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Stimulus and Fiscal Consolidation: The Evidence and Implications

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Draft

Stimulus and Fiscal Consolidation: The Evidence and Implications

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Abstract

This paper examines the evidence on the impact of stimulus and fiscal consolidation in the context of a severe economic slump like the Great Recession. The first part reviews some of the major works on this topic in the last decade. It notes that the research clearly points in the direction of stimulus increasing growth during a prolonged slump. The second part examines the impact of changes in government consumption and investment on growth, using data from advanced countries since 1980. Consistent with most prior literature it finds that increases in government spending during downturns lead to increases in growth. It then constructs siumulations for the period since the Great Recession showing multipliers in the neighborhood of 1.5. The third part notes new evidence suggesting that potential GDP appears to have fallen sharply as a result of the downturn. A full model of the impact of stimulus would have to incorporate this effect which is likely to be large relative to the size of the stimulus.

Introduction

In the immediate aftermath of the 2008 economic collapse governments throughout the world adopted stimulus programs to reverse the downturn. While this stopped the decline and restored growth, by 2010 the agenda had rapidly shifted. Even though the economies in all of the developed countries were still far from full employment, the policy focus turned toward fiscal consolidation. Most countries sharply pared back the measures put in place the prior year with the goal of reducing debt to GDP ratios.

This paper examines the wisdom of that strategy. The first part reviews some of the key works in a now extensive literature on the effectiveness of stimulus and the extent to which fiscal consolidation is consistent with sustaining growth. The second part presents our own analysis of the evidence, focusing on the impact of direct government spending on consumption and investment. It also presents simulations showing a counterfactual in which the developed countries had embarked on a path of simultaneous stimulus in 2010 rather than contraction.

The third part discusses a growing body of literature suggesting long-term effects from a sustained period of stagnation. The implication of the evidence assembled in this work is that countries might pay a substantial price long into the future as a result of a decision not to use stimulus to bring down unemployment. It also suggests that standard short-term measures of multipliers may not be accurate in the context of an economy operating at levels of output that are far below potential. The effect of stimulus in this context would not only be the short-term boost in demand, but also an increase in potential GDP. Since this research indicates that a reduction in potential GDP due to a period of depressed output may occur fairly rapidly, this could mean that a mid-term multiplier (2-4 years) would be substantially larger than estimates based on economies that are operating close to potential GDP. This effect would not be picked up in our analysis or in the research discussed in section 1.

The Evidence on Fiscal Stimulus and Expansionary Contraction

The standard Keynesian case for stimulus is well known. The argument is that in a period when the economy is below full employment fiscal stimulus, either in the form of direct spending, transfer payments, or tax cuts, can create additional demand and pull the economy up toward potential GDP. In recent decades, governments have been reluctant to use active fiscal policy to restore full employment under the assumption that recessions would be short and that a combination of monetary policy and automatic stabilizers would be sufficient to restore full employment before the full effect of active policy measures could be felt. In this situation, active fiscal policy as stimulus would both be unnecessary and risk inflation since it would be boosting the economy when it was already approaching potential GDP. Nonetheless, even if might not generally be desirable as policy, the conventional view was still that expansionary fiscal policy could stimulate the economy.

This view has been challenged in the last two decades, most importantly in a series of papers by Alberto Alesina (e.g. Alesina and Perotti, 1995; Alesina and Ardagna, 1998; and Alesina, Perotti,

and Schiantarelli, 2002). These papers argue the case that conventional Keynesian stimulus can be contractionary while fiscal consolidations can increase growth even in the short-term. The argument advanced in these papers is that the structural determinants of investment and consumption spending can more than offset the direct impact of changes in government spending and taxation. Fiscal consolidation also reduces the risk of debt write-offs, which will reduce the risk premium attached to government debt and thereby help to lower interest rates throughout the economy.

This view highlights the merits of fiscal consolidations based on spending reductions. The argument is that deficit reductions based on reduced spending is likely to give households and businesses more confidence of a lasting change in regime so that they can anticipate lower future tax burdens. This will give consumers more confidence to spend and businesses will invest more in the anticipation of higher future after-tax profits. In addition, if spending cuts are associated with a reduction in government employment and/or a reduction in the wage and benefit packages for government employees, then this will place downward pressure on wages throughout the economy. The prospect of lower wage costs will be a further inducement for businesses to invest, providing another channel through which the private sector response to a fiscal contraction based on spending cuts may be expansionary. Also, lower wage costs may provide a boost to net exports, which would be especially important in the context of smaller open economies.

By contrast, the expansionary austerity literature argues that fiscal consolidations based on tax increases are less likely to be expansionary precisely because they do not signal a regime change on the part of the government. A consolidation that does not involve spending cuts leaves open the prospect of further tax increases in the future, since large deficits may reoccur. As a result consumers and businesses will continue to fear higher future tax rates. Also, if the consolidation does not involve a reduction in public sector employment or reductions in public sector compensation then it will not lead to a reduction in private sector wages. For these reasons, the authors argue that fiscal consolidations should be primarily spending based.

These papers produce a se ries of analyses that largely support the conclusion that fiscal consolidations can be expansionary, if based primarily on reductions in spending. The methodology employed in most of this work is to use a measure of structural budget deficits as the main independent variable. The preferred measure is one derived from Blanchard (1990), which adjusts the year to year budget deficit for changes in unemployment rates based on the longer term relationship between deficits and the unemployment rate.

Using this measure for changes in the deficit, this work finds considerable evidence both that fiscal consolidations based largely on spending cuts can be expansionary and that consolidations based primarily on tax increases will be contractionary. Furthermore, the consolidations based on spending cuts are found to lead to reductions in the debt to GDP ratio, whereas the effect of tax based consolidations is ambiguous.

Their work finds little evidence that either differences in monetary policy or movements in the exchange rate play a major role in determining the success of a fiscal adjustment. It finds little difference in real interest rates between expenditure based or tax based adjustments. It also finds little difference between the changes in the trade balance between successful adjustments and

unsuccessful adjustments, although Alesina and Ardagna (1998) do find evidence of a shift in distribution from wages to profits in export sectors.

In short, the main policy conclusion from this work is that an adjustment based primarily on expenditure reductions is likely to be expansionary, primarily due to the effect of the adjustment on confidence among consumers and businesses. This effect is especially large in countries that already had high initial levels of debt, which presumably can be explained by the fact that such countries were especially likely to face debt crises in the absence of successful adjustments.

The set of papers produced by Alesina provide the basis for the view that consolidations can be carried through at little cost in terms of lost output and unemployment, if they are focused on reductions in spending rather than tax increases. While their work appears to provide substantial evidence for this argument, there is a major problem in its definitions of consolidations. The main variable used in this work is a cyclically adjusted primary balance (CAPB).

There are two obvious problems with this measure that have been identified in subsequent work. First, adjustments may take place in direct response to cyclical conditions. For example, a government may opt to reduce the budget deficit in an economy that is growing rapidly and coming up against labor and capacity restraints. If this is the motivation for consolidations then it would not be surprising if they are associated with expansion. In this context the consolidation would be the result of an expansion, not the cause. In the same vein contractions might be expected to lead to stimulus measures, leading to an association between deteriorations in the CAPB and slower growth.

The other obvious problem is that cyclical adjustments are unlikely to capture the impact of taxes on capital gains on deficits. If boom periods are associated with a rise in the value of capital assets, which in turn leads to more capital gain tax revenue, then the CAPB is likely to move to surplus in boom times and to deficits during downturns. This also would raise an issue of causality where even though the expansion is leading to a rise in the CAPB, statistical analysis may suggest an opposite chain of causation (Guajardo et al 2011). Gechert and Menges (2013) provides another route for addressing the issue that the standard measures of cyclically adjusted budget deficits do not pick up the full impact of the cycle. It explicitly incorporates asset values into its analysis. The study includes the ratio of household wealth to liabilities as a separate exogenous variable explaining changes in GDP.

Using a variety of estimation techniques on quarterly U.S. data covering the years from 1960-2012, Gechert and Menges find clear evidence of a larger multiplier on government spending than in standard analyses. The logic of this result is straightforward. Insofar as wealth is an important factor driving household consumption, an analysis that excludes it as a causal variable will be missing a major driver of changes in GDP. For example, the strong growth in the United States in the late 1990s or the middle of the last decade could be attributed in part to a consumption boom driven by the stock bubble and the housing bubble respectively. An analysis that ignored this impact could wrongly attribute this growth to the decline in the government deficit during these years. Similarly, the declines in consumption following the collapse of these asset bubbles, and the resulting fall in GDP, could be wrongly associated with the increases in deficits in these periods.

The Gechert and Menges approach, which controls for the impact of wealth, should allow for a more accurate measure of the impact of government spending and taxes on GDP. The estimated multipliers in this analysis average more than twice as large as the estimates that do not separately incorporate the impact of household wealth.

A way to circumvent this set of issues is to directly analyze the motivation for policy measures and to only include explicit changes in policy that are not directly tied to cyclical factors. This is the logic behind the data set constructed by the I.M.F. for most of the OECD countries (DeVries et al., 2011).[1] This data set was constructed by reviewing budget documents to determine planned changes in fiscal policy that were not motivated by cyclical factors. In principle this should give a more accurate measure of exogenous changes in fiscal policy than the CAPB measures used in the Alesina work.

Using this data set, the I.M.F. (2010) re-examined the record of fiscal consolidations in the advanced countries over the period from 1980 to 2009. This analysis found that consolidations were in fact contractionary, with a consolidation equal to 1.0 percent of GDP on average leading to a reduction in output of 0.5 percent of GDP after two years and an increase in unemployment of 0.3 percentage points.

The analysis also noted that the effects of fiscal consolidation were typically mitigated by expansionary monetary policy and a real depreciation in the value of the currency. The latter was typically brought on by nominal devaluation rather than changes in relative prices. It also examined the evidence of an asymmetric response to spending and tax based adjustments. While the data showed that spending based consolidations were less contractionary than tax based consolidations this was largely attributable to a more aggressive monetary expansion by central banks.[2]

These two points are especially important in the context of the current downturn. With central banks running up against the zero lower bound in the advanced countries, they have little or no room for traditional monetary expansion. This means that they will be less able to counteract the effect of a fiscal consolidation than in the period analyzed in the sample. Also, with all the advanced countries facing a slump and trying simultaneously to reduce their deficits and debts, the opportunity to offset the impact of fiscal consolidation with improved trade balances will be limited. Finally, if the main difference in the impact between tax based and expenditure based consolidations is the response of central banks, then this choice will matter little in the current downturn since central banks are already up against the zero lower bound. Even if it might otherwise be the case that an expenditure based consolidation would be less contractionary than a tax based consolidation this would not be the case presently. This means that insofar as

1 The methodology used is the same as employed by Romer and Romer (2007).

2 The analysis also tested for evidence that spending based consolidations would be less contractionary if they were associated with cuts in transfer payments rather than cuts in government spending or investment. The argument being that cuts in these areas would show more political resolve by the government and therefore have a greater impact on confidence in the private sector. The analysis found some evidence to support this view, but the sample was too small to be statistically significant.

consolidation is pursued, there is less reason to rely on expenditure reductions in the current context.

There have been several other efforts in the last few years to attempt to estimate the impact of fiscal policy in ways that get around the problem of endogeneity of fiscal policy. Auerbach and Gorodnichenko (2012) use a methodology that explicitly allows for regime shifting between periods of expansion and recession. Using smooth transition structural VARs, the paper finds substantial differences in the impact of increases in government spending in periods of expansion and downturns. Also the paper finds that unanticipated changes in fiscal policy, based on an assessment of forecasts from a group of leading forecasters, have considerably more impact than anticipated changes in fiscal policy.

