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THE EFFECT OF FINANCIAL CRISES ON POTENTIAL OUTPUT: NEW EMPIRICAL EVIDENCE FROM OECD COUNTRIES

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ABSTRACT/RÉSUMÉ

The effect of financial crises on potential output: new empirical evidence from OECD countries

The aim of this paper is to assess the impact of financial crises on potential output. For this purpose a univariate autoregressive growth equation is estimated on an unbalanced panel of OECD countries over the period 1960 to 2007. Our results suggest that the occurrence of a financial crisis negatively and permanently affects potential output. In particular, financial crises are estimated to lower potential output by around 1.5 to 2.4% on average. The magnitude of the effect increases with the severity of the crisis. The occurrence of a deep crisis is found to decrease potential output by nearly 4%, almost twice the amount observed for the average of crises. These results are robust to the use of an alternative measure of potential output, changes in the methodology and in the sample periods.

JEL: E6; H10

Keywords: Financial crisis; Potential output

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**L'effet des crises financières sur la production potentielle:
nouvelle analyse empirique sur les pays de l'OCDE**

L'objectif de ce papier est d'estimer l'effet des crises financières sur la production potentielle. A cette fin, une équation de croissance univariée est estimée sur un panel non cylindré de données sur les pays de l'OCDE sur la période 1960-2007. Nos analyses suggèrent que l'occurrence d'une crise affecte négativement et de façon persistante la production potentielle. En particulier, les crises financières diminueraient d'après nos estimations la production potentielle d'environ 1.5 à 2.4% en moyenne. L'amplitude de cet effet augmente avec la sévérité de la crise. L'éclatement d'une crise profonde est estimé réduire la production potentielle d'un peu moins de 4%, presque deux fois la taille de l'effet moyen observé sur les crises. Ces résultats sont robustes à l'utilisation d'une mesure alternative de la production potentielle, à des changements dans la méthodologie et dans la période d'estimation.

JEL : E6; H10

Mots clés : Crise financière ; Production potentielle

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THE EFFECT OF FINANCIAL CRISES ON POTENTIAL OUTPUT: NEW EMPIRICAL EVIDENCE FROM OECD COUNTRIES

By Davide Furceri and Annabelle Mourougane[1]

1.   Introduction

1.   The ongoing financial crisis is unprecedented in magnitude and its implications on the real economy are expected to last for some years. While most of the public debate has focused on assessing the short-term output loss and on finding the appropriate policy responses to counter the economic downturn, the possible long-term implications of the crisis have not been investigated much.[2] In particular there is very little evidence in the economic literature on the impact of financial crises on potential output, where the latter is defined as the level of output consistent with price stability. One main reason for this lack of evidence is that potential output is not directly observable. Still, potential output and the output gap play a preponderant role in informing policy makers about the current state of the economy as well as that of public finances. Ignoring how potential output is affected by the financial crisis could lead to mis-judgement of the size of the output gap and, as happened in the past, to major policy errors (Orphanides *et al.,* 2000).

2.   Against this backdrop, this paper seeks to estimate the impact of financial crises on potential output for a panel of 30 OECD economies from 1960 to 2007. Given the scarcity of crisis occurrences within the OECD area, the objective is to find an average rather than a country-specific estimate. In addition, the analysis incorporates some of the effects of the current crisis.

3.   The rest of the paper is structured as follows: Section 2 summarises the expected impacts of financial crises on the main determinants of potential output, the latter being constructed using a production function approach. Section 3 describes the empirical approach applied throughout the paper. Section 4 focuses on the results for two measures of potential output, a production-function based measure and a Hodrick-Prescott measure, and presents several robustness tests. Finally, Section 5 concludes and draws some policy implications.

2.   Expected effects of crisis on potential output

4.   A financial crisis can impact potential output through various direct and indirect channels. Direct effects are visible on all the elements of the production function, namely labour and capital inputs and total factor productivity:

- Financial crises lower incentives to invest in capital by decreasing demand for products and raising uncertainty on investment returns and risk premia (Pindyck, 1991; Pindyck and Solimano, 1993). In addition, firms may have to cope with less advantageous investment financing conditions due to tighter lending standards in the form of an increasing real cost of borrowing and/or limited credit supply.

- By weakening the labour market situation, financial crises can lead to an increase in the structural unemployment rate, through hysteresis effects (Ball, 2009). This is particularly the case for economies with rigid labour market institutions. Interaction between institutions can accentuate the rise in the structural unemployment (Blanchard and Wolfers, 2000; Bassanini and Duval, 2006).

