The Permanent Effects of Fiscal Consolidations

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Abstract: The global financial crisis has permanently lowered the path of GDP in all advanced economies. At the same time, and in response to rising government debt levels, many of these countries have been engaging in fiscal consolidations that have had a negative impact on growth rates. We empirically explore the connections between these two facts by extending to longer horizons the methodology of Blanchard and Leigh (2013) regarding fiscal policy multipliers. Using data seven years after the beginning of the crisis as well as estimates on potential output our analysis suggests that attempts to reduce debt via fiscal consolidations have very likely resulted in a higher debt to GDP ratio through their negative impact on output. Our results provide support for the possibility of self-defeating fiscal consolidations in depressed economies as developed by DeLong and Summers (2012).

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1. Introduction.

After more than six years since the global financial crisis started, most advanced economies are still suffering from its aftermath and GDP remains far from its pre-crisis trend. Relative to previous business cycles, the current cycle can be characterized by a much more protracted and persistent recession without a strong recovery that has allowed for a return to trend.

In addition, it has taken years to recognize the persistent negative effects of the crisis. When the crisis started, the original forecasts suggested a progressive return towards previous trends, as it would be expected from a standard recovery phase. But that return never happened, GDP forecasts were revised downwards as the crisis unfolded leading to a succession of positively correlated forecast errors. As time passed, pessimism grew about the potential level of GDP.[1]

While this phenomenon is true for most advanced economies, including the US, the pattern has been the most dramatic for the European economies, where the crisis has been felt the most.

In Figure 1 we show the evolution of GDP as predicted by the IMF World Economic Outlook for the US in three different dates: April 2007 (before the crisis), April 2008 (after the first wave of the crisis) and April 2010 after most of the effects of the crisis were settled (at least for the US). We can see how the downward revisions of GDP that took place in 2008 were followed by additional revisions in 2010 as the crisis was much more persistent than expected.

We can also see from the forecasts that extend five years ahead that in 2010 the deviations from previous trends were expected to be persistent. And this pessimism was not unfounded as the 2010 forecast for GDP in 2014 ended up being very much in line with the actual data for that year.

In the case of Europe the same phenomenon looks even more dramatic. Not only the revisions were large in the first years but they continued even after 2010 as the Euro zone entered its second recession. And when forecasts were being revised downwards, they also did so for long horizons. In Figure 2 we show the change in both GDP as well as estimates of potential output as calculated by the IMF World Economic Outlook (WEO) for the Euro area in three different dates:

[1] See Ball (2014).

April 2007 (before the crisis), April 2011 (after the first wave of the crisis) and today (October 2014).[2]

Figure 1. US GDP

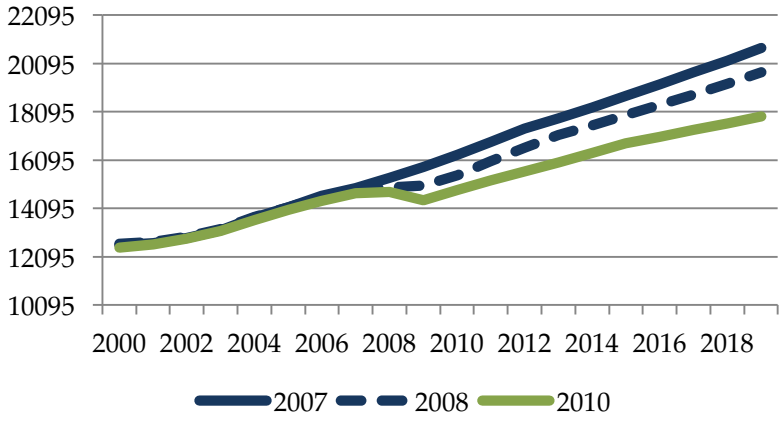
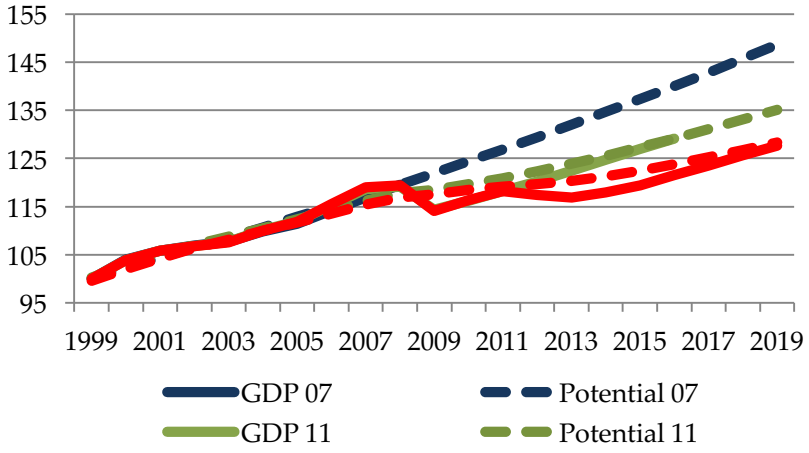


Figure 2. Revisions to Euro GDP and Potential Trend



What is clear from the chart is that the current crisis is very persistent. Relative to the trend that the Euro area was following since the Euro was launched in 1999,

[2] Notes: The April 2007 WEO does not contain forecast beyond 2008 for GDP or Potential. In that case, we are not plotting GDP beyond 2008 and we are extrapolating potential using the average growth rate since 1999. The April 2011 WEO contains forecasts up to 2016. We are extrapolating potential for the next three years using the average growth rate since 1999. The October 2014 WEO contains forecasts up to 2019 for both variables which we include in out chart. GDP data prior to 2007 is not identical in all three vintages because of data revisions. Potential was also revised backwards for several of these years.

GDP today is still far below that level (about 13% below). In addition, potential has been revised downwards by a similar amount. The IMF expects today that by 2019 the Euro area will be about 15% below the level implied by its pre-crisis trend. The revisions to potential output have gone hand in hand with the change in output. By 2011 both output and potential had fallen relative to 2007 projections. By 2014 as output remains far below the 2011 projections, potential output has also been revised downwards and by a similar magnitude.

In some ways the persistence of GDP during the crisis does not entirely come as a surprise. The fact that recessions are persistent and can even leave permanent effects on GDP trend is well known in the academic literature since the discussions on the presence of unit roots in GDP. There is also evidence that crises with a strong financial component, as the one we have just witnessed, tend to last longer.

However, there is no consensus on the origin of the persistence and how it should enter economic policy discussions. While some see it as a sign of structural changes and the illustration of long-term problems where stabilization economic policies have little role to play, others see it as the permanent effects of cyclical phenomenon that might have been exacerbated by poor economic policy choices.

The debate is particularly relevant for the current crisis. Many advanced economies have been dealing with the consequences of large fiscal deficits and debt that required a process of fiscal consolidation. In order to design a process of fiscal consolidation, policy makers need to incorporate their views on GDP and its future growth rate to assess debt sustainability. As fiscal consolidation is implemented, we are likely to see the negative effects on output growth. While there is never-ending debate on the size of fiscal policy multipliers, the work of Blanchard and Leigh (2013) presents convincing evidence that during the crisis multipliers were larger than expected. But if multipliers are large and the negative effects on growth leads to policy makers becoming pessimistic about GDP we can imagine a negative loop in which consolidations lead to lower growth that will need to be addressed by an even larger fiscal adjustment in the years ahead.