Blanchard and Leigh (2013) use an innovative methodology to test the impact of fiscal policy since the 2008 economic crisis. They use the difference between actual growth and forecasted growth as the dependent variable. The main independent variable is the size of planned changes in fiscal policy, as described in the IMF's assessment of consolidation plans. If fiscal multipliers have been accurately estimated in the original forecast the dependent variable should have a mean of zero and be uncorrelated with the size of fiscal consolidation plans. The logic is that any random events leading to better or worse than forecast growth should be independent of the size of any fiscal adjustments.

In fact, it turns out that errors were highly correlated with the size of the adjustment in a wide variety of different specifications. In the years 2009 and 2010 the coefficients on the size of the fiscal variable is generally between 0.7-1.0. It is somewhat smaller and less significant for the forecasts for 2012. This pattern suggests that the multipliers used in the forecasts were consistently too small. The paper indicates that the multiplier used in the forecasts was typically close to 0.5, implying that the true multiplier would be close to 1.5. They speculate that the lower multiplier for the more recent period is likely due to the fact that the IMF has used a large multiplier in response to its earlier forecast errors.

A set of regressions using OECD forecasts finds a similar pattern with the errors also being correlated with the size of the fiscal adjustment, although the coefficients were in the neighborhood of 0.5. They attribute this to the use of somewhat higher multipliers by the OECD in its forecasts. The paper also examines prior periods and finds no relationship between the size of the forecast error and fiscal actions. This suggests that the larger than assumed multiplier is a feature of the crisis and not a more general issue.

This methodology gives a relatively simple and convincing way to assess multipliers in the crisis. The changes in fiscal policy put in place during the crisis were fairly well specified and recorded by the IMF in their country reviews. It is difficult to envision an explanation for a systematic relationship between the size of a fiscal consolidation and the forecast error, if the forecasts did not systematically underestimate the size of the multiplier in the context of severely depressed economies with the short-term interest rate pressed against the zero lower bound.

Alesina, Favero, and Giavazzi, (2012) presents a novel approach in which it separates the adjustments in each country into announced adjustments and actual adjustments. For each

country, the paper assesses the impact of the adjustment program at the point at which it is announced, and compares the effect with the actual implementation of the program. This allows for the possibility that the announcement of a program for deficit reduction can have an impact apart from its actual implementation. This analysis produces interesting differences across countries. For example adjustment programs in countries in which governments have a reputation for following through on commitments, like the United States, seem to have their largest impact at the time of the announcement. By contrast in countries where the reputation of governments for following through on commitments is weaker, like Italy, most of the impact follows the actual implementation of the program.

While this is an interesting result most of the other main findings of the paper are consistent with the other work by Alesina and his co-authors. The paper finds that adjustments that are primarily expenditure-based are associated with relatively short and mild downturns. By contrast, adjustments that are tax-based are associated with longer and more pronounced downturns.

The paper finds that the difference in outcomes is associated with a quicker uptick in both consumption and investment in spending based adjustments compared with tax based adjustments.[3] However the mechanisms for the upturn highlighted in the analysis is the impact on business and consumer confidence. The paper shows that spending based adjustments have a more positive impact on both measures in regardless of specification. This is also true across countries where the confidence indices show a more positive response to expenditure based adjustments in nearly every case.

While this is an interesting finding, its importance for policy is questionable. The indices of business and consumer confidence are not consistent predictors of growth. To a large extent these indices reflect media coverage of economic news. In the case of the business confidence index, it is likely that a government austerity policy that is focused on spending reductions will get positive attention in the business press and will therefore lead to an improvement in business confidence measures. Salmond (2009) found exactly this sort of relationship between measures that are generally perceived as being pro-business and business confidence measures. However the rise in business confidence was not associated with an upturn in economic growth.

There is a similar situation with measures of consumer confidence. Croushore (2005) found that the consumer confidence indices in the United States do not help to forecast consumption. This analysis was based on real time data, which confirmed earlier results that were based on revised data. As is the case with business confidence, consumer confidence measures can be influenced by the media's coverage of economic policy. If the coverage moves these indices, then they

3 One issue with the investment data from the United States is that the growth of car leasing in the 1990s would have led to an upward bias in the measure of investment. While a car purchased by a consumer is treated as consumption in the national accounts, a leased car is owned by the leasing company. This means that as consumers shift from purchasing cars to leasing cars it will lead to an increase in reported investment even if the total number of cars purchased or leased did not change. In the 1990s this led to an increase in the investment share of GDP of approximately 0.3 percentage points, using the growth of the car leasing component of GDP as a proxy for the size of this effect (National Income and Product Accounts Table 2.4.5, Line 71). The shift from car purchases to leasing would raise GDP by the same amount since both the purchase by the leasing company and the subsequent leasing payment would get counted in GDP, whereas with a car purchased outright by the end user only the sale would count in GDP.

move in ways that are not consistent with subsequent behavior. It is worth noting in this respect that the consumer indices are far more volatile that actual consumption patterns.

While Alesina et al. focus on the confidence mechanism for spurring investment and consumption to counteract the contractionary effect of spending cuts, it presents evidence that a more traditional interest rate channel is not likely to be an important transmission mechanism for boosting the economy. The analysis finds that spending based adjustments lead to a larger immediate response by central banks, with rate cuts of averaging roughly 25 basis points following the announcement as opposed to stable or slightly increasing rates in the case of tax based adjustments. However, the cut in the policy rate appears to have little impact on longer term rates. The paper finds that spreads typically increase in spending based adjustments relative to tax based adjustments. Insofar as longer term interest rates are the main determinants of economic activity, the paper finds there is little difference in the impact of spending and tax based adjustments.

The paper's findings are also somewhat at odds with Alesina's earlier papers in that they find that spending adjustments have a substantial negative impact on growth and investment. While this paper emphasizes the more negative impact of tax based adjustments, it still finds that spending based adjustments have negative impact on growth, investment, and consumption. Furthermore, in several of the specifications the impact remains negative for the four year window of analysis (see Figures 10, 11, 12). This result contradicts the view that fiscal adjustments do not have even short-term negative effects on output.

Apart from the specific issues with the Alesina et al. analysis there is a more fundamental problem with the action based approach to fiscal policy used in this paper and other work relying on the IMF data set. The definition of "action" is inconsistent. Tax increases that are written into law long in advance are treated as action based policy. For example, in the United States a series of increases in the payroll tax dedicated to funding Social Security, which were written into law in 1983 and then took effect in steps over the next seven years, are treated as action based increases in taxes even though these increases were written into law many years in advance.

By contrast increases in spending that are direct outcomes of the design of the program are not treated as action based even though these can be known in advance with almost the same degree of certainty. For example the increases in spending on the Social Security program in the United States that could be and were predicted well in advance based on the demographics of the population. In fact, the purpose of the tax increases is precisely to offset these projected increases in spending. The same would be true of the Medicare program where increases in spending can be predicted well in advance based on demographics and trends in health care cost growth.

Since these increases in spending are not included in the analysis, the IMF's measure of action may give a misleading picture of actual spending patterns. In the case of the United States the IMF's data set shows a cumulative reduction in spending from 1988 to 1996 of 2.38 percentage points of GDP. The I.M.F. data set shows a reduction in spending for every year over this stretch except 1989, shown in **Table 1-1**. However the Congressional Budget Office's data shows that spending over this period fell by just 1.1 percentage point of GDP from 21.3 percent in 1988 to 20.2 percent in 1996 (CBO, 2013, Table 3). Almost none of this difference could be explained by

cyclical effects, as the unemployment rate was virtually identical at these two points in time (5.5 percent in 1988 and 5.4 percent in 1996).

The reduction in spending shown in the IMF data is more than 100 percent larger than the reduction in spending shown in the CBO data. This is problematic from the standpoint of an analysis attempting to measure the effect of fiscal adjustments. In effect, the IMF data set is showing cuts in spending that do not correspond to actual reductions in government spending. If spending cuts are in fact contractionary, then an analysis measuring the impact of spending cuts on GDP that relied on the IMF data set would be biased downward (i.e. toward showing less impact) since the reported reduction in spending is much larger than the reductions in spending that actually occurred. In other words, even if planned cuts in spending did typically lead to reductions in GDP, the IMF data set would likely not find evidence for this effect since its measure of planned cuts in spending would be much larger than the actual cuts that would take place.

It would require a thorough analysis of the IMF data set comparing its measure of spending reductions with actual spending reductions to determine the extent to which this problem exists with the data for other countries. However in a context where aging populations were leading to large and predictable increases in spending on public pensions and health care programs, it is virtually certain that the IMF methodology would lead to a systematic overstatement of actual spending reductions, as well as an understatement of spending increases. This is likely to lead to a serious bias in analysis based on these data.

Finally, it is worth noting a recent meta-analysis of research on fiscal multipliers. Gechert (2013) examined 104 separate studies of fiscal multipliers with 1069 separate multiplier regressions. The analysis found estimated multipliers for government spending were generally close to 1.0, although there were substantial variations by the type of model. Estimated multipliers for investment spending were somewhat higher at close to 1.5. Spending on public employment seemed to have a slightly higher multiplier than government spending in general. The multiplier for military spending was the same as for other forms of government spending. The meta-analysis found multipliers for taxes and transfers were typically in the range of 0.5-0.6.

Other findings of the meta-analysis were consistent with standard theory and commonly reported results. The multipliers in more open economies were lower than those for economies that for economies that were more domestically driven. It also found evidence that the multiplier in models for the years since the onset of the crisis, with monetary policy against the zero lower bound, were somewhat higher, averaging near 2.0.

This study provides an up-to-date assessment of the literature on fiscal multipliers. There are large differences in multipliers depending on the type of the model. In particular, real business cycle models produced multipliers close to zero. However, the overwhelming majority of the models examined in this analysis support the view that government spending multipliers are likely to be substantial, especially when monetary policy is rendered less effective by being close to the zero lower bound.

Section 2
Regression Model and Simulation Results

In our analysis we examine the impact of changes in government consumption and investment spending as a share of potential GDP. The logic for picking these two variables is that the changes will generally be a direct result of deliberate policy decisions rather than a passive response to changes in the economy. This is not a perfect measure of some of the reasons noted in the prior section. These policy changes could still be a response to economic conditions, for example an increase in public investment that is made in response to an economic downturn. Of course increased spending could also be the result of a strong economy producing better than expected tax revenue. In the absence of a consistent measure of spending changes that excludes those responding to the cycle, the changes in these categories of government spending may be the closest approximation available.

To test the impact of stimulus in these categories of spending we first did simple autoregression-based simulations of an increase in spending on government consumption and investment each equal to 0.5 percentage points of GDP in over six-year rolling windows from 1985 through 2014. The data used in this analysis are annual data on GDP and its components, and fiscal policy taken from the OECD's Economic Outlook (2013).[4] **Figure 2-1a** shows the simulated impact of a permanent increase in spending while **Figure 2-1b** shows the impact of a temporary (one-year) increase. In both cases exports are held constant as a share of GDP. This is implicitly assuming that the stimulus is coordinated effectively so that other countries' imports are rising to ensure that the rise in imports associated with an increase in GDP is offset by an equal increase in exports.