- The effect of crises on labour force participation rates is in theory ambiguous, as two competing effects are at play. Indeed, the loss of income can encourage second-income earners to look for a job and to enter the labour force (additional worker effect). At the same time, the high unemployment rate may discourage workers to search for a new position (discouraged worker effect). Some of them will exit the labour force to invest in human capital accumulation (Martin and Roger, 1997 and 2000). Evidence from the literature suggests that discouraged worker effect can be significant (Pichelman and Elmeskov, 1993), although there is also evidence that the encouraged worker effect can be also important, in particular for females (Debelle and Vickery, 1998).

- The effect on total factor productivity is *a priori* uncertain. On the one hand, spending in innovation is procyclical and is likely to be massively reduced at times of crisis, lowering total factor productivity. Higher risk premia are also likely to affect R&D spending. On the other hand, firms may have stronger incentives to restructure and/or improve their x-efficiency in periods of crisis to limit their losses.

5.   In addition, a financial crisis can change potential output through indirect effects. Indeed crises usually trigger policy responses from public authorities to cushion the economic downturn (Reinhart and Rogoff, 2009). Stabilisation policies can sometimes have long-term effects. On the one hand, investment in infrastructure is likely to boost potential output. On the other hand, other policies can be detrimental to long-term growth when they introduce distortions or encourage excessive risk-taking. At the same time, temporary fiscal measures can lead to permanent increase in government size and in debt levels, which in turn will have negative effects on growth (Afonso and Furceri, 2008). Finally, the final impact of policies depends on the nature and the design of the specific measures. Financial crises can also foster the implementation of structural reforms that can in turn enhance potential output, by moderating political opposition to reforms (Høj *et al.*, 2006).

6.   Overall, the sign and the amplitude of the effect of financial crises on potential output is an empirical question. Given that the majority of mechanisms listed above are likely to reduce potential output, the suspicion is strong that the final effect will be negative. An approach based on events studies suggests that the evidence of the effect of crises on potential output is mixed (Haugh *et al.*, 2009).

3.   Empirical methodology

7.   The methodology used in this paper to assess the impact of financial crises on potential output follows Cerra and Saxena (2008).[3] It consists of estimating an univariate autoregressive growth equation and to derive the relative impulse response functions (IRFs):

$$g_{it} = a_i + \sum_{j=1}^{4} \beta_j g_{i,t-j} + \sum_{j=0}^{4} \delta_j D_{i,t-j} + \varepsilon_{it} \tag{1}$$

where g is the annual growth rate of potential GDP, D is a dummy variable which is equal to 1 at the start of a financial crisis, and a_i are country fixed effects.

Equation 1 was estimated on an unbalanced panel of annual observations from 1960 to 2008 for 30 OECD economies.

8.   The number of lags has been restricted to 4, but the presence of additional lags was rejected by the data. As financial crises are proxied by a dummy, the effect captured also encompasses the policy reaction triggered by the crisis and its consequences on the real economy. However, it is not easy to disentangle the pure crisis effect from the policy response, given the absence of a counterfactual.

9.   Obtaining a reliable measure of potential output is fraught with difficulty. Many methods, ranging from statistical filters to structural methods, have been used but each of them presents advantages and drawbacks (Cotis *et al.*, 2005). Many of the measures of potential output include some filtering element which, to the extent it involves a two-sided filter is likely to underestimate the impact of the crisis. In this paper, data for potential output growth rates are taken from the OECD Economic Outlook database, where potential output is derived from a production function approach (Beffy *et al.*, 2006). A Hodrick-Prescott measure has also been used to check the robustness of the results.

10.   Financial crises dates are taken from Laeven and Valencia (2008) and correspond to the starting date of currency and banking crises which occurred over the period 1960 to 2007. The current financial crisis is included in the dataset and coded as starting in 2007.

11.   Impulse response functions (IRFs) are obtained by simulating a shock on the crisis dummy[4]. The shape of these response functions depends on the value of the δ and β coefficients, the coefficients associated with the financial crisis dummy and past potential output growth. For instance, the simultaneous response will be δ_0, the one-year ahead cumulative response will be $\delta_0 + (\delta_1 + \beta_0 \delta_0)$. The significance of the results is assessed by computing 99% level confidence bands derived from Monte-Carlo simulations. This is more stringent than what was is usually assumed in the literature where confidence bands are most of the time derived at a 95% confidence level.

