly product market regulation and less stringent employment protection legislation are associated with smaller crisis-related losses of potential output and employment, respectively. This suggests that more flexible product and labour markets facilitate a reallocation of resources across firms and sectors in the aftermath of an adverse shock and so help to mitigate its consequences.

4. The remainder of the paper is organised as follows: Section 2 reviews multi-country studies which have been used to evaluate the medium-term output costs of previous financial crises; Section 3 describe the method used in the current study and presents the results of the analysis; Section 4 examines what pre-crisis macro and structural conditions and policies are correlated with the crisis hit to potential output.

2. A selective review of recent studies of the medium-term output losses following financial crises

5. While a number of studies have examined the immediate consequences of past financial crises, there are fewer that have focussed on the medium-term losses to output. The focus here is on 3 such studies (Cerra and Saxena, 2008; Mourougane and Furceri, 2009; and IMF, 2009), because differences between them are helpful in motivating the approach in the current paper as well as explaining differences in the results. While these studies are all relatively recent, they do not include an assessment of the effect of the current financial crisis.

6. The papers by Cerra and Saxena (2008) and Mourougane and Furceri (2009), hereafter referred to as CS and MF, form a natural comparison pair because both adopt a similar methodology, namely estimating an autoregressive panel model to explain GDP growth rates augmented by crisis dummies. The average effect of a crisis is then evaluated by calculating the impulse response function from the estimated
coefficients. There are, however, important differences between the two papers, most notably CS consider a much broader coverage of developing and developed countries and separately distinguish the effect of banking, currency and political crises, whereas MF focus on banking and currency crises and only consider OECD countries. Both in order to have a better basis for comparison across the two studies and because of the greater relevance to the estimates of the effect of the current crisis, we focus here only on a comparison of the effects of banking crises in high income countries in CS and the effect of the so-called ‘Big Five’ banking crises (Rheinhart and Rogoff, 2008) in MF. The results from the two studies are strikingly different even for what should be a similar set of crises, with the adverse effects more than 3½ times larger in CS compared to MF; thus after 10 years, CS estimate that banking crises in high-income countries reduce output by 15%, whereas MF estimate a reduction of nearly 4% for the ‘Big Five’ crises.

7. The large difference in these estimates is probably mostly due to the different dependent variables used in each of the studies; whereas CS use actual observed GDP growth rates, MF use potential output growth rates. Using actual GDP growth rates is likely to bias upwards implicit estimates of both the pre-crisis growth rate and the pre-crisis level of GDP which is sustainable, and hence lead to an exaggerated estimate of the post-crisis loss in output. This is because prior to a financial crisis, there is typically an extended period of above average growth, usually associated with a number of symptoms of overheating.

8. To illustrate the difference which using actual and potential GDP can make in establishing a counter-factual trend and hence to calculations of the medium-term output loss following a crisis, the example of OECD aggregate GDP over the recent crisis is considered. However, one important change which is made relative to the approach of both CS and MF, is that in common with the approach in the rest of the paper and in IMF (2009), the effect of the crisis is evaluated on GDP per capita rather than just GDP. This is a simple and intuitive improvement in modelling growth given that changes in population growth are likely to imply changes in trend GDP growth of a similar order of magnitude, independently of the incidence of crises. Not taking into account such effects risks attributing the effect of a slowdown in population growth to the effect of a crisis. Considering the start of the crisis to be 2008 (the bankruptcy of Lehman Brothers), for the purposes of this illustration a pre-crisis OECD trend growth rate is calculated as the average growth rate over the period 2000-07 of alternatively actual or potential OECD GDP per capita (Figure 1). Alternative post-crisis counter-factuels are then calculated by extending either actual or potential OECD GDP per capita from 2007 according to their respective pre-crisis growth rates, where potential output estimates are taken from the latest OECD Economic Outlook projections (OECD, 2014). The counter-factual based on actual GDP per capita is progressively higher than that based on potential output; the difference in 2007 is initially 3%, and after 10 years (the horizon used by both CS and MF) the difference is 5%. This difference in the counter-factual trend is likely to translate into a corresponding difference in estimates of the medium-term output loss.