The figures show substantial differences in the impact of stimulus over this period. In periods where economies faced recession, such as at the end of the 1980s or in the years since the 2008 downturn, the simulated impact of stimulus is considerably larger than in the years when most economies were closer to their potential levels of output. The impact of the permanent increase in these periods of economic weakness is considerably larger than the temporary increase. The impact of the temporary increase fades to zero or turns negative by the second year even in periods of recession. This implies that there would not be a lasting boost to GDP from temporary stimulus, at least using the variables in this model.[5]

Figures 2-2a and 2-2b show the projected impact of a permanent 1.0 percentage point increase in government consumption and investment, respectively. In each case the other component is held fixed. The figures show that investment appears to provide a larger boost to the economy. This could be due to the fact that government investment also has a supply side impact, increasing the economy's potential level of output. However it is also possible that the analysis has inadequately controlled for cyclical effects. In that case, the projected impact of consumption

4 The regression equation is structured to follow the IMF (2010) Appendix 3.2 (http://www.imf.org/external/pubs/ft/weo/2010/02/pdf/c3.pdf) (See also our Technical Appendix)

5 The next section will discuss the issue of whether sustained periods operating below potential GDP can lead to permanent losses in output. Insofar as this is the case, it might be expected that there would be permanent effects from a temporary stimulus. However this may only be relevant in a downturn of the magnitude of the 2008 crisis, not a more typical recession.

spending, which may be easier to undertake quickly in a downturn, could be biased downward. However, the fact that the differences in the impact are largest in years two and three support the view that the investment spending is actually increasing potential GDP.

Figures 2-3a and 2-3b show the simulated effect of a permanent and temporary increase in the budget surplus (net lending) equal to 1 percentage point of GDP. Both graphs show little evidence of a positive impact. This shows that there is at least no simple story whereby fiscal contraction leads to faster growth. Of course this does not fully control for the extent to which changes in the fiscal stance have been endogenous, so it is not a full test of the expansionary austerity hypothesis.

To sum up these simulations, government investment spending was shown to have the strongest impact on growth, with consumption also having a modestly positive effect. The effect of permanent increases was substantially larger than temporary increases, particularly so during recessions. And, the positive impact varied considerably over this three decade period. There is strong evidence of a positive impact around the recessions of the 1990s and especially since the 2008 downturn. In years when the economy was operating closer to potential GDP, there is little evidence of a positive growth effect from any form of stimulus.

The Impact of Stimulus Following the 2008 Downturn

In this section we explicitly model the impact of stimulus applied in the years since the downturn.

Real GDP growth is the dependent variable in the regressions in **Table 2-1**. The first column shows results from a model using lagged growth, government consumption (CGAA), and government investment (IGAA) (see appendix for a fuller description). It also includes an export term (XGS), which was restricted to remain constant as share of actual GDP. The logic in this restriction was to approximate the impact of a coordinated stimulus in which all of a country's trading partners carry through a comparable stimulus. In principle this should lead exports to grow at roughly the same pace as each country's GDP.

In this regression, the coefficients for CGAA and IGAA are large and highly significant. The long-run multiplier, which is defined as the sum of the contemporaneous impact on GDP, plus two lagged years, is 1.5 in the case of CGAA and 2.2 in the case of IGAA.

The second column shows the result from a regression which holds net exports as a percent of potential GDP constant (FBGS) as an alternative way to approximate a coordinated stimulus. This model shows a somewhat smaller, but still highly significant multiplier for both CGAA and IGAA. It is likely with this control, output is constrained in order to limit the rise in imports, as opposed to the specification in Column 1 in which exports would be assumed to rise to hold the export share of GDP constant.

The third column shows results from a regression without any controls on the trade variables. In this case the multipliers are virtually the same as in the regression shown in column 1. This is

useful since it shows that the multiplier results shown in column 1 do not in depend on any constraints on the trade variable.

The fourth column shows the results of a regression that includes a permanent increase in primary net lending an independent variable. This is an unspecified increase in the prinary budget spending, not distinguishing between spending cuts or tax increases. This increase appears to have little, if any, long-term impact on growth, though the short-term effect may be contractionary. In part, this uncertainty is due to the timing of lags, and in part this is due to composition effects as an increase in net lending could be the result of an increase in net taxes, cuts in government consumption, or cuts in government investment. The fifth column shows similar results from a regression without any controls on trade variables.

In order to estimate the effects on unemployment, the ratio of unemployment rate (UNR) to OECD estimate of the NAIRU is modeled as a function of potential output divided by GDP (IFU3). **Table 2-2** shows the country-specific coefficients.[6] This Okun's Law type inverse relationship between GDP and unemployment is found to be significant in nearly every country, but the magnitude of the effect is uncertain and varies greatly from country to country.[7] Note for example, Germany, which has successfully cut hours to fight unemployment.

Due to the large uncertainties in the regression coefficients and the question of timing of the effects, it is not easy to get a good idea of what this data mean in real-world terms. To help visualize the results, we present simulations of the effect of stimulus relative to an historical baseline.

In **Figure 2-4**, we see results for the United States. The figure uses the regression results shown in Table 2-1, with a confidence interval derived from the variance-co-variance matrix as indicated in the appendix. This figure shows baseline (solid red) and counterfactual (broken red with confidence bounds) series for real GDP (GDPV), the unemployment rate (UNR), primary net lending (NLGX) and government net debt (GNFL). The counterfactual represents a one-percentage point of potential output expansion of government expenditures (split evenly between consumption and investment) in 2009. The stimulus is removed in 2012.

The stimulus adds between 0.5 and 1.6 percentage points to real output when in effect, while not hurting output in the medium run. Likewise, the stimulus reduces the unemployment rate by 0.3-0.9 percentage points during the same period. The increased output increases revenues and the lower unemployment reduces transfers, so the actual increase in actual primary net borrowing is only 0.6-0.9 percentage of GDP per year. By 2012, net borrowing is a bit smaller than without the stimulus, so by 2014, government debt is increased by 1.8-2.4 percentage points of GDP, in a context where the total stimulus was six percent of potential output over three years.

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6 A coefficient of 5 implies that an economy with a NAIRU of 5% would see a 1 percentage point rise in unemployment for every 4 percent decline in GDP. The coefficient means that the percentage increase in unemployment rate from the NAIRU is five times as large as the fall in GDP from potential. Therefore a 4 percent fall in GDP below potential implies that the unemployment rate rises by 20 percent (5*4) above the NAIRU, or 1 percentage point. By comparison, a country with a NAIRU of 15% would see a 3 percentage point rise in unemployment for each 4 percent decline in output.

7 The Okun relationship between output and unemployment is taken from OECD's Economic Outlook.

The effects scale closely with the size of the stimulus, as seen in **Figure 2-5**, where the spending increases are doubled. The effect on output peaks in 2011 at 1.3-2.9 percent of GDP, with a 0.8-1.7 percentage point drop in unemployment. By 2014, debt is raised by 3.8-4.9 percent of potential output.

Note that while these regression results incorporate any effect the additional investment has on short-run GDP, these simulations assume potential output is held fixed regardless of the size of the stimulus. To the extent that additional investment (either government investment, or induced private investment) raises potential output and increases the space for additional growth, these results understate the benefits of stimulus.

The following figures parallel Figure 2-5, but we see results for several different countries. We see two other large economies in Germany and France as well as three countries (Greece, Spain, and Italy) that have seen large downturns. The results of these simulations are briefly summarized in **Table 2-3** following the figures.

As we see in Table 2-3, the effects on output are consistent across countries, but the various unemployment responses coupled with different tax and spending elasticities widen the range of net budgetary effects. Additionally, we see the effect of higher interest rates in Greece.

Even there, the simulations suggest effective stimulus. If we compute the 2014 future value of the additional GDP between 2009 and 2014 and divide by the increase in 2014 net debt, the lower bound on this multiplier is not $1.5/5.6 \approx 0.2$ because the increase in output and the increase in debt are negatively related. Rather, the confidence interval of estimated multipliers in Greece is 0.7-2.9 with a central estimate of 1.8. **Table 2-4** shows these results for Greece and other countries in the sample.[8]

In Table 2-4, we see that the simulations show most of the uncertainty in the multiplier on the upper bound—that the lower bound is consistently in the 0.7-0.8 range, with central estimates in of at least 1.5. The most notable exception is Italy, with the highest multiplier estimate of 2.6, but with a very wide range of uncertainty—anywhere from 0.3 to 5.2.

8 Though in the sample, Estonia and Israel are excluded here for missing data required for these additional calculations.

Section 3
The Long-Term Impact of Divergences from Potential GDP

There is a growing body of research suggesting that economies will experience lasting declines in potential GDP as a result of a prolonged period of below full employment levels of output. The main channels for this drop in potential output are through the reduction in the size of the potential labor force, a falloff in the rate of capital accumulation as investment growth drops in response to slower demand growth, and a weakening of multi-factor productivity growth as fewer new firms are created and the ones that do exist have a more difficult time getting access to capital.

The argument on the reduction in the size of the potential labor force is probably the longest standing and best established channel for claiming that a prolonged downturn can have a lasting impact on potential GDP. This reduction can occur if a substantial percentage of the long-term unemployed lose their attachment to the labor force and fail to maintain their skills. This can make it considerably more difficult for them to become employed even when demand picks up to the point where their labor can be used. This hysteresis argument largely stems from Blanchard and Summers (1986).

In addition it may also be the case that the quality of labor will not improve to the same extent if a substantial segment of the workforce is unemployed or underemployed. Workers may improve their skills less quickly in this context both because there is less demand, since employers are not placing a premium on maximizing output and there is less opportunity.

The reduction in capital accumulation is a simple outcome of slower growth. With firms seeing less demand they have less need to invest in new more productive equipment. They also have less internally generated capital insofar as profits are depressed, as was the case during the years of the recession itself. This effect will be even more serious insofar as outside sources of capital are restricted due to the disruptions experienced by the financial system.

Finally, the creation of new firms falls off in downturns. Insofar as new firms are sources of innovation in production and organization, the slowing rate of firm creation will imply a slower rate of multi-factor productivity growth.

Reifschneider, Wascher, and Wilcox (2013) use a model of unobserved components of potential GDP to estimate that the prolonged downturn following the collapse of the housing bubble in the United States led to a reduction in potential GDP of 7.0 percent in 2013 from its 2007 trend path. This implies a substantial cost from allowing the economy to persist at levels of output that are substantially below potential.[9]

This is lowering of estimates of potential GDP is not unique to the United States. In the years since the downturn, official forecasters such as the OECD and the IMF, along with most

9 DeLong and Summers (2012) produce a similar analysis, arguing that the downturn in the United States is likely to have enduring cost in the form of higher rates of unemployment and lower potential GDP. See also Kienzler and Schmitt (2013).

independent forecasters, have sharply lowered their estimates of potential GDP for most wealthy countries. **Figure 3-1** shows the IMF's estimate of potential GDP for 2013 in its April 2008 Economic Outlook compared to the estimate from its October 2013 Outlook.

The base of comparison is 2007 actual GDP. This is a useful denominator since it shows not only the change in the estimates over this five year period, but it allows for a comparison with what these economies were actually capable of producing six years earlier. The average difference between the 2008 projection for 2013 potential GDP and the 2013 estimate of potential GDP for this list of countries is 13.7 percentage points of 2007 GDP as shown in **Table 3-1**. This gap is driven in part by extreme drops in the estimate of potential GDP in countries like Greece (37.2 percentage points), Slovenia (30.3 percentage points) and Cyprus (29.6 percentage points), but even if these extreme cases are removed it still leaves an average gap of 11.0 percentage points.