12.   Finally, it is important to stress that since our dependent variables are non-observable, the regression residuals can be thought of as having two components. The first component is sampling error (the difference between the true value of the dependent variable and its estimated value). The second component is the random shock that would have been obtained even if the dependent variable was directly observed as opposed to estimated. This would lead to an increase in the standard deviation of the estimates, which would lower the t-statistics. This means that any correction to the presence of this un-measurable

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3.   Cerra and Saxena (2008) apply this methodology to actual real GDP. This approach was originally developed by Romer and Romer (1989) to analyse the long term impact of monetary policy on output. It was subsequently applied by Romer and Romer (2007) and Furceri and Karras (2009) to examine the impact of a tax cut on long-term output.
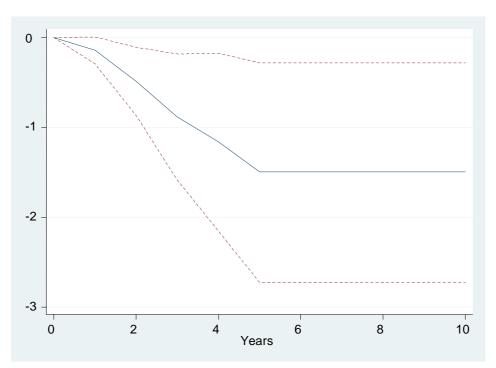
4.   In practice, D_t is set equal to 1 for only one period and assumed to be equal to 0 otherwise.

error term will increase the significance of our estimates. Related to this problem would be the possibility of heteroskedasticity. In most of our estimations heteroskedasticity turns out not to be a problem. When it does, we correct for that using White standard errors.

4. Results

4.1 Baseline

13. The methodology is first applied to the production-function measure of potential output using OLS estimates (Figure 1). On average, a financial crisis is found to lower permanently the level of potential output by 1.5 %. The results are significant at a 99% confidence level and point to a negative impact of financial crises on the level of potential output in the short and long run.[5]

Figure 1. **The effect of financial crises on potential output: production function and OLS**

Note: The solid line is the IFRs derived from equation 1. The dotted lines are the upper and lower bound of the 99% confidence band.

14. The question is whether these results still hold with alternative measures of potential output, as the latter can be derived from a large variety of methods. Applying the methodology to a Hodrick-Prescott

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5 . The coefficient δ_0 plays an important role in the shape of the IFRs as it determines the depth of the short-term impact but also influences the impact in the periods ahead. Imposing the restriction that financial crises dampen output only with a lag by setting $\delta_0 = 0$, would alter the shape of the IFRs, but financial crises would continue reduce potential output both in the in the short and in the long run. At the same time, the magnitude of output loss would be unsurprisingly diminished. Under this scenario the effect of a financial crisis occurrence on potential output would be around 0.5 %, which is considerably smaller than the loss observed when financial crises have a coincident effect on potential output

filter measure of potential output[6], the long-term effect of financial crisis is found to be slightly larger than with the production-function measure, at 2.1% (Figure 2). The width of the confidence band is slightly larger. But the results are not fundamentally different, in light of the already large uncertainty surrounding potential output estimates.
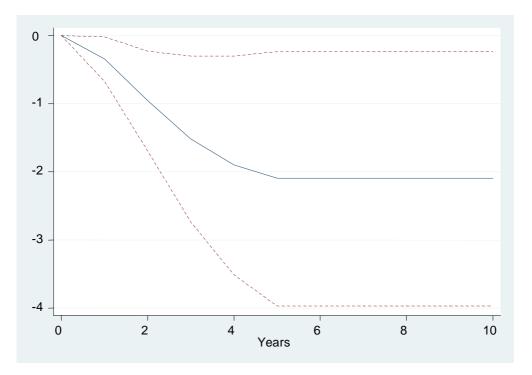
Figure 2. **The effect of financial crises on potential output: Hodrick-Prescott measure**

Note: The solid line is the IFRs derived from equation 1. The dotted lines are the upper and lower bound of the 99% confidence band.

4.2 *Endogeneity*

15. The potential endogeneity of financial crises is a critical issue and should be corrected for when assessing the impact of the crisis. Indeed, it could be argued that at least on some occasions, structural economic weaknesses as reflected by low contemporaneous and past values of potential output have favoured the occurrence of crises. The exogeneity assumption of financial crisis, under which the OLS-based estimates presented above will be unbiased, thus needs to be empirically tested. This is done by estimating a probit model which expresses the probability of a crisis occurrence as a function of past potential output growth rates:

$$Prob(D_{it} = 1) = F\left(constant + \sum_{j=1}^{4} \beta_j g_{i,t-j} + \sum_{j=1}^{4} \delta_j D_{i,t-j} + \omega_{it}\right) \qquad (2)$$

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6. Following Ravn and Uhlig (2002), the smoothness parameter has been set to 6.25. It should be noted that the HP measure of the potential output is not fundamentally different from the OECD production function measure, which uses as inputs HP filtered-series for total factor productivity and capital services. It differs nonetheless in the sense that the filter is applied after aggregation and that the smoothness parameter is different.