In order to avoid this potential negative loop, policy makers look at measures of sustainability that are based on a long-run perspective to avoid the pessimistic bias introduced by using current GDP. For this reason it is common practice for debt ratios to be calculated as a % of potential GDP. But as shown in Figure 2,

potential GDP measures were changing as a result of the crisis in a way that was not too different from GDP. This is the focus of our paper. By extending the methodology of Blanchard and Leigh (2013) to longer horizons as well as to estimates of potential output we analyze how fiscal consolidations changed the long-term views on GDP and how this relates to the observed persistence of the crisis. We make use of IMF forecasts of both actual and potential GDP and analyze how they changed in responses to fiscal consolidations plans implemented in the early years of the crisis (2009-2011).

The results suggest a strong correlation between fiscal consolidations and revisions to potential GDP. In fact, our estimates provides evidence supporting the argument of DeLong and Summers (2012) who bring up the possibility of self-defeating fiscal consolidations, i.e. reductions in deficits that end up delivering higher debt-to-GDP ratios because of their negative effects on GDP growth. This has strong implications for the assessment of economic policies during the crisis and provides strong support for the notion that austerity policies not only have caused significant temporary damage to growth but that they might have resulted in exactly the opposite outcome that they were seeking by permanently reducing output.

Section 2 presents an analysis of the persistence of GDP during the crisis. Section 3 compares this persistence to the behavior of potential output. Section 4 discusses alternative theoretical explanations for this behavior. Section 5 uses the fiscal consolidation of 2009-2011 as a way to identify the causes of persistence. Section 6 compares our estimates to the parameters of DeLong and Summers (2012) and Section 7 concludes.

2. The persistence of the Global Financial Crisis.

2.1 Forecast errors and persistence.

Starting in early 2007 many advanced economies' GDP growth slowed down. By the end of 2007 the decrease in growth rates was evident and it materialized in a recession that started in 2008 and deepened in 2009.[3] The crisis came as a surprise to forecasters, both private and official.

[3] The NBER declared December 2007 as the starting month for the US recession. The CEPR assessed that the Euro had entered a recession in the first quarter of 2008.

To understand how far forecasts were from the actual values of GDP we make use in our analysis of the forecasts made by the World Economic Outlook (WEO). The WEO is produced every 6 months, in April and October. The IMF makes its forecasts available through an online database that includes forecasts for at least two years but the original database, to which we had access, includes a five-year forecast horizon for all variables.

We start with the April 2007 issue of the WEO that, to a large extent, precedes the crisis. We take the 2006 data in that vintage of the database as factual and ignore the fact that later issues of the WEO will revise the data. We make use of the available forecasts going all the way to the year 2012.

We use the following notation for the forecast made in year t of a variable Y for the year $t + i$.

$$Y_{t+i}^{F,t}$$

So for GDP in 2009, the forecast made in 2007 will be expressed as

$$GDP_{2009}^{F,2007}$$

We compare these forecasts with the actual data for GDP. The data comes from the most recent edition of the WEO, the one from October 2014. We can for example calculate the forecast error for the year 2009 as:

$$FE_{GDP,2009}^{2007} = \frac{GDP_{2009} - GDP_{2009}^{F,2007}}{GDP_{2009}^{F,2007}}$$

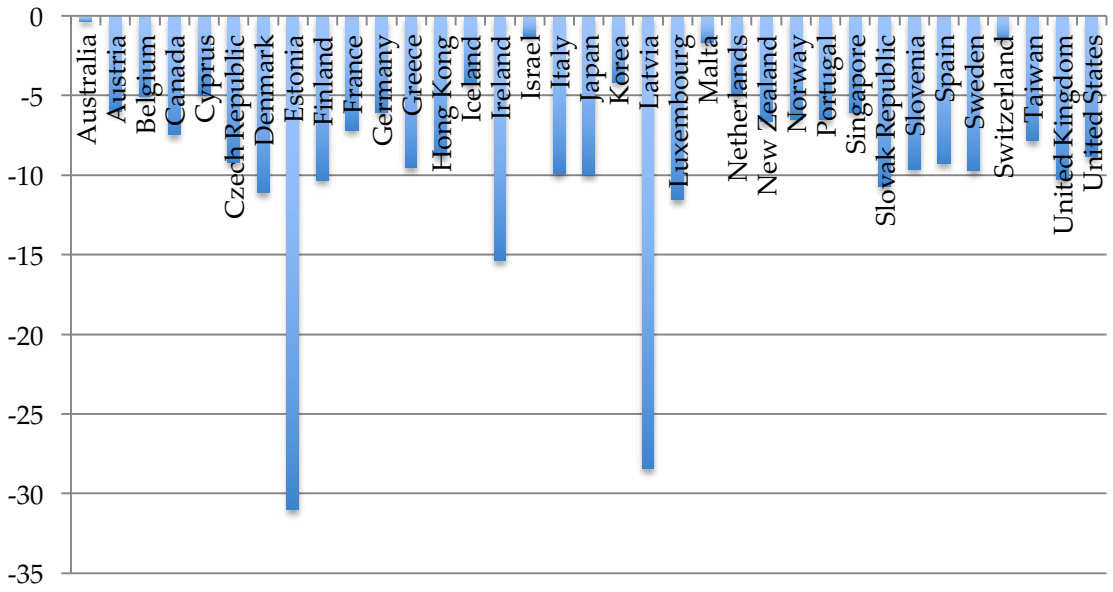
Because of data revisions, changes in base year and also changes in national accounting rules, the forecast and the actual data might not be comparable as they might not be in the same units or follow the same national accounting criteria.[4] Because we are interested in revisions to growth rates, we will make the two number comparable by rebasing the original WEO 2007 real GDP series and its forecasts so that the 2006 data matches the data for that year of the WEO October 2014. Given that the 2006 data now coincides in both the April 2007 and the October 2014 databases, the expression above can be simply calculated as the forecast error of accumulated GDP growth from 2006 to 2009.[5]

[4] The October 2014 WEO has started using updated data using ESA2010 criteria.

[5] An appendix at the end of the paper describes in detail the calculation of the forecast error.

We first plot the data for all advanced economies (Figure 3). The forecast of real GDP for the year 2009 was clearly too optimistic compared to the actual data. And for some countries such as Estonia, Latvia or Ireland the forecast error is as large as 30%.