While these calculations are somewhat crude, they imply a large falloff in potential GDP as a result of five years in which economies were operating below potential GDP. Of course, it is possible that the drop off in potential GDP shown in the table is inflated either by the 2008 overstating potential GDP or the 2013 estimate understating potential.

In this respect the use of the 2007 actual GDP numbers as the denominator is helpful. In 9 of the 23 countries shown, the 2013 estimate of potential GDP is below 2007 actual GDP. In most of the remaining countries where the 2013 estimate for potential GDP is higher than the 2007 actual the implied growth rate of potential GDP is less than 1.0 percent annually. The fact that the 2013 estimates of potential GDP are so low relative to actual 2007 GDP, implies that if the downturn itself did not lower potential GDP, then almost all of these countries would have been operating at levels of GDP that were far above their potential in 2007.

This seems at least implausible, if not altogether impossible. The notion that some countries were operating above potential GDP, for example as a result of unsustainable inflows of capital, is plausible. However it would be difficult to construct a scenario in which all of the wealthy countries were simultaneously operating at levels of output that was far above potential GDP.

It is also quite plausible that the 2013 estimates of potential GDP are understating the true potential output of these economies. This would also lead to a situation in which the calculations in Table 3-1 would overstate the actual decline in potential GDP. (It is worth noting that if estimates of potential GDP become the basis for policy then they could prove to be self-fulfilling even if they are not accurate. Specifically, if policymakers wrongly assume a country is at potential GDP because have underestimated its true potential, this could lead them to pursue more contractionary policy than would otherwise be the case. Such policy could prevent an economy from reaching its true potential GDP.)[10]

However, even if there is a large amount of error on both sides of these calculations, it is almost certainly the case that the advanced countries saw a sharp decline in their potential GDP as a

10 This issue can also arise in terms of performance targets set by the IMF, ECB, and EU for the crisis countries. If deficit targets are set in terms of structural deficits, then an erroneous estimate of potential GDP will have real effects. If the estimate of potential GDP is lower than true potential GDP then countries will be required to undertake more contractionary fiscal policy than had been intended.

result of the downturn. This impact of a prolong period of below full employment levels of output on potential GDP is important to consider in assessing multipliers, since it provides another reason for believing that multipliers are likely to be higher during a severe downturn like the one following the 2008 crisis.

In effect, a boost to demand from fiscal stimulus will not just be increasing short-term output but also lifting potential GDP as well. This means that some of the impact of short-term stimulus will be permanent. It would not be possible to pick up this effect in standard analyses of macro data of the sort discussed in the first section or shown in the second section. Through most of this period most countries were arguably reasonably close to their potential level of output most of the time, so that they would not have experienced enduring declines in potential GDP due to the recessions that did occur.

The downturn following the 2008 crisis would be unique in this respect. To determine the rate and extent of this effect it be necessary to examine cross country declines in potential GDP as a function of the drop in actual output. The calculations shown in Table 3-1 indicate that the rate of loss of potential output is quite rapid. With an average drop in estimated potential GDP of 13.7 percentage points following five years of recession, the implied annual loss of potential is 2.7 percentage points. Even if the outliers are excluded and it is assumed that half of the decline is attributable to measurement error rather than a true decline in potential output, it would still imply a loss in potential output averaging 1.1 percentage points for each year of the downturn.

As a practical matter it is almost certainly the case that the loss of potential GDP is not linear either in duration or with respect to the departure of actual GDP from potential. It will require further research to understand the determinants of this drop in potential output. However the effect is clearly large enough to indicate that the multipliers in a severe downturn are much larger than conventional analysis indicates, not only because of short-term factors like the zero lower bound on central bank rates, but also as a result of the impact of fiscal stimulus in raising potential output.

Conclusion

This analysis has briefly reviewed some of the key literature on the effectiveness of fiscal stimulus. It notes that most of it appears to point in the direction that government spending can have a substantial impact on output during a downturn. It also notes that some of the findings in this area are likely biased downward due to miscategorization of substantial areas of government spending. Specifically, predictable increases in spending that are attributable to well-known demographic trends are not treated as spending increases in a widely used IMF data set identifying deliberate changes in spending and taxes that are not linked to the business cycle.

The second part examined the impact of increases in government consumption and investment spending. It also constructed a series of simulations examining the impact of an increase in government consumption and investment each equal to 0.5 percentage points of GDP over the years 2009-2011. The analysis found standard Keynesian type effects with the spending leading to substantial increases in output and reductions in unemployment over this period.

The third part briefly referenced a growing body of research that is related drops in potential GDP to prolonged periods of depressed output. This research notes that workers lose skills after being unemployed for long periods of time. In addition, economies will forego productivity gains due to delayed investment and a reduction in the number of new firms introducing innovations in production and organization. As a result, there are likely to be long-term effects from a prolonged slump. The sharp declines in the IMF's projections of potential GDP for 2013 between its 2008 projections and 2013 estimates, suggest that the enduring impacts of a prolonged slump are likely to be substantial. This would imply that the mid-term multipliers in a severe slump like the one currently facing the wealthy countries will be larger than conventional estimates, since the latter only measure the short-term impact on demand, not the effect on increasing potential GDP.

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Tables and Figures

TABLE 1-1

Reductions in U.S. Government Spending in I.M.F. Action-based Data Set and Actual Spending as a Share of GDP, 1988-1996.

	I.M.F. Data Set (percentage points of GDP)	Actual Spending as (percent of GDP)
1988	0.46	21.3
1990	0.07	
1991	0.29	
1992	0.28	
1993	0.23	
1994	0.5	
1995	0.33	
1996	0.22	20.2
Total change	**-2.38**	**-1.1**

Source: Devries et al. 2011, Table A1 and CBO, 2013 Table 3.

TABLE 2-1
Growth Results (2009-)

Variable	Lag	(1)	(2)	(3)	(4)	(5)
G	1	0.15 (0.07)*	0.04 (0.07)	0.07 (0.07)	0.04 (0.07)	0.20 (0.07)**
	2	-0.32 (0.07)***	-0.37 (0.06)***	-0.35 (0.06)***	-0.30 (0.07)***	-0.25 (0.07)***
CGAA		1.2 (0.2)***	0.9 (0.2)***	1.0 (0.2)***		
	1	-0.1 (0.2)	-0.4 (0.2)	-0.1 (0.2)		
	2	0.5 (0.2)*	0.5 (0.2)*	0.5 (0.2)*		
	joint	9.92***	7.43***	8.00***		
IGAA		1.3 (0.3)***	0.9 (0.4)*	1.2 (0.4)***		
	1	0.7 (0.3)*	0.8 (0.3)*	1.0 (0.3)**		
	2	0.2 (0.3)	0.2 (0.3)	0.2 (0.3)		
	joint	6.35***	3.64*	6.49***		
NLGA					-0.07 (0.05)	-0.13 (0.06)*
	1				-0.07 (0.05)	-0.02 (0.05)
	2				0.03 (0.05)	0.12 (0.05)*
	joint				1.61	4.37**
FBGS			-0.02 (0.08)		-0.21 (0.09)**	
	1		-0.28 (0.07)***		-0.32 (0.07)***	
	2		-0.06 (0.07)		-0.11 (0.07)	
	joint		6.35***		10.11***	
XGS		0.16 (0.06)***				
	1	-0.09 (0.04)*				
	2	0.07 (0.04)				
	joint	6.40***				
Countries		30	30	30	29	29
Obs		180	180	180	174	174
R^2		0.58	0.52	0.53	0.51	0.52
LR mult	CGAA	1.5 (0.4)***	1.0 (0.4)*	1.5 (0.4)***		
	IGAA	2.2 (0.7)***	1.9 (0.7)**	2.4 (0.7)***		

Regressions include country-specific and year fixed effects
Standard errors in parentheses
"joint" results are F-tests for joint significance of all lags of the variable
Approximate (permanent) long-run multiplier is sum of coefficients for current and lags variable
* Significant at 5% ** Significant at 1% *** Significant at 0.1%

TABLE 2-2
95% Confidence Intervals on Unemployment Equation Coefficients

Country	Lower Bound	Upper Bound
AUS	3.1	8.9
AUT	1.7	6.5
BEL	1.5	6.4
CAN	3.1	5.9
CHE	6.8	11.6
CZE	2.0	5.5
DEU	**0.4**	**4.6**
DNK	4.4	7.8
ESP	3.5	6.6
EST	3.5	5.2
FIN	2.7	4.9
FRA	0.8	5.5
GBR	2.0	6.1
GRC	3.5	5.8
HUN	-0.3	3.6
IRL	3.5	5.5
ISL	4.8	6.9
ISR	0.6	4.7
ITA	0.5	4.3
JPN	2.1	5.3
KOR	4.3	6.7
LUX	0.8	4.4
NLD	6.4	10.6
NZL	1.5	6.3
POL	0.8	7.3
PRT	3.5	6.2
SVK	1.1	4.0
SVN	1.2	4.2
SWE	4.2	7.2
USA	6.2	10.5

TABLE 2-3
Sample results for select countries

Country	Increase in GDP (% of baseline GDP) 2011	Drop in Unemployment (% of labor force) 2011	Increase in Deficit (% of GDP) 2011	Increase in Debt (% of GDP) 2014
DEU	1.5-3.3	0.3-0.5	0.8-1.4	2.8-4.3
ESP	1.5-3.4	1.3-3.0	0.8-1.5	4.3-5.7
FRA	1.5-3.3	0.4-0.9	0.5-1.3	2.8-4.5
GRC	1.5-3.4	1.0-2.1	0.8-1.5	5.6-7.9
ITA	1.5-3.4	0.3-0.6	0.4-1.3	2.3-4.7
USA	1.5-3.3	0.8-1.7	1.0-1.6	4.2-4.8

Source: OECD Economic Outlook and author's calculations.

TABLE 2-4
Simulated Multipliers (95% Confidence Intervals)

Country	Lower Bound	Central Estimate	Upper Bound
AUS	0.8	1.5	2.2
AUT	0.7	2.0	3.4
BEL	0.7	2.0	3.4
CAN	0.8	1.7	2.6
CHE	0.8	1.6	2.3
CZE	0.8	1.8	2.8
DEU	0.8	2.0	3.3
DNK	0.5	2.4	4.6
ESP	0.8	1.7	2.6
FIN	0.8	2.1	3.3
FRA	0.7	2.1	3.6
GBR	0.7	2.0	3.4
GRC	0.7	1.8	2.9
HUN	0.8	2.0	3.2
IRL	0.8	1.7	2.7
ISL	0.8	2.0	3.2
ITA	0.3	2.6	5.2
JPN	0.8	1.6	2.5
KOR	0.8	1.5	2.2
LUX	0.6	2.3	4.2
NLD	0.8	1.8	2.9
NZL	0.8	1.6	2.4
POL	0.8	1.5	2.3
PRT	0.7	1.8	2.8
SVK	0.8	1.7	2.5
SVN	0.7	2.1	3.5
SWE	0.7	2.2	3.7
USA	0.8	1.5	2.2