9. The approach used in IMF (2009) is to calculate medium-term output losses relative to a pre-crisis trend calculated using actual GDP per capita, although it is acknowledged that estimating the pre-

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2. The ‘Big Five’ banking crises are Spain (1977), Norway (1987), Finland (1991), Sweden (1991) and Japan (1992). Judging from the source CS use to identify banking crises, namely Caprio and Klingebiel (2003), this corresponds with the “high-income” banking crises identified by CS.

3. For upper-middle income countries, CS estimate that banking crises reduce GDP after 10 years by about 12%.

4. Moreover, changes in population growth can have quantitatively important effects on GDP growth over the medium term horizons considered in this paper. For example in the case of Japan, the difference between the annual average population growth in the decade following the 1992 banking crisis compared to the decade preceding it, was about -0.2% per annum, which if cumulated over a decade would imply a difference in the level of GDP of 2%.
crisis trend is “tricky” particularly because of the problem of “insulating the analysis from the impact of any immediate pre-crisis boom or slump”. The method adopted by the IMF is to estimate a linear trend through the actual GDP series during a seven year pre-crisis period that ends 3 years before the onset of the crisis. While this approach has the merit of being transparent, it will not necessarily insulate the pre-crisis trend from any immediate pre-crisis boom if there is a protracted run-up prior to the financial crisis as typically seems to be the case (Borio, 2012). For example, applying the IMF methodology to the previous example of OECD GDP over the period of the current crisis (so calculating the pre-crisis trend over the period 1998-2005), leads to an even higher counter-factual trajectory for output and so an even larger medium-term output loss. The use of actual GDP to establish pre-crisis trends probably explains why the IMF findings of the medium-term output loss following a financial crisis are closer to those of CS than MF; for high-income countries the average reduction in GDP after 7 years is about 10%. Applying the IMF methodology to the current example of OECD aggregate GDP over the current financial crisis, and treating the most recent OECD projections as being realised, would give a similar result in 2015 (i.e. 7 years after the crisis) with a loss in medium-term output of just under 11%. However, this estimate is likely to be an exaggeration of the permanent output loss, not only because the pre-crisis trend in output may be exaggerated, but also because many countries are still currently operating well below capacity. Indeed, while it might be reasonable to assume that 7 years after a typical cyclical downturn GDP has returned to its medium-term trend, following a financial crisis the downturn is likely to be more protracted (see, for example, Haugh et al., 2009) and so this is less likely to be the case.

Figure 1. **OECD GDP per capita compared to various pre-crisis trends**

In 2005 PPP US dollars

![Graph showing OECD GDP per capita compared to various pre-crisis trends](image)

Note: OECD GDP per capita in 2014-15 is based on May 2014 OECD Economic Outlook projections.

Source: OECD calculations based on OECD Economic Outlook, May 2014 long-term database.

10. Both because of the difficulties of establishing a pre-crisis trend and because GDP in many OECD countries does not appear to have returned to trend and is not likely to do so in the next year or so, the estimates of medium-term output losses generated in the remainder of this paper are based on estimated

5. For IMF (2009), the 90 per cent confidence interval around the output loss after 7 years for high-income countries is roughly between 5% and 15%. The average output losses after 10 years for both low-income and middle-income countries are similar to the 10% estimate for high-income countries.
trends in potential output rather than actual output. However, as explained in more detail in the next section, the counter-factual used in the paper is not as crude as a simple extrapolation of the pre-crisis trend in potential output per capita (as used in Figure 1), but rather adopts different assumptions regarding different components of potential output. Using potential output does raise issues about the methodology of constructing potential output (described in Appendix 1), but these estimates do have the merit of following the same procedure across all countries and are subject to checking from country specialists.

3. Analysing the effect of the current crisis on potential output

3.1 Methodology

11. To derive the counter-factual post-crisis trajectory for potential output per capita, the pre-crisis growth rate in trend productivity is extrapolated, but the potential employment rate is treated differently, as explained below.