16.   The results reported in Table 1 suggest that lagged potential GDP growth rates (as well as lagged financial crises) do not explain the occurrence of financial crises. The assumption of exogeneity of the financial crisis dummy to potential output growth rates thus appears to be valid.

17.   Moreover, as an additional robustness check, equation 1 has been re-estimated using the Generalised Method of Moments (GMM) developed by Blundell and Bond (1998). The associated impulse response function points to an almost identical impact than those obtained with OLS (Figure 3). This again signals that the OLS estimates are free from endogeneity biases.

Table 1. **Probit model of the effect of past growth on the probability of financial crisis**

Crisis (-1)	-	-	-	-	-0.388 (-0.89)
Crisis (-2)	-	-	-	-	0.533 (1.26)
Crisis (-3)	-	-	-	-	-6.991 (-0.00)
Crisis (-4)	-	-	-	-	-6.395 (-0.00)
Potential growth (-1)	0.030 (0.64)	0.127 (0.69)	0.278 (1.30)	0.359 (1.45)	0.416 (1.63)
Potential growth (-2)	-	-0.093 (-0.50)	-0.471 (-1.29)	-0.563 (-1.26)	-0.621 (-1.36)
Potential growth (-3)	-	-	0.230 (1.02)	0.104 (1.25)	0.059 (1.14)
Potential growth (-4)	-	-	-	0.150 (0.63)	0.203 (0.83)
Number of observations	888	858	828	798	798

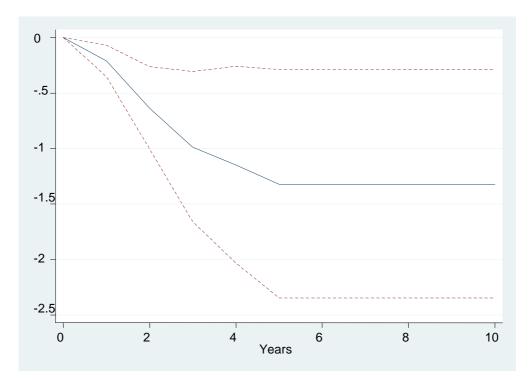*Note*:   z- statistics in parenthesis

Figure 3. **The effect of financial crises on potential output: GMM**

Note: The solid line is the IFRs derived from equation 1. The dotted lines are the upper and lower bound of the 99% confidence band.

4.3   *Omitted Variables*

18.   Another possible source of bias is the omission of non-financial crisis shocks which could affect potential output. To tackle this issue, the equation has been re-estimated using time fixed effects to control for time specific shocks common among countries and oil prices to control for oil price shocks following Cerra and Saxena (2008) (Figure 4)[7]. Both variables are found to be significant. However, their inclusion does not fundamentally modify the results: financial crises continue to dampen significantly potential output in the short and long term. The average long-term impact of crises on potential output is slightly stronger, amounting to more than 2%[8].

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7.   We acknowledge that oil shocks could be endogenous. However, we got almost identical results using lags of oil prices instead of current values, or instrumenting oil prices with its past lags.

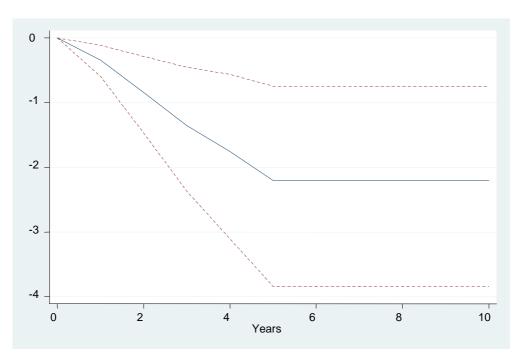8.   This suggests that the occurrence of the crisis is weakly correlated with other time and oil shocks.

Figure 4. **The effect of financial crises on potential output: Additional controls**

Note: The solid line is the IFRs derived from equation 1. The dotted lines are the upper and lower bound of the 99% confidence band.

4.4 *Estimates for severe financial crises*

19. The results presented so far have shown that on *average* financial crises has a significant and persistent effect on potential output. However, output losses are likely to vary with the severity of the crisis, both in terms of depth and duration, implying that an average estimate would overestimate the impact of "small" financial crises and underestimate those of "large" ones.