Figure 3. Forecast Error Real GDP 2009



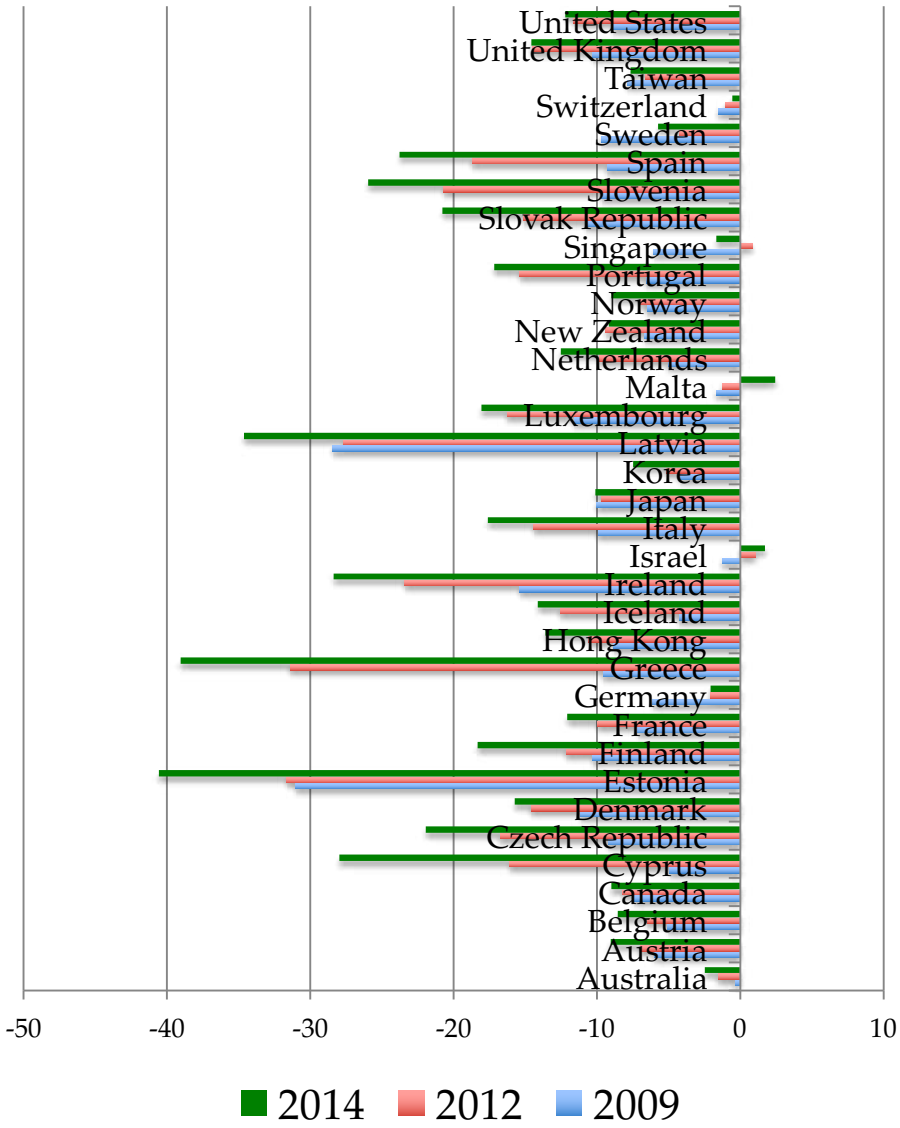
We can think of these figures as the cyclical shock that hit all these economies in the years 2007-2009, where by cyclical shock we have in mind the unexpected change in GDP during those years.

The question is how persistent was this shock? As we move our horizon forward and as time passes, did these cyclical events became temporary deviations from trend or did the shock became persistent? If these deviations were indeed transitory, we would expect the forecast error to decrease over time as output returns to trend.

We continue using the April 2007 WEO and look at the forecast made for 2012. We also extend the forecast horizon to 2014 by extrapolating GDP grow rates in the years prior to the crisis (2000-2006).[6]

[6] Although we refer to the 2014 figure as a forecast error, this is not correct. The 2014 data from the October 2014 WEO remains a forecast and therefore what we are really capturing is the change in forecast for the year 2014 between October 2014 and April 2007.

Figure 4. Forecast Error Real GDP 2009, 2012 and 2014.



When we compare the three forecast errors for all advanced economies we see a very large amount of persistence. The deviations of real GDP from forecasts in 2012 are similar or typically larger than those in 2009. The 2014 forecast error is in most cases line with the 2012 figure except in some European countries where the error is even larger. This suggests that the first shock continued its propagation during the 2009-2012 years and, in that sense, it became permanent.

Alternatively, it can also be that there was a second shock that sent GDP growth to an even lower level.

But regardless of the cause, we can confirm that there is very little trend reversion during the crisis and that the long-term consequences of the crisis (as measured by either 2012 or 2014 data) are as large as the short-term effects (confirming the results of Ball (2014)). By long-term effects we mean seven years after the crisis started, a horizon that is long relative to the typical length of recessions and recoveries.

The fact that shocks to GDP are persistent is known since the first discussions on the existence of a unit root in GDP. For example, Campbell and Mankiw (1989) were one of the first ones to look at GDP persistence in an international sample. Using simple univariate regressions, they analyzed as how much of an unexpected 1% change in GDP has an effect on future values of GDP. We are performing the same exercise but for a single event over a seven-year window.

What is clear from Figure 4 is not just that GDP was also lower in 2012 or 2014 than what we expected, it is that, across countries, the deviation of GDP from its forecast in those years is very much correlated with the first shock. The countries where the initial shock was large are the same countries where the forecast error several years ahead is the largest. This is an important fact because it suggests that there is a positive correlation in forecast errors across time so the revisions to GDP in the later years are related to the size of the initial shock. This would not be the case if we were looking at two independent shocks taking place in different years.

One way to check this correlation in cross-country persistence is to simply run a regression of the forecast error for these later years against the forecast error for 2009. For this analysis we also include an additional horizon by calculating the forecast error for 2019.[7]

What we see is that the outlook for 2012, 2014 and 2019 has changed even more than the unexpected change in GDP in 2009. By 2019 the persistence if even magnified reflecting an overall tendency for growth rates. But what the regression shows is that these revisions to the forecasts are correlated with the

[7] We include 2019 because it is the latest year for which the October 2014 WEO produces a forecast. Although we refer to this figure as a forecast error, what we are really capturing is the change in forecast for the year 2019 between October 2014 and April 2007.

initial change in GDP. In other words, countries that suffer larger crisis have seen a much larger downward revision of our GDP estimates for the future, the crisis is seen as long lived.

Table 1. Persistence of Forecast Errors Real GDP. Advanced Economies.

Advanced	Forecast Error Real GDP		
	2012	2014	2019
Forecast Error Real GDP 2009	1.033***	1.301***	1.843***
	(0.112)	(0.141)	(0.170)
Constant	-2.823**	-3.261*	-1.009
	(1.334)	(1.855)	(2.334)
Observations	35	35	35
R-squared	0.583	0.554	0.619

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2. Persistence of Forecast Errors Real GDP. Emerging.

Emerging	Forecast Error Real GDP		
	2012	2014	2019
Forecast Error Real GDP 2009	1.581***	1.939***	2.421***
	(0.220)	(0.261)	(0.386)
Constant	1.936	0.783	0.203
	(1.297)	(1.732)	(3.008)
Observations	31	31	31
R-squared	0.749	0.735	0.599

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Interestingly, a similar pattern is visible among emerging markets. Using the same methodology as above we replicate the analysis for a sample of 31

emerging markets and we get similar result with an even larger coefficient (Table 2).[8]

Why is output so persistent? Is the labor market relevant to explain the persistence of GDP shocks? We include in our previous regressions the forecast error of both the unemployment rate and employment over the same years to understand if changes in the labor market can help explain the persistence of GDP forecast errors in 2014 and 2019.

Table 3. Persistence of Forecast Errors Real GDP. Advanced Economies.