12. The current OECD method of estimating potential output, see Appendix 1 and Johansson et al., 2012 for details, assumes a Cobb-Douglas production function, which can be simplified so that potential output ($Y^*$) is represented in terms of potential employment ($N^*$), the capital stock ($K$) and labour-augmenting technical progress ($E^*$), so that:

$$y^* = \alpha (n^* + e^*) + (1 - \alpha) k,$$

where lower case letters denote logs and $\alpha$ is the wage share.

13. Potential output per head of population ($P$) can be explained in terms of two components: trend productivity and a potential employment rate, as follows:

$$\Delta(y^* - p) = \Delta(y^* - n^*) + \Delta(n^* - p).$$

For the purposes of the post-crisis counter-factual, the trend productivity component is extrapolated at the same average growth rate as over the pre-crisis period 2000-07. This trend productivity component can also be split into two components (each of which are assumed to follow their pre-crisis growth rate), which can be derived from combining (1) and (2), to give an effect from labour efficiency (or equivalently an effect from total factor productivity) and an effect from changes in capital per worker, represented as:

$$\Delta(y^* - n^*) = \alpha \Delta e^* + (1 - \alpha) \Delta(k - n^*).$$

6. A further illustration of the problem of using actual GDP to generate pre-crisis trends is that it can generate estimates of large output losses even when no crisis has occurred, because strong cyclical upswings are confused with strong pre-crisis trends. For example, applying the IMF (2009) methodology to Canada, France and the United Kingdom, but treating every single year over the period 1965-2000 as a potential “crisis”, gives 27 years in which output losses exceed 10%. However, according to the various sources used by all the studies referenced in this paper, none of these countries experienced a financial crisis over this period. While a majority of these large output losses occurred in the 1970s following the first oil shock, six episodes occurred during the 1990s.

7. A different approach to estimating the crisis-hit to potential output is to compare the projections of potential output made prior to the crisis with the most recent vintage of potential output projections (see Box 4.3 in (OECD, 2010a)). However, such an exercise becomes more difficult as historical data is revised, especially where this involves the introduction of a new system of national accounts. It is also difficult because the OECD changed its potential output methodology in 2011, so hindering any analysis of component effects.
A different assumption is adopted for the potential employment component (the second term in (2)), which can itself be split into three parts:

\[ \Delta(n^* - p) = \Delta(n^* - \text{lf}^*) + \Delta(\text{lf}^* - \text{pwa}) + \Delta(\text{pwa} - p), \]

where LF* is the trend labour force and PWA is the population of working age (here taken to be the population aged 15 to 74). Each of the three right-hand-side terms is treated in a different way as follows:

- The first term on the right-hand side of (3) corresponds to the change in the structural unemployment rate. For the purposes of projecting the counter-factual, the structural unemployment rate is assumed to remain at its pre-crisis (2007) level, hence the contribution from this term to the post-crisis counter-factual growth rate is zero.

- The second term corresponds to the change in the trend labour force participation rate. One possibility would be to hold the trend labour force participation rate constant, however this would not allow for the effect of changes in the demographic composition of the working-age population on the aggregate participation rate. One simple way of allowing for this would be to hold age- and gender-specific participation rates constant and then project the aggregate participation rate allowing for the evolving demographic structure of the population of working age. However, a drawback of such an approach is that it does not allow for social trends whereby each generation or cohort may have a different tendency to work than its predecessors, depending on socio-cultural factors but also individual characteristics, such as the level of education and number of children. Allowing for such effects is particularly important, for example, to capture the tendency for female participation to increase over time. Such effects are modelled here by holding the probability of entry and exit of the labour force for each age and gender cohort at its pre-crisis (2007) level. The evolution of the participation rate by age-gender cohort after 2007 is then influenced by what the same cohort did when younger. The counter-factual is then derived by aggregating across age-gender cohorts, although obviously it cannot take into account policy changes implemented after 2007.