20. This assumption can be empirically tested by restricting the analysis to the so-called *Big Five* crises which have been classified as being very severe by Reinhart and Rogoff (2008).[9] These include the following episodes: Spain (1977), Norway (1987), Finland (1991), Sweden (1991), and Japan (1992). [10] Severe crises are estimated to have a much more pronounced impact on potential output than the average of all financial crises (Figure 5). In particular, the occurrence of a deep crisis is found to decrease potential output by nearly 4%, almost twice the amount observed for the average of crises.

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9. It was not possible to use a variable that would summarise the depth and the duration of the crisis, the main reason being that such a variable is likely to be highly endogenous with respect to potential GDP growth.

10. The previous analysis is repeated assuming D_i=1 for Spain (1977), Norway (1987), Finland (1991), Sweden (1991), and Japan (1992), and zero otherwise.
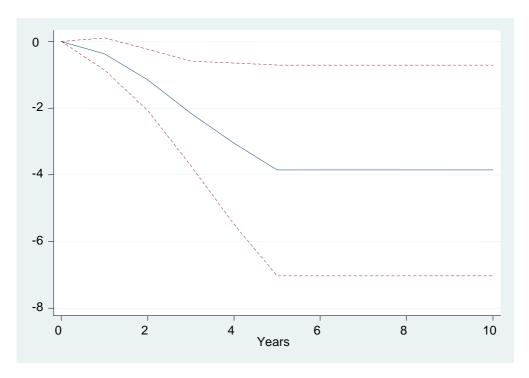
Figure 5. **The effect of financial crises on potential output: severe crises**

Note: The solid line is the IFRs derived from equation 1. The dotted lines are the upper and lower bound of
         the 99% confidence band.

4.5   *Time Sample*

21.   Although the current crisis started in 2007, its effects are still ongoing and can be only partially
captured. It is thus important to assess to what extent the last few observations influence the results. This is
evaluated by excluding the last two years from the sample. Estimates are broadly consistent with what was
previously found, but the effect of financial crises on potential output appears to be somewhat
underestimated when the ongoing financial crisis is included. Indeed, by incorporating only incomplete
information on the current crisis, we implicitly underestimate its actual effect on potential output and as a
result lower the average effect (Figure 6). The correction is however not large in particular with regard to
the difference existing between all and severe crises, and does not invalidate the results obtained
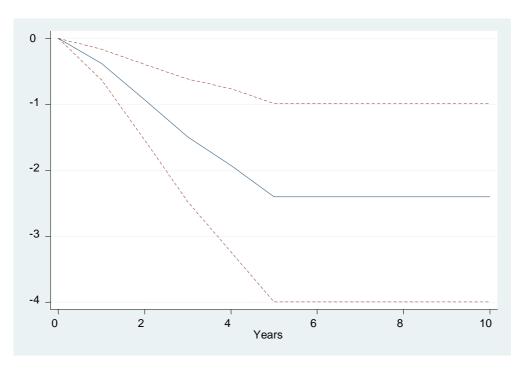precedently.

Figure 6. **The effect of financial crises on potential output: Before 2007**

Note: The solid line is the IFRs derived from equation 1. The dotted lines are the upper and lower bound of the 99% confidence band.

5.   Conclusion and policy implications

22.   This paper casts some light on the impact of financial crises on potential output. It is found that financial crises have a negative and persistent effect on potential output. The amplitude of the long-term effect lies in general between 1.5 to 2.4%, but a much more pronounced effect is observed for deep and severe financial crises (Table 2). Although the methodology and results appear robust to a number of tests, their main limitation is that they estimate an average impact. As it stands, the framework and the scarcity of crisis dates does not allow the analysis to differentiate the impact by country, nor to interact the effect of the crisis with structural policy indicators.

23.   These findings have, nonetheless, direct policy implications and point to the necessity for reliable estimates of the effects of financial crises on potential output. The estimated impacts are not trivial, especially as the ongoing financial crisis resembles more severe rather than mild crises (OECD, 2009). Ignoring this effect could imply to a sizeable over-estimation of the magnitude of the output gap and lead to mis-judgment on the current economic situation. This could in turn lead to an under-estimation of the inflation pressures in the economy or inversely overstate the risk of deflation. By blurring signals, this increases the probability that the stimulus initially injected to support demand, will start to be removed at a later date than optimal. On the fiscal side, an over-estimated negative output gap will bias the measure of the fiscal stances.

Table 2. **Summary**

	Long-term effects on potential output, %
Production-function potential output	1.5
Hodrick-Prescott measure of potential output	2.1
Correction for endogeneity	1.3
Correction for omitted variables	2.2
Severe crises	3.8
End sample 2006	2.4

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