Advanced	Forecast Error Real GDP			
	2014	2019	2014	2019
Forecast error GDP 2009	1.215***	1.719***	1.143***	1.747***
	(0.223)	(0.288)	(0.168)	(0.207)
Forecast error Unemployment 2009	-0.276	-0.399		
	(0.555)	(0.706)		
Forecast error Employment 2009			0.337	0.206
			(0.254)	(0.321)
Constant	-3.416*	-1.233	-4.280**	-1.633
	(1.844)	(2.351)	(1.730)	(2.298)
Observations	35	35	35	35
R-squared	0.557	0.623	0.569	0.622

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

While these results have to be taken with great care given the unstructured nature of our specification, labor market variables do not seem to have an

[8] The fact that persistence is larger for emerging markets with higher growth rates is consistent with the findings of Fatás (2000).

independent explanatory power beyond the changes in GDP. This does not mean that the labor market does not matter, as it is behind the initial change in GDP, but it shows that differences in labor market performance among two countries with similar GDP change in the earlier years does not help us understand the long-term persistence of GDP.

2.2. Persistence or permanent effects?

So far we have seen that an unexpected change in GDP was very persistent and that the 2014 or 2019 forecasts were revised by an amount that is as large or larger than the initial impulse. Will these persistent effects ever die out? Or will these persistent effects become permanent?

One way to answer this question is to make use of measures of potential output. While potential output is not observable and it has to be estimated, it is an indication of the future dynamics of GDP beyond the current year. If cyclical events are seen as transitory, a fall in GDP should lead to no change in potential output. But if the changes in GDP as seen as having not just a persistent effect but a permanent effect on output, then potential output will be revised downwards. In that sense, the estimates of potential output offer us an opportunity to assess the persistent effects of recessions even beyond the year 2019.

We now replicate our previous regressions but using as dependent variable the forecast error of potential GDP for the same three years (2012, 2014 and 2019).[9] We once again use the unexpected change in GDP during 2006-09 as our measure of the initial shock and we ask how potential output changed relative to what we had earlier anticipated.

The estimates suggest that the revisions to potential output were very large as well. In fact the size of the coefficients in Table 2 and Table 4 are very similar, suggesting that the large revisions to GDP are becoming permanent, as captured by the change in potential. As an example, the unexpected decrease in GDP until

[9] Calculating forecast errors for potential output is more complicated than for GDP. Potential output is not observed but estimated. In addition, revisions to current level of potential output tend to lead to revisions of past levels of potential output. In our calculations we ignore these historical revisions. What we are comparing is how our view of future potential output changes as time passes. This means that we cannot simply compare forecast errors in growth rates as we did with GDP. We make these calculations explicit in an appendix at the end of the paper.

2009 can help explain a decrease in about 2 percentage points of potential output in 2019, slightly smaller than the 2.4 percentage points we found for GDP. Another way to reach the same conclusion is to look at current estimates of output gap. While they signal some expected recovery in the years ahead, this recovery is much smaller than the output that has been lost so far.

Table 4. Persistence of Forecast Errors Potential GDP. Advanced Economies.

	Forecast Error Potential GDP		
	2012	2014	2019
Forecast Error Real GDP 2009	1.071***	1.430***	1.990***
	(0.218)	(0.262)	(0.343)
Constant	-1.968	-1.700	-1.783
	(2.002)	(2.151)	(2.408)
Observations	29	29	29
R-squared	0.267	0.336	0.414

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5. Persistence in Potential GDP in the Euro Area.

	Forecast Error Potential GDP		
	2012	2014	2019
Forecast Error Real GDP 2009	0.801***	0.974***	1.303***
	(0.228)	(0.256)	(0.318)
Interaction with Euro	0.360	0.609**	0.917***
	(0.242)	(0.266)	(0.307)
Constant	-2.594	-2.760	-3.379
	(1.958)	(2.182)	(2.504)
Observations	29	29	29
R-squared	0.312	0.427	0.545

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

While these effects seem to be present across all 29 advanced economies, they are stronger in some countries. For example, a simple interaction term between our dependent variable and a Euro dummy reveals that the strength to which changes in output become persistent is much larger for the Euro countries, more so after 2012 (see Table 5).

3. Is the persistence of GDP surprising? Literature review.

3.1. Output shocks tend to be persistent.

So far we have shown that the shock that hit advanced economies after 2007 has been very persistent. In fact, there is overwhelming evidence, both from the current level of output, seven years after the crisis started, as well as the estimates of potential GDP that this has become a permanent shock. It is by now well accepted that these countries will not regain their pre-trend crisis levels.

In many ways this should not be a big surprise, since we know from the pioneering work of Nelson and Plosser (1982) that fluctuations are persistent and that US GDP displays a unit root in GDP. And Campbell and Mankiw (1989), among others, later confirmed that this persistence is also present for G7 countries: a 1% fall in output lowers its long-term projection by more than 1%.

The large persistence is also supported by a separate and more recent literature that has studied the long-term permanent effects of large crises. The focus of this literature is quite different from the previous one as it only studies negative shocks, those that are large and clearly identifiable in the data. The focus of this literature has been on either emerging markets (where crises tend to be larger) or on financial crises that tend to be characterized by deep and protracted recessions. The evidence shows that output fails to catch up with its previous trend after any of these events.

Cerra and Saxena (2008) produce evidence that after financial and political crises output losses are very persistent even after taking into account the possibility of endogeneity. Using a much longer time horizon Reinhart and Rogoff (2014) also show that recovery from financial crisis is slower than from regular crisis (similar results in International Monetary Fund (2009), Jordà, Schularick, and Taylor (2011) or Claessens, Kose, and Terrones (2011)).[10]

[10] Although others have expressed partial disagreement with this assessment. Howard, Martin, and Wilson (2011) show that recoveries are in fact very quick after deep financial crisis although

Some of these papers assess directly the effect that financial crises have on potential output. Furceri and Mourougane (2012) show that financial crisis have a significant effect on potential output for OECD economies. Ball (2014) focuses on the Great Recession to show that potential output has been reduced significantly among OECD countries.

The strong persistence of recessions applies to more than just large financial crisis. Blanchard, Cerutti, and Summers (2015), Martin and Wilson (2013) and Haltmaier (2013) show that across all recessions in advanced economies over the last 40 years GDP is very persistent. More interestingly, they also show that potential output is consistently revised downwards during crisis years.

A related, although separate literature, emphasizes the persistent or permanent effects of recessions on the labor market. The literature started with the observation that European unemployment failed to return to its pre-crisis level during the 70s (Blanchard and Summers (1986)). The literature has recently regained some interest because of the persistent behavior of unemployment and, in particular, long-term unemployment, during the Great Recession not only in Europe but also in the US.

3.2. Interpreting the persistence of shocks (and large crises).

The early evidence on the persistence of GDP shocks, both positive and negative, provided support to theories where technology shocks were the driving force of business cycles (RBC). Traditionally, the trend was seen as driven by a standard growth model (e.g. Solow) and models of the business cycles, even those based on Keynesian views of fluctuations, assumed that booms and recessions represented deviations from this trend.

The fact that Nelson and Plosser (1982) show that the trend itself was stochastic and its variance could account for a large amount of the GDP variation was seen as evidence that technology shocks were a significant driving force of fluctuations. In fact, the persistence of shocks was used as a way to separate demand (temporary) from supply (permanent) sources of shocks as in Blanchard and Quah (1989).