- The final term captures an effect on the employment rate as the share of the population which is of working age changes. For most OECD countries, ageing populations mean that this share is declining and so acting as a drag on the employment rate. For the purpose of the post-crisis counterfactual, this term is set to its realised values and then extended with the most recent vintage of projections. The essential point is that this demographic effect is the same in the most recent estimate of potential output and in the counter-factual, so that it does not contribute to estimates of the hit from the crisis.

The effect of the crisis is then evaluated as the difference between the counter-factual trend and the latest estimates and projections of potential output consistent with the projections published in the May 2014 *OECD Economic Outlook*. This “crisis hit” to the level of potential output can then be decomposed into an effect on trend productivity (which can be sub-divided into effects from total factor productivity and from other sources).
productivity and capital per worker) and potential employment (which can be sub-divided into effects from structural unemployment rate and the trend participation rate).

3.2 Empirical results

16. Applying the method described above to individual OECD countries implies a reduction in aggregate OECD-wide potential output of about 2½ per cent in 2014 (Figure 2 and Table 1). There is, however, wide variation in the estimated effect of the crisis on individual countries. The estimated effect on the median OECD country is over 4% in 2014, because smaller countries have typically been hit harder than larger ones.

Figure 2. Estimated effects of the crisis on the potential output of OECD countries

Percentage reduction in potential output relative to a pre-crisis counter-factual scenario

Note: Estimated effects of the crisis are measured relative to a counter-factual scenario in which trend productivity continues at its pre-crisis (2000-7) trend growth rate, structural unemployment rates remain at their pre-crisis (2007) levels and trend participation rates are projected to allow for evolving demographics by holding labour force entry and exit rates constant at pre-crisis levels.

Source: OECD calculations based on OECD Economic Outlook, May 2014 long-term database.

17. The estimated impact of the crisis on individual OECD countries is heterogeneous and, especially for those most severely affected, is mostly explained by the loss in productivity (Table 1, Figure 3 and Figure 4). For the Czech Republic, Estonia, Greece, Hungary, Iceland, Ireland and Slovenia, the estimated negative impact of the crisis is above 10%, mostly reflecting lower trend productivity. Lower productivity is both a result of lower tfp and lower capital per worker, with the former typically being more

11. Turkey has been excluded from the calculation of the OECD aggregate, median and quartiles, although the results for Turkey are shown in Table 1. The reason for this exclusion is that a comparison with the counter-factual suggests the crisis has led to a massive improvement in trend participation which boosts potential output for Turkey by about 10 percentage points. However, this surge in participation is largely policy-related rather than a consequence of the crisis. In particular, substantial job creation incentives in favour of disadvantaged groups (youth and women) were very successful, particularly in a context where female participation was initially very low (OECD, 2010b). On the other hand the crisis may have had some effect on boosting female participation as a response to one-earner households facing job and/or income losses.

12. The positive productivity effect for Spain may seem surprising, but this probably reflects the consequence of a shift of production away from construction where productivity is low.
important. The decline in capital per worker accounts for more than 3 per cent of the decline in potential output in 2014 for Estonia, Greece, Iceland, Hungary, Korea and Portugal, with these countries also being among those in which the pre-crisis growth of capital per worker was most rapid.

Table 1. Estimated effects of the crisis on the potential output of OECD countries in 2014

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage reduction relative to a pre-crisis counter-factual scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Productivity</td>
<td>TUR</td>
</tr>
<tr>
<td>(1a) Capital/worker</td>
<td>-0.4</td>
</tr>
<tr>
<td>(1b) Total factor productivity</td>
<td>-3.4</td>
</tr>
<tr>
<td>(2) Employment</td>
<td>10.2</td>
</tr>
<tr>
<td>(2a) Labour force participation</td>
<td>10.3</td>
</tr>
<tr>
<td>(2b) Structural unemployment</td>
<td>-0.1</td>
</tr>
<tr>
<td>(3) Total Hit</td>
<td>7.5</td>
</tr>
</tbody>
</table>

Notes: Estimated effects of the crisis are measured relative to a counter-factual scenario in which trend productivity continues at its pre-crisis (2000-7) trend growth rate, structural unemployment rates remain at their pre-crisis (2007) levels and trend participation rates are projected to allow for evolving demographics by holding labour force entry and exit rates constant at pre-crisis levels.