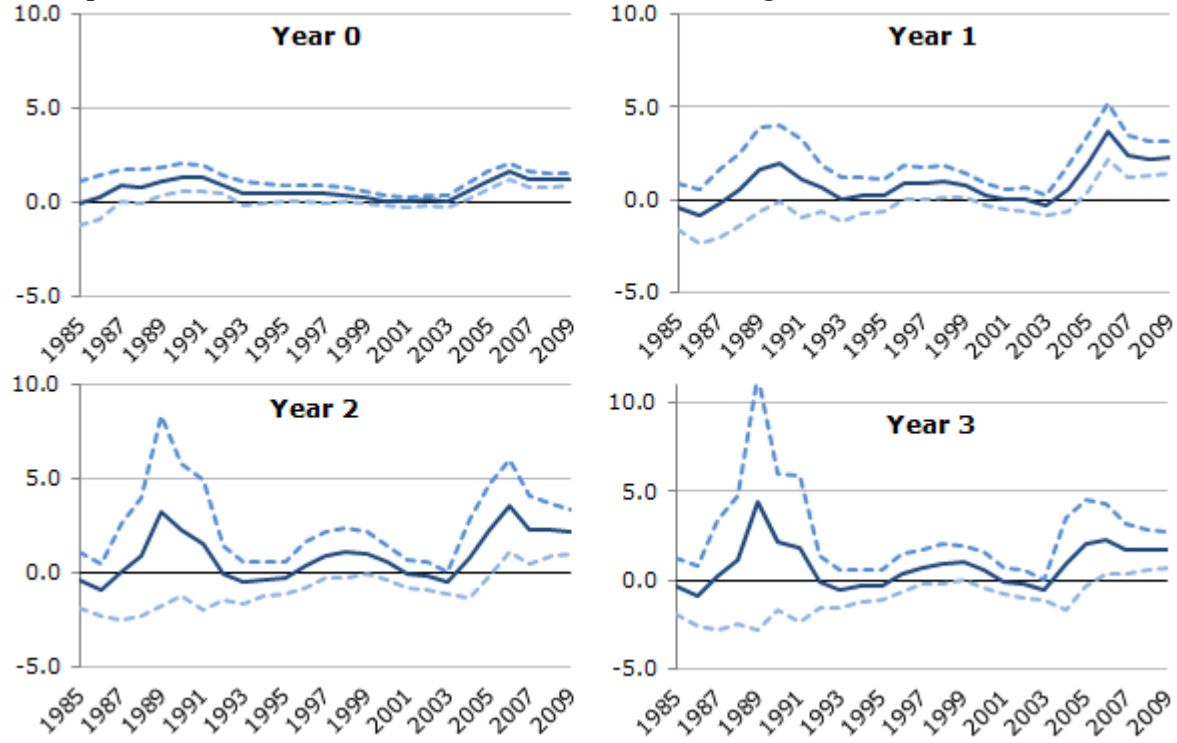
Source: OECD Economic Outlook and author's calculations

TABLE 3-
IMF Estimates of 2013 Potential GDP as a Percentage of 2007 Actual GDP

	2008 projection	2013 estimate	Difference
Australia	21.6%	16.5%	5.1%
Austria	13.2%	5.1%	8.1%
Belgium	12.1%	3.3%	8.8%
Canada	16.6%	9.3%	7.3%
Cyprus	25.2%	-4.4%	29.6%
Denmark	6.5%	1.1%	5.4%
Finland	14.8%	-0.1%	14.9%
France	13.8%	3.2%	10.6%
Germany	10.7%	4.6%	6.1%
Greece	22.9%	-14.3%	37.2%
Iceland	11.6%	-3.4%	15.0%
Ireland	22.6%	-5.0%	27.6%
Italy	4.8%	-3.9%	8.7%
Japan	10.2%	2.1%	8.1%
Netherlands	13.1%	3.2%	9.9%
New Zealand	16.4%	6.3%	10.1%
Norway	13.5%	4.6%	8.9%
Portugal	12.4%	-2.8%	15.2%
Slovenia	28.0%	-2.3%	30.3%
Spain	18.9%	-1.8%	20.7%
Sweden	15.9%	7.9%	8.0%
United Kingdom	16.4%	1.1%	15.3%
United States	15.2%	10.0%	5.2%
Average Difference			**13.7%**

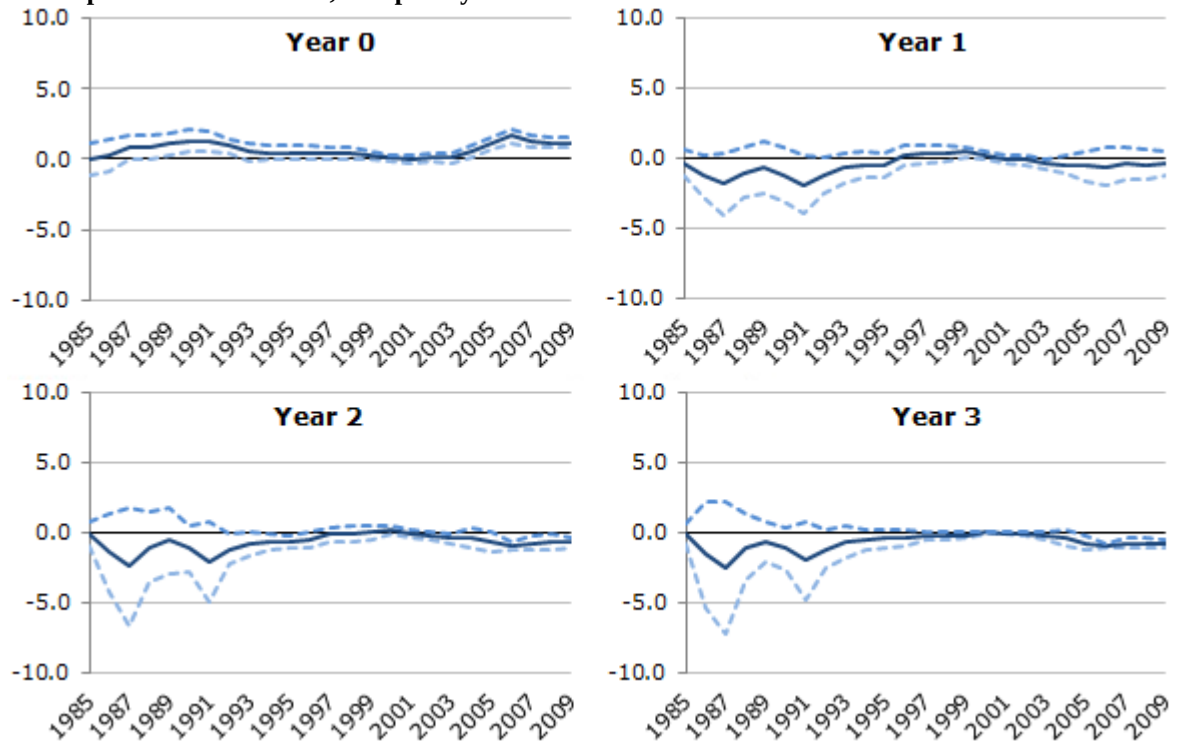
Source: International Monetary Fund.

FIGURE 2-1a
Consumption and Investment, Permanent Increase of One Percentage Point of GDP



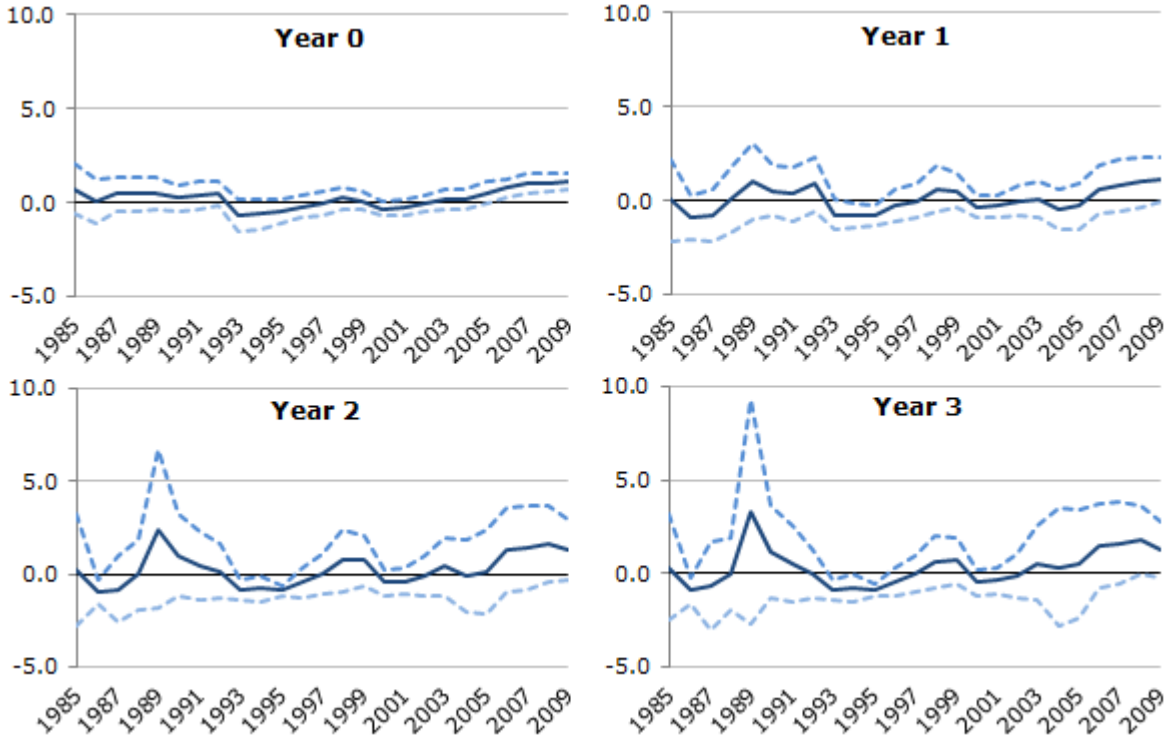
Source: Authors calculations.

FIGURE 2-1b
Consumption and Investment, Temporary Increase



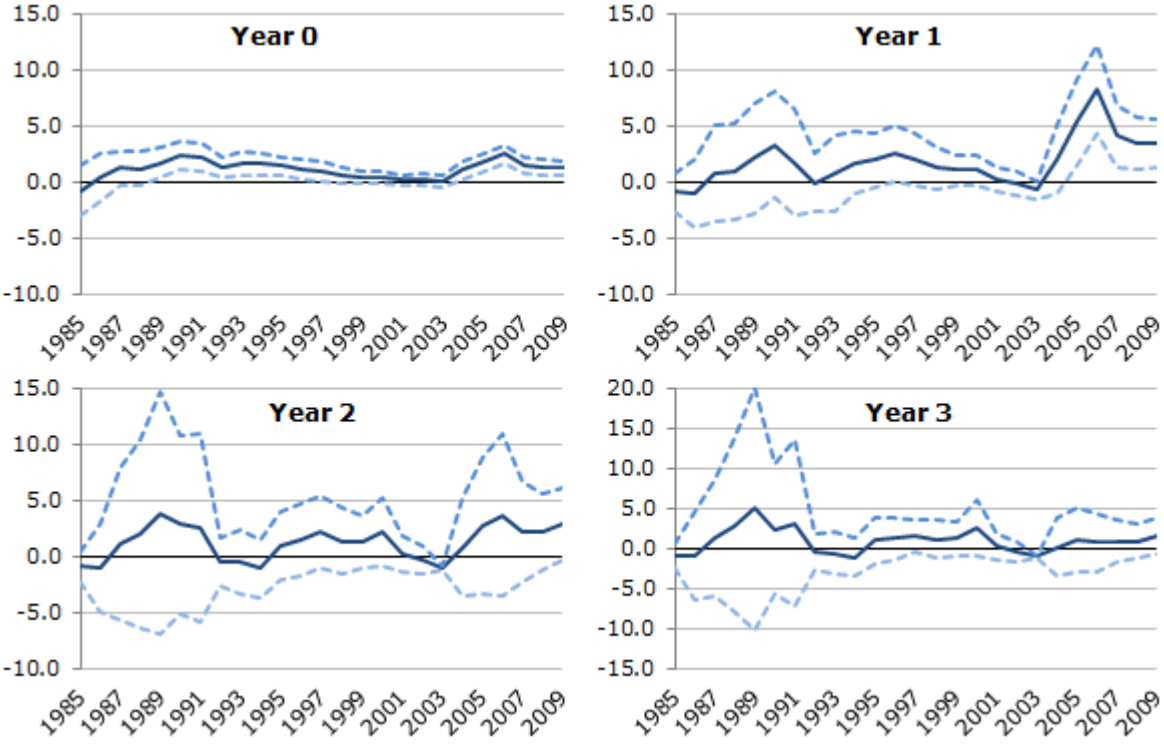
Source: Authors calculations.