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they agree that they are very slow after *long* financial crisis. And Bordo and Haubrich (2012) or Romer and Romer (2014) present an even more dissenting view about why financial crisis are special using data for US or advanced economies.

But there is as well a very different interpretation of the persistence of GDP, if we are willing to deviate from the tradition of separating long-term dynamics and business cycles. This interpretation was brought forward at the time when the growth literature started taking seriously the idea that growth is endogenous. This endogeneity also means that long-term growth can also react to cyclical conditions, regardless of their origin. Stadler (1990) showed how in endogenous growth models any type of shock has permanent effects on GDP because it temporarily affects the underlying growth dynamics. During recessions, investment is lower, R&D expenditures are lower and trend growth happens at a lower pace that during normal years. Fatás (2000) presents a similar model as well as evidence supporting this logic.

The difficulty of testing which of the two explanations accounts for the persistence of output is, as usual, dealing with endogeneity. There have been several approaches to providing evidence in favor of models where cyclical events leave permanent effects on output. First, variables that drive trend growth are indeed affected by cyclical conditions (e.g. there is evidence that R&D expenditures are procyclical). Second, there is a correlation between the growth process and the persistence of fluctuations (Fatás (2000) shows that persistence is correlated to average growth rates). An alternative is to identify specific shocks that are cyclical in nature (such as monetary or fiscal policy shocks) and then analyze the persistence of GDP in response to these shocks. Blanchard, Cerutti, and Summers (2015) show that recessions that are caused by demand shocks also tend to be very persistent. International Monetary Fund (2009) presents evidence that during the Asian crisis, countries with stronger countercyclical policies had less persistent fluctuations. We follow this literature by studying the cyclical movements in output that resulted from the 2009-11 fiscal consolidation to see how much they can explain of the observed persistence in GDP.

4. Is it cyclical or structural? A test using the 2009-11 fiscal consolidation.

4.1. Identifying fiscal policy shocks.

As argued in the previous section, our analysis of the persistence of GDP during the global financial crisis can be subject to two separate interpretations depending on the direction in which causality runs. First, it could be that the depth of the crisis is simply driven by changes in potential output. For this to be

true, it would have to be that during the years 2008-14 these countries have suffered several structural changes that have made forecasters revise downwards the estimates of potential output. These changes must have had a country-specific component that explains the cross-country variation. And they must have been unanticipated; i.e. aging and demographic changes could be relevant but it would have to be that the IMF did not consider those as relevant to forecast potential output before the crisis.

The alternative explanation is that country-specific factors (such as economic policies or labor market characteristics or pre-crisis dynamics) have generated variation in the depth and length of the crisis that has translated into a fall in potential output via hysteresis effects.

Separating these two effects from an empirical point of view is. Ideally one needs to identify exogenous movements in macroeconomic variables that can be used to identify one of the directions of causality. This issue is no different from the endogeneity problems of the literature on fiscal policy multipliers and the debate about the effects of austerity: we know that fiscal policy austerity seems to be correlated with decreases in output but in which direction does causality run?

In the context of the fiscal policy multiplier debate Blanchard and Leigh (2013) introduced a simple methodology to deal with endogeneity in order to measure the impact of the 2009-2010 fiscal consolidations in advanced. Their methodology is in many ways similar to the identification assumptions of more complex econometric specification (such as a VAR) but in a much simpler framework. Their methodology relies on the fact that GDP forecast errors should be uncorrelated with fiscal policy if the model used to generate the forecasts has the right assumptions about fiscal policy multipliers. If we find that the correlation is negative and significant it means that the model is underestimating fiscal policy multipliers.

We make use of their methodology to explore how fiscal policy can be responsible for the changes in both GDP over a long horizon and potential output during the years that followed the fiscal consolidation. In other words, their methodology allows us to identify a shock to fiscal policy and we want to understand the response of GDP and potential output to this shock.

We start by replicating the results of Blanchard and Leigh (2013). We use the same years, 2010 and 2011 where fiscal consolidations were planned and executed among many economies. We also focus on the same set of countries

(European countries among the advanced economies), with the exception that we drop Cyprus from our analysis.[11] We collect data from the April 2010 issue and measure the planned fiscal consolidation over the next two years (2010 and 2011) as the change in the forecast of the change in the structural balance as a percentage of potential GDP ($\Delta SB^{F\ 2010}_{i,2010-2011}$). This is identical to the specification in Blanchard and Leigh (2013) and this magnotude can be thought of as the size of the planned fiscal consolidation. We then measure the forecast error for real GDP in the level of output for different years (t).

The forecast error is computed using the latest data available ($GDP_{i,t}$) (from the IMF World Economic Outlook of October 2014) against the forecast made in April 2010. ($GDP^{F,2010}_{i,t}$). We then regress the forecast error on the planned fiscal consolidation.

$$FE^{2010}_{GDP,t} = \frac{GDP_{i,t} - GDP^{F,2010}_{i,t}}{GDP^{F,2010}_{i,t}} = \alpha + \beta\, \Delta SB^{F,2010}_{i,2010-2011} + \varepsilon_i$$

Under the assumption that the forecast had been made using the right fiscal policy multipliers, the coefficient β should be equal to zero. Blanchard and Leigh (2013) found that the coefficient was negative, large and significant, a sign that fiscal policy multipliers had been underestimated by the IMF model.

Blanchard and Leigh (2013) mainly used 2011 for the forecast year for GDP, matching the timing of the fiscal consolidation. Their methodology does not require that; we can use any future year to calculate the forecast error. Because we are interested in the persistence of the shock, we will look at 2011 but also at 2014 and 2019.

Realize that contrary to Blanchard and Leigh (2013), when we look at 2014 and 2019, the timing of the variables is different on both sides of the regression. On the right hand side we include the planned consolidation only for the years 2010 and 2011 while on the left-hand side we will have in some cases a longer horizon. We could match the timing in both and include the planned consolidation for a longer period of time (e.g. 2010-2014) as the explanatory variable. But it is unlikely that in 2010 there was a good sense on what that consolidation was going to look like four years later. So we restrict ourselves to the fiscal

[11] The reason to drop Cyprus is that because we extend the analysis beyond 2012, Cyprus becomes a very large outlier as output collapses in the years that follow.

consolidation of the first two years as the explanatory variable that helps us understand the persistent effects that this particular shock left on output at longer horizons. The cross-country variation in persistence allows us to estimate these effects.

Also notice that the interpretation of the coefficient is different from that of Blanchard and Leigh (2013). The forecast made by the IMF in April 2010 for the next two years takes into account that a fiscal consolidation affects GDP with a multiplier of 0.5. In that sense, the coefficient β represents the effects of fiscal consolidation in addition to the effects already assumed by the IMF forecast, and can be interpreted as how large the fiscal policy multiplier was above the assumed value of 0.5. As we extend the forecast period beyond 2011, we are once again looking at how actual GDP deviated from the forecast but the multiplier implied in the forecast is not anymore 0.5. In the absence of other shocks or changes to any other variables, the effects of fiscal consolidation are assumed to be lower over time but its value depends on the specifics of the dynamics of output of the economic model used by the IMF.

Table 6. Blanchard and Leigh Replication.