Row (3) = Row (1) + Row (2); Row (1) = Row (1a) + Row (1b); Row (2) = Row (2a) + Row (2b).

Source: OECD calculations based on OECD Economic Outlook, May 2014 long-term database.

Figure 3. Contributions to the crisis hit on potential output for individual OECD countries

Percentage point difference in 2014, relative to the counter-factual

Source: OECD calculations based on OECD Economic Outlook, May 2014 long-term database.
18. The contribution of lower potential employment to the crisis hit is typically much smaller, although this contribution is more than 4 percentage points for Iceland, Ireland, Greece, Portugal, Spain and Slovenia. For Greece, Portugal and Spain most of this effect is explained by a rise in structural unemployment.

Figure 4. Estimated effects of the crisis on the components of potential output
Breakdown by components, deviation from the baseline

Note: Each of the components relate to their potential, i.e. cyclically-adjusted, levels.
Source: OECD calculations based on OECD Economic Outlook, May 2014 long-term database.

19. For the majority of OECD countries, trend participation rates have held up remarkably well when assessed against the counter-factual; for the median country trend participation is marginally higher than the counter-factual (Figure 4) (which, playing by the rules of the analysis, implies a positive effect of the crisis on participation). This might be compared with the effect of previous severe downturns in OECD countries, which have been estimated to typically reduce participation rates by 1½ to 2½ percentage points over the medium term (Duval et al, 2011). The more resilient response from participation in the current crisis reflects policy reforms which increase incentives to work at older ages, including pension reforms, the phasing out of early retirement schemes and the tightening of eligibility criteria for other social transfer schemes that operated as de facto early retirement schemes (OECD, 2013). It is also possible that

13. Two countries, Turkey and Poland, stand out in Table 1 as having an apparently large positive effect on participation from the crisis in a mechanical comparison with the counter-factual. Clearly in both cases this effect is mostly policy-related and not a direct cause of the crisis. The case of Turkey was discussed in a previous footnote. In the case of Poland, the strong rise in participation relative to the counterfactual, which
declines in the value of defined-contribution pensions due to falls in equity prices have encouraged workers to postpone retirement. Nevertheless, there are some countries where the decline in the participation rate has substantially contributed to the negative effect of the crisis on potential output, mostly in countries where the increase in structural unemployment has been greatest. Thus, the adverse effect of the crisis is estimated to have subtracted between 2 and 4½ percentage points from potential output in 2014 for Iceland, Ireland, Greece, Slovenia and Spain.

20. The large fall in labour force participation in the United States since the start of the crisis is worth highlighting because there has been much discussion about the extent to which this is cyclical or explained by demographic or other trend factors. In terms of the most recent Economic Outlook projections, the participation rate for the age group 15-74 is projected to fall by about 3½ percentage points between 2007 and 2014, with about 1½ percentage points of this explained by cyclical factors and the remainder by a fall in the trend participation rate. In terms of the analysis presented in this paper, this fall in the trend participation rate is nearly all explained by demographic factors and so coincides closely with the counter-factual and hence virtually none of the fall in the trend participation rate is attributed to the crisis.

4. Relating the crisis hit to potential output with pre-crisis conditions

21. This section attempts to cast light on the cross-country diversity of the hit to potential output, by examining which pre-crisis conditions are correlated with it. A similar exercise was undertaken by IMF (2009) in explaining medium-term output losses from previous financial crises (but excluding the present one) and thus provides a basis for comparison.

22. For the purpose of the current paper, the crisis hit in 2014 (row (3) in Table 1) is regressed on a range of variables summarising pre-crisis conditions relating to the macro conjuncture, indebtedness, pre-crisis trend growth and structural settings (Table 2). As the sample is relatively modest (at most 34 OECD countries), each explanatory variable was tested separately and then with only the addition of a control variable. The level of the output gap in 2007 is used as a control variable; it is statistically significant in nearly all cases and negatively signed, implying that those countries which were overheating more prior to the crisis tended to be those which experienced bigger losses in potential output.