FIGURE 2-2a
Consumption, Permanent Increase



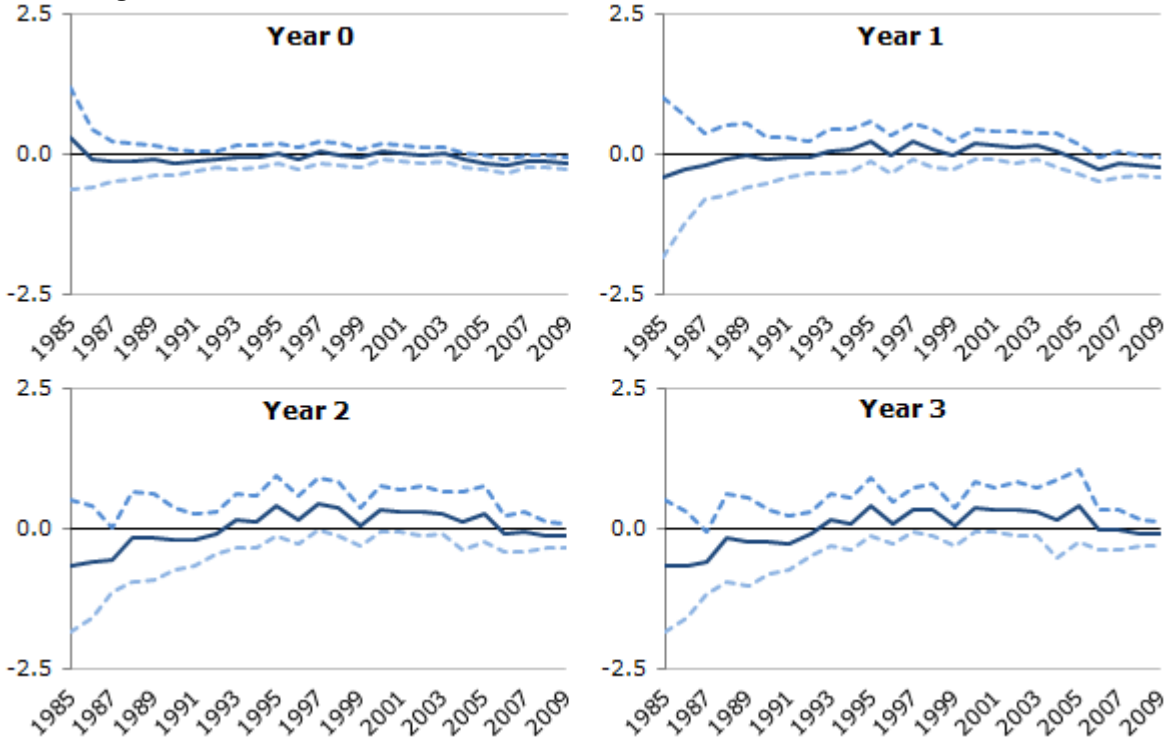
Source: Authors calculations.

FIGURE 2-2b
Investment, Permanent Increase



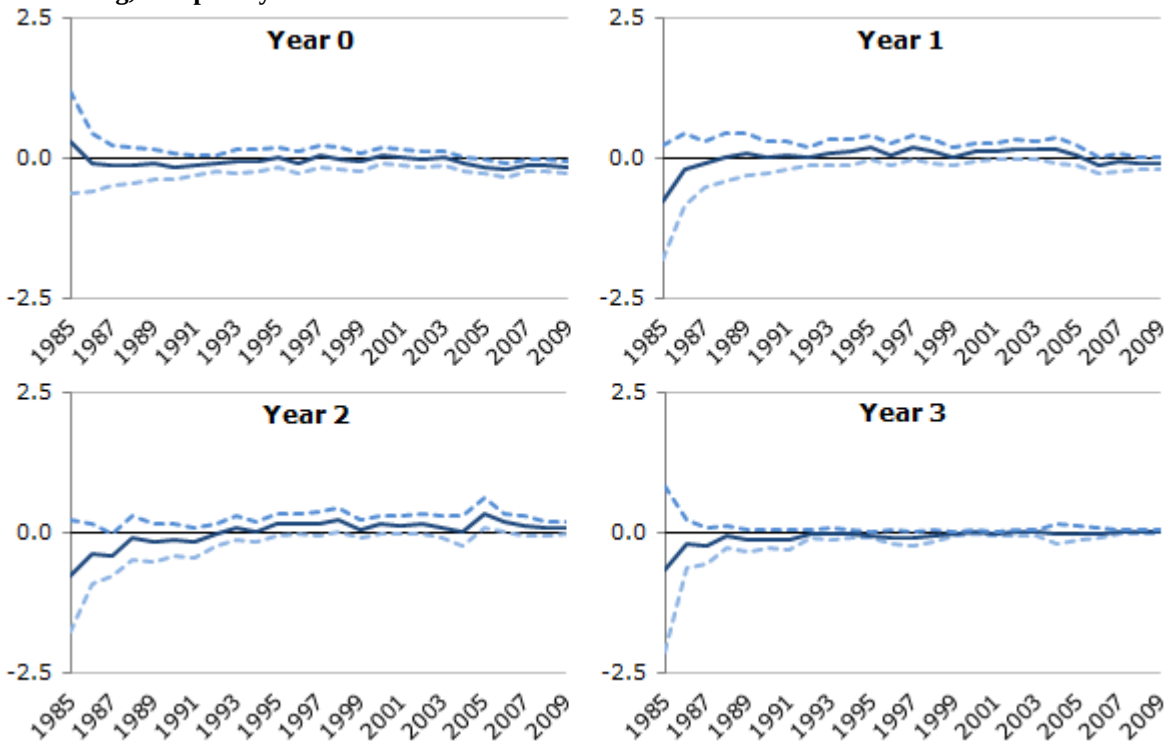
Source: Authors calculations.

FIGURE 2-3a
Net Lending, Permanent



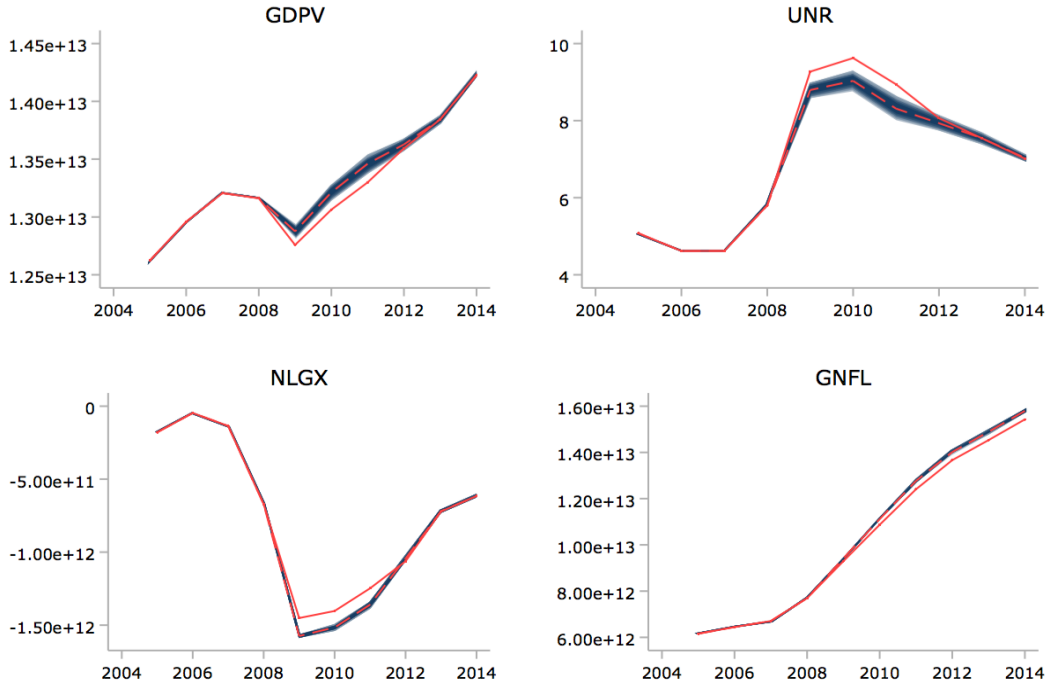
Source: Authors calculations.

FIGURE 2-3b
Net Lending, Temporary



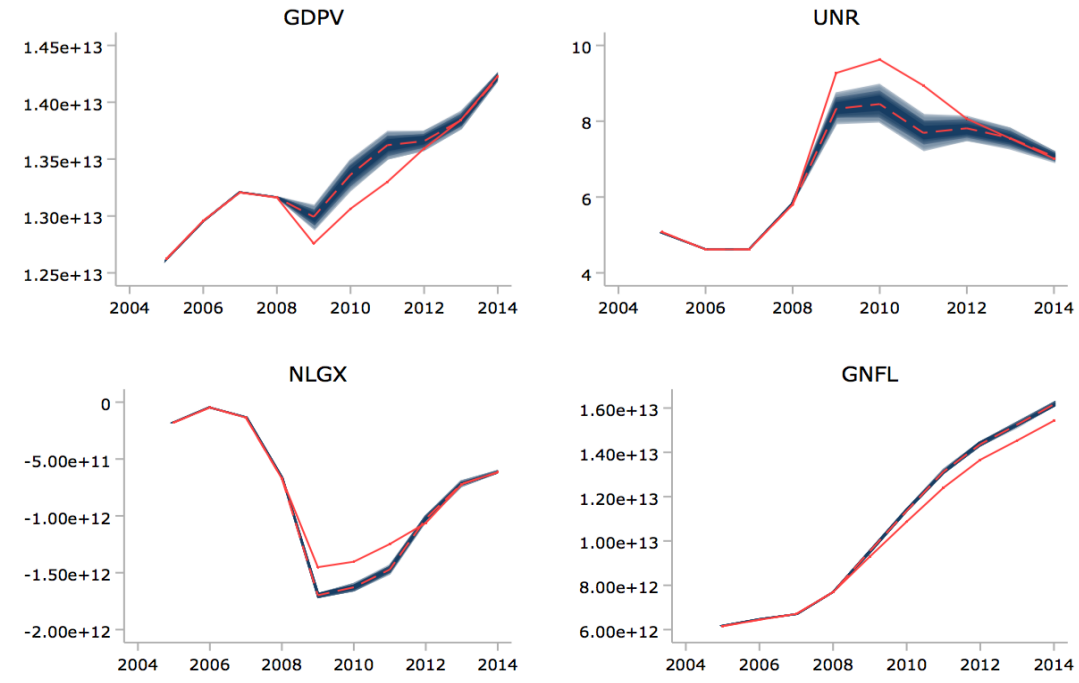
Source: Authors calculations.