Europe	Forecast Error Real GDP		
	2011	2014	2019
Fiscal Consolidation 2009-10	-1.145**	-1.724**	-2.141***
	(0.407)	(0.684)	(0.570)
Constant	1.111**	-3.961***	-3.459***
	(0.408)	(0.793)	(1.188)
Observations	22	22	22
R-squared	0.480	0.356	0.295

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

When we replicate their results for 2011, we find almost identical result (there are small differences because the data has been revised since their analysis). The first column replicates Blanchard and Leigh (2013) and we find a coefficient of about 1, similar to their results. The next two columns use 2014 and 2019 to understand

the persistence of the shock and see whether the effects on GDP die out over time. We find that the effects on GDP are, once again, very persistent and, in fact, the coefficient increases over time.

It is important to understand that in this regression we are not simply looking at the persistence of GDP movements. We are looking at the changes in GDP caused by a specific shock, a fiscal consolidation. As long as the fiscal consolidation variable properly captures an exogenous shock to demand, what we see in this table is a measure of the persistent effects of this shock to demand on GDP.

4.2. The persistent effects of fiscal policy shocks.

Having replicated Blanchard and Leigh (2013) and show that the results hold or become even stronger as we extend the forecast horizon, we now apply the same methodology to explain the change in potential output. The logic, once again, is that potential output is supposed to capture an even longer horizon than GDP. Taken literally, the methodology of potential output is supposed to capture the permanent changes in GDP in response to these events. We will refer to the level of potential output for that year as ($PGDP_{i,t+4}$) and we run a regression of the type

$$FE^{2010}_{PGDP,t} = \frac{PGDP_{i,t} - PGDP^{F,2010}_{i,t}}{PGDP^{F,2010}_{i,t}} = \alpha + \beta\, \Delta SB^{F,2010}_{i,2010-2011} + \varepsilon_i$$

The interpretation of this regression is slightly different from the one above. Remember that when GDP was used, the parameter β represented the size of the fiscal multiplier in excess of the 0.5 multiplier assumed in the IMF model. For potential output, the model used by the IMF (and others) imply that there are no permanent effects of fiscal consolidations as there is a clear distinction between the trend and transitory deviations from the trend, the ones that define the business cycle. In that sense, the parameter β can now be interpreted as a pure effect of the fiscal consolidation on potential output.

The results show that the planned fiscal consolidation of the years 2010-11 had a strong and significant effect on the 2014 and 2019 forecast error on potential output. The effects are the largest for the Euro area, where the fiscal consolidation of 2010-11 helps explain more than 40% of the variation in potential output forecast errors among the 14 countries in the sample.

Table 7. Permanent Effects of Fiscal Consolidation.

	Forecast Error Potential GDP			
	Europe		Euro	
VARIABLES	2014	2019	2014	2019
Fiscal Consolidation	-0.999*	-1.868***	-1.365**	-2.247***
	(0.534)	(0.505)	(0.524)	(0.528)
Constant	-2.872***	-5.309***	-2.343***	-5.789***
	(0.690)	(1.093)	(0.689)	(1.422)
Observations	21	21	14	14
R-squared	0.225	0.325	0.422	0.431

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In order to compare the coefficient with the ones in the previous table, we need to remember that when we look at output, the forecast made by the IMF already includes a multiplier of 0.5. So the fact that in that first specification we found a coefficient of around 1.1 for the Euro area, it meant that the actual estimated multiplier was about 1.6. For potential output, there is no multiplier built into the forecast so the coefficient represents a true "multiplier", So when we find a multiplier which is about 1.3 for the Euro area, we conclude that is about 80% of the short-term effect on output.

4.3. Fiscally-induced cyclical changes in GDP becoming permanent

So far we have used as an explanatory variable the change in the structural budget balance for the years 2010-11. But what if this change was not implemented? What if the change was implemented using different fiscal policy tools in different countries (taxes, spending, transfers)? In that case we would not expect the coefficient to be the same across all countries.

One way to capture the true cyclical effects of these fiscal changes is to run a two-stage procedure: we first regress changes in output during the earlier years of the crisis (2010-11) on the planned fiscal consolidation during those years.

$$FE^{2010}_{GDP,2011} = \frac{GDP_{i,t} - GDP^{F,2010}_{i,t}}{GDP^{F,2010}_{i,t}} = \alpha + \beta\, \Delta SB^{F,2010}_{i,2010-2011} + \varepsilon_i$$

We then use the fitted values from this regression $\widehat{FE}^{2010}_{GDP,2011}$ as the explanatory variable to understand the forecast error of potential GDP.

$$FE^{2010}_{PGDP,t} = \alpha + \beta\, \widehat{FE}^{2010}_{GDP,2011} + \varepsilon_i$$

The interpretation of this second regression is that we are measuring the effects on potential output of changes in GDP during 2010-11 *that were caused by the fiscal consolidation during those two years*. In other words, we are isolating changes in GDP that are caused by identifiable changes in demand (via fiscal policy).

Table 8 Permanent Effects of Fiscal Consolidation. 2SLS Estimation.

	Forecast Error Potential GDP			
	Europe		Euro	
	2014	2019	2014	2019
$\widehat{FE}^{2010}_{GDP,2011}$	0.862***	1.605***	1.060***	1.744***
	(0.224)	(0.449)	(0.166)	(0.562)
Constant	-3.917***	-7.336***	-3.692***	-8.009***
	(0.502)	(1.035)	(0.531)	(1.229)
Observations	21	20	14	14
R-squared	0.652	0.512	0.786	0.590

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results show a coefficient close to one for 2014 and around 1.6-1.7 for 2019. This suggests that every 1% fiscal-policy-induced decline in GDP during the years 2010-11 translated into a 1% decline in potential output by 2014 and even

more for 2019. The results are significant for both samples and the coefficient is similar for the Europe and Euro. [12]

The fact that the coefficient is similar across the two samples in this table should not be a surprise. We are not measuring a fiscal policy multiplier in this table, we are capturing the extent to which changes in GDP caused by fiscal policy in the early years of the crisis became permanent. Even if fiscal policy multipliers were different across countries, it would not affect the coefficients on this table, it would simply mean that the changes in GDP were different even if fiscal policy changes were similar.

4.5 Interpreting our results. Are there alternative explanations?

We have exploited the strong cross-country correlation between the fiscal consolidations in 2010-11 period and the subsequent changes to GDP and potential output to claim that fiscal policy has had a large and permanent effect on GDP. The fact that our estimated multipliers are large suggest the possibility of a strong countercyclical role for fiscal policy. We need to keep in mind that our estimates take place during the worst recession since the Great Depression at a time when monetary policy was constrained by the zero-lower bound in many countries. In addition, for the countries inside the Euro area monetary and exchange rate policy was unavailable at the country level. As Blanchard and Leigh (2013) show, applying the same methodology to other periods of time where these conditions do not apply produce much smaller effects of fiscal policy on output.