23. In terms of the pre-crisis macroeconomic conjuncture, larger current account deficits and high inflation are both correlated with larger potential output losses. High levels of pre-crisis investment or housing investment as well as low real interest rates are also correlated with potential output losses, but only if the output gap control variable is omitted. However, the pre-crisis fiscal balance is not found to be significant in explaining potential output losses. These results are broadly similar to the findings of IMF (2009), which found that high investment, large current account deficits, high inflation (relative to an historical average) all helped to explain cross-country differences in medium-term output losses from past financial crises. Overall, this provides support to arguments that macroeconomic policy should be

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14. See, for example, Erceg and Levin (2013) and Van Zandweghe (2012) for alternative views on the relative importance of demographic/trend and cyclical factors explaining the fall in US participation.

15. If, instead, all of the fall in the trend participation rate since 2007 was attributed to the crisis then the estimated effect of the crisis on US potential output would rise from 2½ to 5 percentage points in 2014.
concerned with financial developments over and above their immediate implications for inflation and fiscal balances.

24. The extent of total pre-crisis total economy indebtedness, either in terms of low net worth or high external debt, is correlated with the loss in potential output, as is more (more weakly) household net worth, but not government debt and. These results confirm the findings of Sutherland and Hoeller (2013) in suggesting that a high level of debt creates weaknesses and vulnerabilities that both amplify shocks and limit countries scope to react during a crisis.

25. The pre-crisis trend growth rate is not a useful predictor of subsequent output losses, however faster growth in the pre-crisis capital-per-worker component is correlated with larger post-crisis potential output losses (and is the only component which is so). These results, together with those that link the scale of output losses to indebtedness and other variables associated with financial excesses, suggest that underlying the potential output losses is a substantial misallocation of resources in the pre-crisis boom, especially capital but also labour, as well as the adverse effect of debt and capital overhangs during the bust (see Borio (2013) for a discussion of typical balance sheet recessions). By the same token, the pre-crisis potential growth rate is likely to have been exaggerated by the boost to productivity from rapid capital accumulation, which was never likely to be sustained and so some fall in potential output relative to the pre-crisis trend was inevitable.

26. Flexible labour and product markets are associated with smaller crisis-related losses in potential output and employment, which may be because this allows a more easily reallocation of resources across firms and sectors in the aftermath of an adverse shock. Thus, countries with more competition-friendly product market regulation experienced smaller losses in potential output; a difference in the OECD’s PMR indicator by one standard deviation being associated with a difference in output losses of 2½ percentage points. Additionally, there is some evidence to suggest that losses in potential employment in 2014 are correlated with the level of employment protection legislation prior to the crisis (Table 3), which is similar to the findings of IMF (2009). On the other hand, while trade openness and financial openness may be related to the international transmission of shocks, only trade openness is weakly correlated with medium-term output losses. \(^\text{16}\)

\(^{16}\) IMF (2009) has a contrary finding that greater financial openness is associated with smaller output losses, although the evidence is described as “weak”
Table 2. The relationship between the loss in potential output and pre-crisis conditions

<table>
<thead>
<tr>
<th>Pre-crisis macro conjuncture</th>
<th>Standard dev. of explanatory variable</th>
<th>Coefficient</th>
<th>Output gap, 2007</th>
<th>Adj. R2</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fiscal balance, 2007, % of GDP</td>
<td>4.4</td>
<td>0.147</td>
<td>-1.704</td>
<td>***</td>
<td>0.50</td>
</tr>
<tr>
<td>Current account balance, 2007, % of GDP</td>
<td>7.3</td>
<td>0.295</td>
<td>-1.346</td>
<td>***</td>
<td>0.56</td>
</tr>
<tr>
<td>Real interest rate, average 2003-2007</td>
<td>2.3</td>
<td>1.474</td>
<td>-1.568</td>
<td>***</td>
<td>0.46</td>
</tr>
<tr>
<td>Housing investment, % of GDP (^1)</td>
<td>1.8</td>
<td>-0.385</td>
<td>-1.127</td>
<td>*</td>
<td>0.27</td>
</tr>
<tr>
<td>Total investment, % of GDP (^1)</td>
<td>2.7</td>
<td>-0.379</td>
<td>-1.374</td>
<td>***</td>
<td>0.43</td>
</tr>
<tr>
<td>CPI inflation, 2003-07, % points</td>
<td>1.2</td>
<td>-2.630</td>
<td>-1.485</td>
<td>***</td>
<td>0.55</td>
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</table>