FIGURE 2-4
Effects of 1 percentage point stimulus for United States



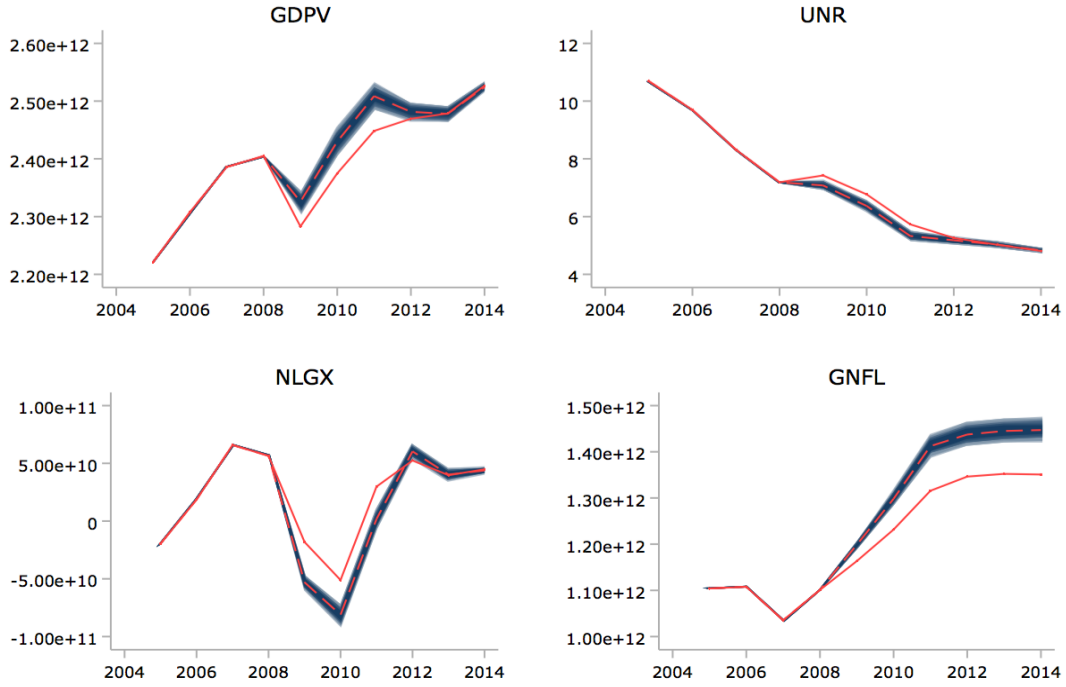
Source: OECD Economic Outlook and author's calculations.

FIGURE 2-5
Effects of 2 percentage point stimulus for United States



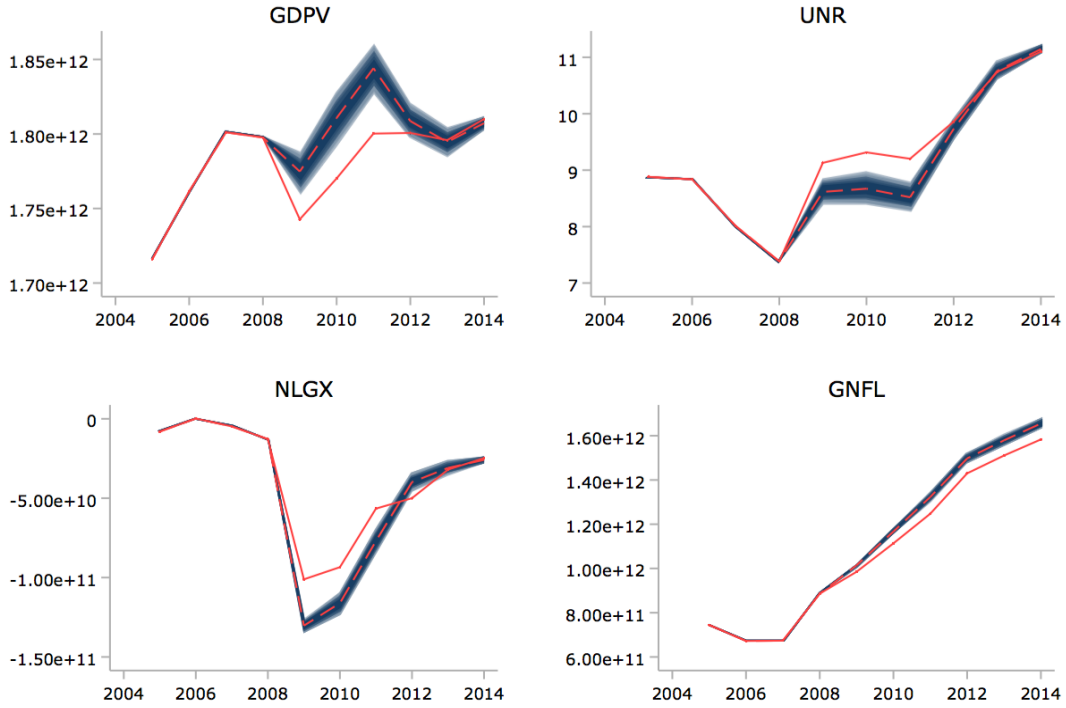
Source: OECD Economic Outlook and author's calculations.

FIGURE 2-6
Effects of 2 percentage point stimulus for Germany



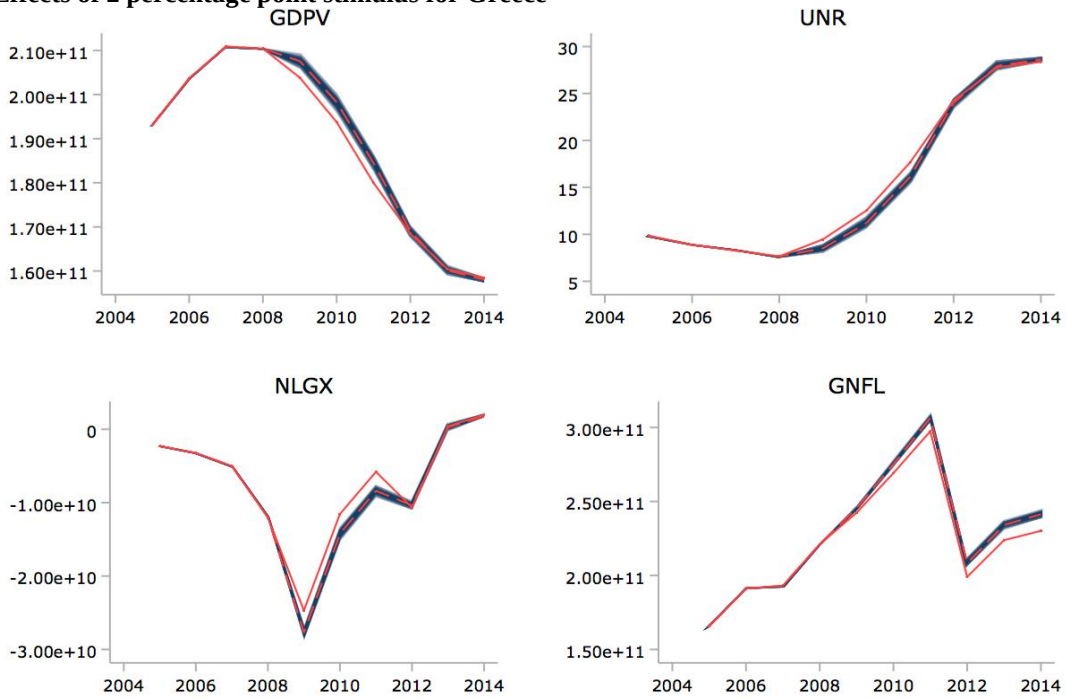
Source: OECD Economic Outlook and author's calculations.

FIGURE 2-7
Effects of 2 percentage point stimulus for France



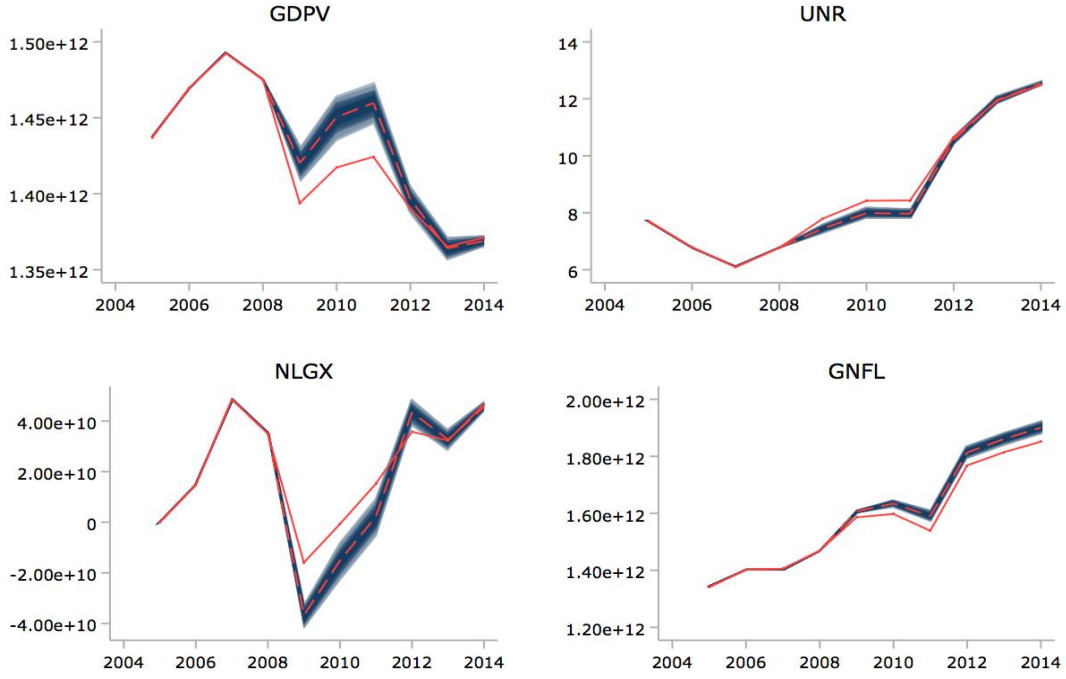
Source: OECD Economic Outlook and author's calculations.