When it comes to interpreting the size of our coefficients one needs to be careful. While our specification is very similar to that of Blanchard and Leigh (2013) the fact that we are looking at a longer horizon makes the the interpretation of our results as multipliers less straightforward than in the case of Blanchard and Leigh (2013). In addition, in their analysis by matching the timing of the fiscal consolidation to the change in the forecast error for GDP one could argue that the variation in changes in GDP is directly related to fiscal policy changes (which

[12] Our 2SLS can be interpreted as an IV estimation of the permanent effects of cyclical changes in GDP using fiscal policy as an instrument. A Durbin-Wu-Hausman test shows that the hypothesis of exogeneity in the OLS estimates cannot be rejected. This means that the permanent effects identified by our 2SLS estimation are not different from the permanent effects of other cyclical movements in GDP (those unrelated to fiscal policy). This is not a surprise, and it simply confirms that the persistence of cyclical movements in GDP is not particular to dynamics created by fiscal policy shocks.

constitutes the standard definition of multipliers). Of course, there could be longer-term effects on GDP that are not captured in their analysis but as long as we believe that the majority of the effects of fiscal policy shocks are felt contemporaneously, the estimate of multipliers will be close enough.

In our case we extend the horizon by an additional three to eight years beyond the years where the fiscal policy changes are taking place. In that sense, it is possible that we are capturing some additional effects. In particular, the initial fiscal policy shock could be correlated (across countries) with similar shocks in the years ahead that also have an effect on GDP. While this makes more difficult the interpretation of our estimates as multipliers, we see this possibility as strengthening the story we want to tell from our analysis. Countries that implemented large fiscal consolidations in 2010-11 might have found themselves in 2012 with a depressed economy that might have required even larger adjustments in fiscal policy that further depressed growth. As we move the timing of GDP to 2014 and 2019 we are likely to capture in our estimates the effects of the second-round fiscal consolidations, as they happened. It is very likely that this is why the estimates in Table 6 increase overt time. But what matters is that the final effects on GDP are correlated with the initial fiscal policy shock and our estimates are capturing the full impact of all what followed from those policy decisions.

The use of potential GDP should in some ways provide us with a better way to look beyond the short-term dynamics of output and focus on long-run forecasts of GDP. As shown in Table 7, our estimates using potential output confirm our results using GDP. The fiscal policy contraction of 2009-11 had an impact on our views on potential output already in 2014 which is confirmed with the change in forecast we have constructed for 2019.

The use of potential output could raise some concerns because it is a constructed variable that might be following GDP too closely and not capturing an accurate long-term forecast of GDP. This is possible but it is very unlikely that this explains our results for two reasons. First, our results with potential output match the results using GDP over a long-enough horizon to avoid cyclical dynamics. The fact that the value of GDP in 2014 or its current forecast for 2019 are affected by the fiscal changes in 2010-11 are already a good indication of the long-term effects on output. Second, if potential output was being wrongly estimated by simply extrapolating the cyclical dynamics of GDP it would mean that over the next years we would be expecting a very strong recovery in those countries most affected by the crisis. There are no current forecasts of GDP from

any national government or international organization that suggests this will be the case. While one can never rule out the possibility of a surprising performance from those countries but all information currently available points in the direction that the GDP losses they have suffered are indeed permanent. Ideally we would like to wait 10 more years and run similar regressions using GDP in 2024. In the absence of actual data for GDP for 2024, our analysis provides the best estimates one can do of the long-term effects of the economic policy choices countries made during the global financial crisis.

5. Was the fiscal consolidation self-defeating?

Our estimates suggest that the fiscal contraction in European economies reduced output not only in the short term but also in the medium term and possibly on a permanent basis. This reduction in output makes the goal of the fiscal consolidation harder as it raises the ratio of debt to GDP and it reduces tax revenues.

This is a point made by DeLong and Summers (2012) who argue that in a depressed economy a fiscal consolidation can be self-defeating, it can lead to an increase in debt. To understand the logic, and following closely their analysis, let D_t be the level of government debt, G_t spending, T_t taxes and Y_t the level of GDP in year t. Imagine a government that introduces a fiscal consolidation plan that involves a decrease in spending.

$$\Delta G_t = G_{t+1} - G_t$$

where G_{t+1}refers to the level of government spending planned for next year which we assume matches its execution. But the change in spending is likely to affect negatively GDP next year. The change in GDP will depend on the fiscal policy multiplier (μ).

$$\Delta Y_t = \mu\, \Delta G_t$$

The level of debt will be reduced by

$$\Delta D_t = \Delta G_t - \Delta T_t = \Delta G_t - \mu\tau \Delta G_t = (1 - \mu\tau)\, \Delta G_t$$

This reduction in the level of debt imposes a burden on future government balances equal to

$$(\mathrm{r}-\mathrm{g})\,\Delta D_t = (\mathrm{r}-\mathrm{g})\,(1-\mu\tau)\,\Delta G_t$$

Where r is the government borrowing rate and g is the long-run growth rate of GDP.

Assume some permanent effects of the recession caused by the fiscal consolidation. In particular potential output is likely to change by an amount (ΔY_t^p) that is related to the cyclical change in output (ΔY_t^c).

$$\Delta Y_t^p = \eta\,\Delta Y_t^c = \eta\,\mu\,\Delta G_t$$

Where the parameter η is the hysteresis parameter. Because of this change in output there will be a permanent loss of revenues equal to

$$\tau\,\Delta Y_t^p = \tau\,\eta\,\mu\,\Delta G_t$$

A fiscal contraction is self-defeating as long as

$$\tau\,\eta\,\mu > (\mathrm{r}-\mathrm{g})\,(1-\mu\tau)$$

DeLong and Summers (2012) calibrate the above parameters for the US economy. Assuming plausible values for g and r, they look for combination of parameter values for the short-run fiscal multiplier and the hysteresis parameter that make the above equation hold. The range of values they consider for the fiscal multiplier is between 0-2.5. Our analysis above, following Blanchard and Leigh (2013) produces a multiplier of about 1.7. Given this number and using DeLong and Summers (2012) calibration, the hysteresis parameter would have to be between 0 and 0.025 (this is assuming a real treasury rate between 2.5 and 5%).

How does this correspond to our estimates of the permanent effects of fiscal consolidations? If we take our results at face value, the hysteresis effect is much larger than any of these values. For example, if look at the regression of the forecast error of potential output on the fiscal policy indicator, which should be considered a reduced-form estimation of the parameter η, the coefficient is always higher than one (Table 7).

Alternatively, we can think of the two-stage procedure where we estimate the permanent effects of cyclical changes of output (Table 8). To translate these estimates into a value of η we need to assess how long are the cyclical changes in output. If we were to interpret the years 2009-11 as the cyclical component of the

crisis, then we would be once again calibrating the parameter η to be around or above 1. The difficulty here is that GDP behaves very closely to a random walk which makes it very difficult to estimate the transitory component of output.

But regardless of the method we use, given our very large estimates of the permanent (not just persistent) effects of the fiscal consolidation on GDP and potential, our estimates strongly suggest that the fiscal consolidation that took place during those years was self defeating and instead of delivering the outcome of reducing debt, it led to an increase.

The idea that a government trying to restore debt sustainability should opt for spending more can be seen as implausible, or as some might call a "free lunch" (Rogoff (2015)). Our results do not suggest in any way that this is a standard policy advise for all governments at all times. We are looking at a particular episode where several special circumstances are coming together. First, for many of these countries monetary policy was constrained either by the zero-lower bound or because of the institutional arrangements of the Euro area. This is likely to generate larger short-term fiscal policy multipliers (Eggertsson (2011) and Eggertsson and Krugman (2012)). Second, this was a very deep crisis with growth rates reaching negative numbers that had not been seen since the Great Depression. In addition, the nature of the crisis made the recession long and the recovery slow. This persistent short-run dynamics are likely to leave a much larger permanent effects on output through hysteresis effects (see Blanchard, Cerutti, and Summers (2015)). In the case of the Great Recession, this hysteresis effects are the outcome not only of very persistent labor market dynamics but of a depressed behavior of investment that results in a much lower capital stock (see evidence in International Monetary Fund (2015)).