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<tbody>
<tr>
<td>Gross government debt</td>
<td>-0.023</td>
<td>-1.773</td>
<td>***</td>
<td>0.50</td>
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<tr>
<td>Net government debt</td>
<td>-0.006</td>
<td>-1.716</td>
<td>***</td>
<td>0.49</td>
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<tr>
<td>Net foreign debt</td>
<td>-0.036</td>
<td>-1.457</td>
<td>***</td>
<td>0.56</td>
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<tr>
<td>Net worth, total economy</td>
<td>0.034</td>
<td>-1.408</td>
<td>***</td>
<td>0.57</td>
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<tr>
<td>Net worth, household</td>
<td>0.016</td>
<td>-1.488</td>
<td>***</td>
<td>0.51</td>
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<table>
<thead>
<tr>
<th>Pre-crisis structural conditions</th>
<th>Coefficient</th>
<th>Output gap, 2007</th>
<th>Adj. R2</th>
<th>Observations</th>
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</thead>
<tbody>
<tr>
<td>Product Market Regulation, 2008 (^2)</td>
<td>-7.963</td>
<td>-1.456</td>
<td>***</td>
<td>0.57</td>
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<tr>
<td>Trade openness, 2007 (^3)</td>
<td>-0.007</td>
<td>-1.642</td>
<td>***</td>
<td>0.47</td>
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<tr>
<td>Financial openness, 2007 (^4)</td>
<td>0.001</td>
<td>-1.632</td>
<td>***</td>
<td>0.49</td>
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<tbody>
<tr>
<td>Potential output per capita growth rate</td>
<td>0.625</td>
<td>-1.835</td>
<td>***</td>
<td>0.48</td>
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<tr>
<td>Trend labour efficiency growth rate</td>
<td>0.379</td>
<td>-1.750</td>
<td>***</td>
<td>0.47</td>
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<tr>
<td>Potential employment growth rate</td>
<td>1.589</td>
<td>-1.688</td>
<td>***</td>
<td>0.51</td>
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<tr>
<td>Capital per worker growth rate</td>
<td>-1.014</td>
<td>-1.288</td>
<td>***</td>
<td>0.55</td>
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</tbody>
</table>

Notes: The table reports regression results where the dependent variable is the estimated percentage point effect of the crisis on potential output in 2014, taken from row (3) of Table 1, so for most countries it has a negative sign. For each of the explanatory variables, listed in the first column, two regressions are run: the first (in the upper row) also includes the pre-crisis output gap as a control variable; the second regression (in the lower row) excludes the output gap variable. Statistical significance at the 1, 5 and 10 per cent level is denoted by ***, **, and *, respectively.

(1) Nominal housing and total investment as a percentage of GDP are measured as the difference between their averages over 2003-07 compared to 1980-2007.
(2) A lower value of the Product Market Regulation indicator implies more competition-friendly regulation (see OECD (2014b) for more details).
(3) Trade openness is defined as the sum in 2007 of exports and imports divided by GDP.
(4) Financial openness is defined as the sum in 2007 of liabilities and assets divided by GDP.

Source: Authors’ calculations based on OECD Economic Outlook, May 2014 long-term database.
Table 3. The relationship between the loss in potential employment and Employment Protection Legislation

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<tbody>
<tr>
<td>0.6</td>
<td>-2.6809</td>
<td>**</td>
<td>-0.2481</td>
<td>**</td>
<td>0.13</td>
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</table>

Notes:
The dependent variable is the estimated percentage point effect of the crisis on potential employment in 2014, taken from row (2) of Table 1. The EPL indicator summarises the strictness of employment protection for individual and collective dismissals (regular contracts) and is described in OECD(2013). Statistical significance at the 1, 5 and 10 per cent level is denoted by ***, **, and *, respectively.

Source: Authors’ calculations based on OECD Economic Outlook, May 2014 long-term database.
APPENDIX 1. THE OECD METHODOLOGY FOR GENERATING POTENTIAL OUTPUT

Potential output ($Y^*$) for the whole-economy is assumed to be determined by a Cobb-Douglas production function with constant returns to scale and factor inputs of physical capital ($K$), human capital ($H$) and potential employment ($N^*$), with technical progress of the Harrod-neutral labour-augmenting form, hereafter referred to as ‘trend labour efficiency’ ($E^*$):

$$y^* = \alpha (h + n^* + e^*) + (1 - \alpha) k,$$

where lower case letters denote logarithm and $\alpha$ is the wage share.

Each component is estimated and projected separately using different techniques.

The physical capital stock is defined in terms of the non-housing productive capital stock. It corresponds to the accumulation of past non-housing investment flows, taking into account that the efficiency of assets typically falls as its life expectancy diminishes (Schreyer, 2003) and can be expressed as:

$$K_t = K_{t-1} (1 - r_t) + I_t,$$

where $r$ is the implicit rate of loss of productive capacity, and $I$ is the non-housing investment flow. When available, historical data is extracted from the OECD Productivity Database. Otherwise a starting point for the capital output ratio is estimated based on average investment rate over the previous ten years and a loss rate at 4 per cent. The projected capital stock is built up from short-term projections of investment consistent with the Economic Outlook projections.

Human capital is derived from empirical estimates of the return to average years of schooling with falling marginal returns at higher level of education as in Morrison and Murtin (2010). The resulting human capital series is smoothed using an Hodrick-Prescott filter to better reflect the trend evolution of the variable.

Potential employment is computed as the combination of structural unemployment rate (NAIRU), the working-age population (POP1574) and the trend participation rate (LFPRS):

$$N^* = LFPRS \times POP1574 \times (1 - NAIRU)$$

The NAIRU is estimated using a reduced form Philips-curve by means of a Kalman filter (see Guichard and Rusticelli, 2011). Beyond the estimation period the NAIRU is usually held constant, except where there is evidence that policy reforms may have an influence or where projections imply large changes in long-term unemployment, in which case rules-of-thumb and judgement are used to revise the projection.

The working-age population is defined as the population age between 15 and 74. The data is sourced from either Eurostat (for EU countries) or United Nations (for other countries).

The trend participation rate for the population age 15 to 74 is computed in a two-step stage. First a reduced-form equation for the actual participation rate has been estimated for each country using the unemployment gap and time trends, and the predicted values from this equation when the unemployment gap is closed are used to remove economic cycles from the actual participation rate. The resulting
The trend participation rate is then smoothed with a Hodrick-Prescott filter to obtain the trend participation rate. The trend participation rate is projected using a cohort model described in Johansson et al. (2012).

Labour efficiency is defined as the residual of the production function. Hence an initial (unsmoothed) estimate of labour efficiency is calculated using the Cobb-Douglas production function in (1) but using actual GDP in place of \( Y^* \) and actual employment in place of potential employment. Beyond a Hodrick-Prescott filter is then applied to this unsmoothed labour efficiency to provide an estimate of the trend labour efficiency. To project labour efficiency as well as to reduce end-point problems associated with using an HP-filter, data on GDP and factor-inputs is extended with short-term forecasts of these variables. Beyond a two year horizon, labour efficiency is projected using a conditional convergence model described in Johansson et al. (2012).

One simplification which is made in the main paper is to combine the human capital and trend labour efficiency component into a single component which is referred to as labour efficiency.
BIBLIOGRAPHY