Hysteresis is crucial for the possibility of self-defeating fiscal consolidations. A lower permanent level of output increases the debt-to-GDP ratio and it also reduces the level of tax revenues. Because output is likely to trend upwards, so are fiscal variables. While the recipe for a government with high debt is likely to be a lower spending to GDP ratio, reducing spending and, as a result, GDP by a similar amount not only does not achieve its objective but it leads to a higher debt-to-GDP ratio. And the fact that some or all of the change in output is permanent, makes austerity the wrong fiscal policy.

Our conclusion that countercyclical fiscal policy should have been more aggressive given the nature and persistence of the crisis also applies to monetary policy. As suggested in Blanchard, Cerutti, and Summers (2015), the fact that

cyclical shocks are likely to have permanent effects on output calls for a much stronger stabilization policy.

A final caveat regarding our reading of the empirical results. We are talking about an alternative to fiscal consolidation but it might be that in some cases there was no alternative because financial markets had completely cut access to additional funding to some of these governments. Of course, if our results are correct and both governments and markets agreed with our logic, capital will continue to flow to support a fiscal policy that promotes a reduction in the debt-to-GDP ratio without having to produce a strong fiscal consolidation in the short run. In addition, even if markets do not accept the logic of our conclusions, it would be up to international organizations (IMF or other governments not constrained in their funding) to decide on additional funding to support a certain fiscal policy in the constrained economies (as it is always the case when any form of bailout is discussed).

6. Conclusions

The global financial crisis has permanently lowered the path of GDP in all advanced economies. In none of these countries GDP is expected to return to its pre-crisis levels. At the same time, many of these countries have been engaging in fiscal consolidations in response to rising government debt levels that had a negative impact on growth rates. In this paper we use the methodology of Blanchard and Leigh (2013) to show that fiscal consolidations had long-term effects on GDP, at horizon much longer than the traditional analysis of fiscal policy multipliers.

We have first documented the persistence of the effects of the global financial crisis. They are visible both in the current level of GDP and in the IMF forecasts for 2019. In addition, we show that potential output has been revised downwards by a similar amount, a sign that the reduction in GDP is mostly seen as permanent, i.e. there is strong evidence of hysteresis.

While permanent changes in GDP could be associated to structural changes in economic conditions (e.g. productivity shocks or changes in demographics), we exploit the cross-country variation in persistence to show that a significant part of the changes in actual and potential GDP are the direct result of the fiscal consolidation implemented during the period 2009-2011.

The combination of strong cyclical effects of fiscal policy and hysteresis provides support to the hypothesis of self-defeating fiscal consolidations of DeLong and Summers (2012). If the negative effects of fiscal consolidation are long lasting, countries can enter a negative loop where attempts to reduce government debt are less effective because of the reductions in GDP. As GDP falls permanently, attempts to reduce debt via reductions in spending or increases in taxes lead to a higher debt to GDP ratio. Using our empirical results we produce a quick calibration of the model of DeLong and Summers (2012) and show that the calibrated parameter values support the notion of self-defeating fiscal consolidations for the group of advanced economies, more so for the Euro countries.

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8. Appendix. Calculation Forecast errors for potential and actual GDP.

When it comes to GDP forecast errors our methodology is straightforward. Let the forecast made in year $\boldsymbol{t}$ of a variable $\boldsymbol{Y}$ for the year $\boldsymbol{t+i}$.

$$\boldsymbol{Y_{t+i}^{F,t}}$$

So for GDP in 2009, the forecast made in 2007 will be expressed as

$$\boldsymbol{GDP_{2009}^{F,2007}}$$

We can compare these forecasts with the actual data for GDP at a later date to compute the forecast error. In some cases when we are talking about a future date from the perspective of both years we are calculating the change in forecast between the two years.

As an example, we an calculate the forecast error for the year 2009 made in 2007 by comparing to the actual data from the 2014 vintage of the WEO as:

$$FE_{GDP,2009}^{2007} = \frac{GDP_{2009} - GDP_{2009}^{F,2007}}{GDP_{2009}^{F,2007}}$$

The only issue we face when comparing these two GDP levels is that because of data revisions, changes in base year and also changes in national accounting rules, the forecast and the actual data might not be comparable as they might not be in the same units or follow the same national accounting criteria. Because we are interested in revisions to growth rates, we make the two number comparable by rebasing the original WEO 2007 real GDP series and its forecasts so that the 2006 data matches the data for that year of the WEO October 2014. In other words, given that the 2006 data now coincides in both the April 2007 and the October 2014 databases, the expression above can simply be calculated as the forecast error of accumulated GDP growth from 2006 to 2009:

$$FE_{GDP,2009}^{2007} = \frac{GDP_{2009}^{2014} - GDP_{2006}^{2014}}{GDP_{2006}^{2014}} - \frac{GDP_{2009}^{F,2007} - GDP_{2006}^{2007}}{GDP_{2006}^{2007}}$$

Where

$$GDP_t^{t+1}$$

refers to the data of GDP for year t as reported in the vintage for year $t+1$.

When it comes to potential output we face a more challenging task. In April 2007 when the IMF produces a number for potential output for 2006, this is not observed, it is an estimation of what they believed at that point potential was. Future values of potential output are also dependent on their views at that point in time.

Later when the crisis is in full force the IMF revises its views of potential output but it also changes its views on the level of potential output in the past. These revisions are very large and they completely change the perception of potential output levels in previous years. This means that a calculation of forecast errors of the level of potential GDP based on the accumulation of forecast errors of potential growth rates, as calculated above, would be misleading. Because the IMF has dramatically changed their views on potential output for both the current and future years by rewriting history, it would seem as if the previous path of potential output (measured in growth rates) has not changed that much. But the level has and we need to incorporate that in our estimates.

The way we do it is by ignoring these revisions and focusing on the level of potential GDP and not on its growth rates. We still need to take into account changes in national account rules or base year that might make the two numbers not fully comparable. In order to deal with these issues, we apply a correction factor to the potential output figures based on the revisions done to the latest GDP data from the perspective of the earlier vintage of the WEO being used. For example, in the calculation above for the forecast error for potential GDP in 2009 from the perspective of the April 2007 vintage, we rebase the potential output series found in the April 2007 database by the following factor:

$$\frac{GDP_{2006}^{2014}}{GDP_{2006}^{2007}}$$

We use 2006 as the year where the GDP data is known in April 2007 and look at the ratio of GDP in 2006 as calculated in the April 2007 and October 2014 vintages to make the potential output series comparable across the two databases.

Once this correction is applied we can calculate the forecast error as:

$$FE_{GDP,2009}^{2007} = \frac{POT_{2009}^{2014} - POT^{*F,2007}_{2009}}{POT^{*F,2007}_{2009}}$$

Where

$$POT^{*F,2007}_{2009}$$

is the rebased series of the forecast of potential GDP from the April 2007 vintage using the adjustment factor.