FIGURE 2-8
Effects of 2 percentage point stimulus for Greece



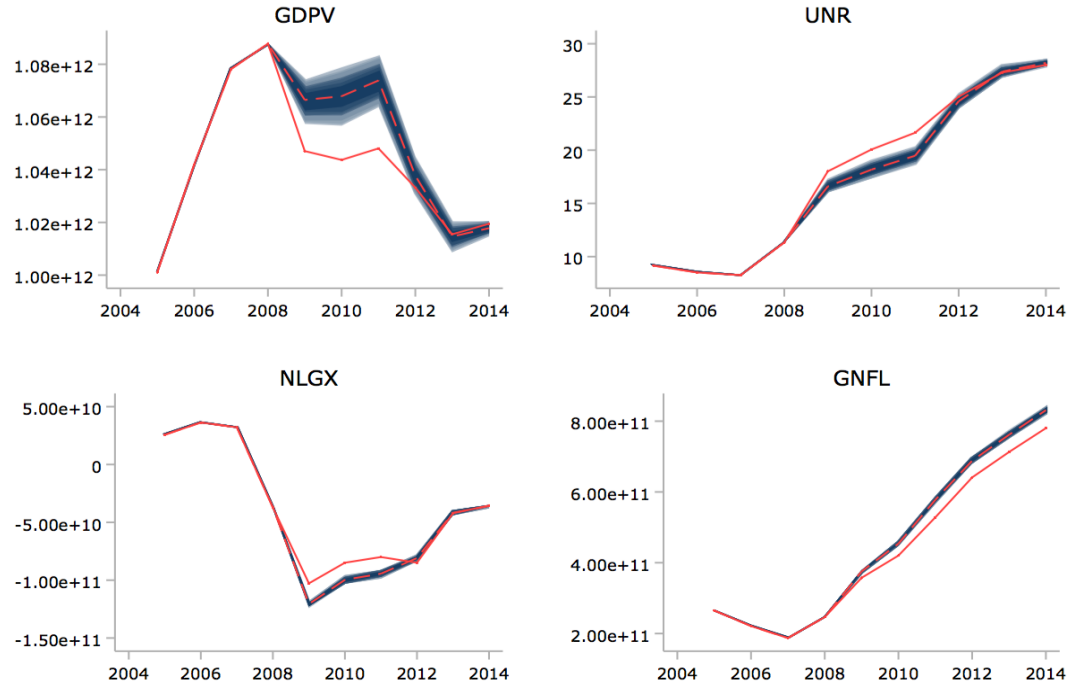
Source: OECD Economic Outlook and author's calculations.

FIGURE 2-9
Effects of 2 percentage point stimulus for Italy



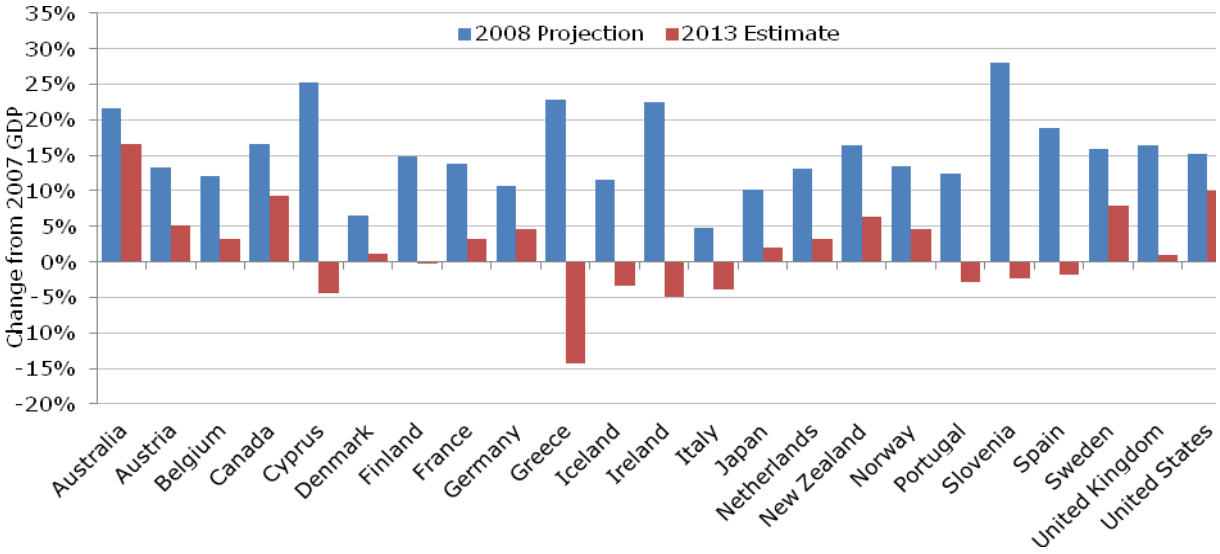
Source: OECD Economic Outlook and author's calculations.

FIGURE 2-10
Effects of 2 percentage point stimulus for Spain



Source: OECD Economic Outlook and author's calculations.

FIGURE 3-1
IMF Projections of 2013 Potential GDP



Technical Appendices

Multiplier estimates

The underlying growth regression model (following the IMF) is

$$g_{i,t} = \sum_{j=1}^{2} \alpha_j g_{i,t-j} + \sum_{j=0}^{2} \sum_{k=1}^{K} \beta_{k,j} x_{k,i,t-j} + \mu_i + \tau_t + \varepsilon_{i,t} \tag{1}$$

where $g_{i,t}$ is real (percent) GDP growth in country i from year $t-1$ to year t and similarly $\{x_1 \dots x_K\}$ are K independent regressors also indexed by country and year. Country (μ) and year (τ) effects are included such that

$$\sum_i \mu_i = 0 \tag{2}$$

For example, let $K = 1$ with $x_{1,i,t}$ equalling the percentage point change in cyclically adjusted net lending share of potential output in country i from year $t-1$ to t. Suppose that in year t_0 the cyclically adjusted net lending increased by 1 percentage point of potential GDP, permanently. Then relative to baseline growth,

$$\Delta g_{i,t_0} = \beta_{1,0} \tag{3}$$

so that real GDP is raised by

$$\begin{aligned} \Delta Y_{i,t_0} &= \left(1 + \frac{1}{100} g_{i,t_0} + \frac{1}{100} \Delta g_{i,t_0}\right) Y_{i,t_0-1} - \left(1 + \frac{1}{100} g_{i,t_0}\right) Y_{i,t_0-1} \\ &= \frac{\Delta g_{i,t_0}}{100} Y_{i,t_0-1} = \frac{\beta_{1,0}}{100} Y_{i,t_0-1} \end{aligned} \tag{4}$$

or, relative to baseline GDP,

$$\%\Delta Y_{i,t_0} \equiv 100 \frac{\Delta Y_{i,t_0}}{Y_{i,t_0}} = \frac{100 \Delta Y_{i,t_0} / Y_{i,t_0-1}}{Y_{i,t_0} / Y_{i,t_0-1}} = \frac{\beta_{1,0}}{1 + g_{i,t_0}/100} \approx \beta_{1,0} \tag{5}$$

For simplicity, then, we proceed by simply estimating the multiplier under the assumption of steady baseline growth $g_{i,t} = 100\,(G-1)$ so that

$$\%\Delta Y_{i,t_0} = \frac{1}{G} \beta_{1,0} \tag{6}$$

In the following year, however,

$$\Delta g_{i,t_0+1} = \alpha_1 \Delta g_{i,t_0} + \beta_{1,1} = \alpha_1 \beta_{1,0} + \beta_{1,1} \tag{7}$$

so that

$$\frac{\Delta Y_{i,t_0+1}}{Y_{i,t_0-1}} = \left(G + \frac{1}{100}\Delta g_{i,t_0+1}\right)\left(G + \frac{1}{100}\Delta g_{i,t_0}\right) - G^2$$
$$= \frac{G}{100}\left(\Delta g_{i,t_0+1} + \Delta g_{i,t_0}\right) + \frac{1}{10000}\Delta g_{i,t_0+1}\Delta g_{i,t_0} \quad (8)$$

and

$$\%\Delta Y_{i,t_0+1} \approx \frac{1}{G}\left[\left(1+\alpha_1\right)\beta_{1,0} + \beta_{1,1}\right] \quad (9)$$

Noting the fact that in the nth year,

$$\%\Delta Y_{i,t_0+n} \approx \frac{1}{G}\sum_{j=0}^{n}\Delta g_{i,t_0+j} \quad (10)$$

we may simply estimate the multiplier under the assumption $G = 1$ and recognize that we may adjust according to alternative baseline assumptions. As G is an exogenous scaling factor, it is irrelevant to any hypothesis testing. Thus, we compute the approximate *zero-growth* multipliers

$$\hat{m}_n \approx \sum_{j=0}^{n}\Delta g_{i,t_0+j} \quad (11)$$

or more precisely

$$1 + m_n = \left(1 + m_{n-1}\right)\left(1 + \Delta g_{i,t_0+n}\right) \quad (12)$$

where $m_{-1} = 0$ and

$$\Delta g_{i,t_0-1} = 0 \quad (13a)$$
$$\Delta g_{i,t_0+0} = \beta_{1,0} \quad (13b)$$
$$\Delta g_{i,t_0+1} = \alpha_1\Delta g_{i,t_0} - T\beta_{1,0} + \beta_{1,1} \quad (13c)$$
$$\Delta g_{i,t_0+2} = \alpha_1\Delta g_{i,t_0+1} + \alpha_2\Delta g_{i,t_0} - T\beta_{1,1} + \beta_{1,2} \quad (13d)$$
$$\Delta g_{i,t_0+3} = \alpha_1\Delta g_{i,t_0+2} + \alpha_2\Delta g_{i,t_1} - T\beta_{1,2} \quad (13e)$$
$$\Delta g_{i,t_0+j} = \alpha_1\Delta g_{i,t_0+j-1} + \alpha_2\Delta g_{i,t_j-2} \text{ (for } j > 3) \quad (13f)$$

where $T = 1$ if the increase in net lending is temporary, but $T = 0$ if it is permanent.

Simulation of Counterfactuals

Suppose that baseline values of X, Z and y are related as

$$Y_{i,t} = Y'_{i,t-1}A + X'_{i,t}\beta + Z'_{i,t}\gamma + \rho_i + \tau_t$$

where the coefficient matrices A, β, and fixed effects ρ, τ, all estimated by regression of the form.

$$Y_{i,t} = Y'_{i,t-1}\hat{A} + X'_{i,t}\hat{\beta} + \hat{\rho}_i + \hat{\tau}_t + \hat{\varepsilon}_{i,t}$$

where Z is not known. For purposes of establishing counterfactuals we would like to interpret these residuals as the exogenous movements explained by variables outside the model. That is, we estimate $Z'\gamma$ as

$$\widehat{Z'_{i,t}\gamma} = Y_{i,t} - Y'_{i,t-1}\hat{A} - X'_{i,t}\hat{\beta} - \hat{\rho}_i - \hat{\tau}_t = \hat{\varepsilon}_{i,t}$$

However, if we are uncertain about the values of the regression coefficients, we are also uncertain about these exogenous movements. That is, we may dynamically forecast Y exactly as

$$\hat{Y}_{i,t} = \hat{Y}'_{i,t-1}\hat{A} + X'_{i,t}\hat{\beta} + \hat{\rho}_i + \hat{\tau}_t + \widehat{Z'_{i,t}\gamma}\left(\hat{A},\hat{\beta},\hat{\rho},\hat{\tau}\right) = Y_{i,t}$$

where the static (one-step ahead forecasts) of a counterfactual X would be simply

$$\hat{Y}^s_{i,t} = \hat{Y}'_{i,t-1}\hat{A} + \left(X_{i,t} + \delta X_{i,t}\right)'\hat{\beta} + \hat{\rho}_i + \hat{\tau}_t + \widehat{Z'_{i,t}\gamma}\left(\hat{A},\hat{\beta},\hat{\rho},\hat{\tau}\right) = Y_{i,t} + \delta X'_{i,t}\hat{\beta}$$

yet the counterfactual dynamics are less simple

$$\hat{Y}^d_{i,t} = \hat{Y}^{d'}_{i,t-1}\hat{A} + \left(X_{i,t} + \delta X_{i,t}\right)'\hat{\beta} + \hat{\rho}_i + \hat{\tau}_t + \widehat{Z'_{i,t}\gamma}\left(\hat{A},\hat{\beta},\hat{\rho},\hat{\tau}\right)$$

Thus, while we might easily produce a single dynamic forecast based on a counterfactual X, the procedure for assessing uncertainty in the counterfactual is a little more tricky. To determine confidence bounds around the counterfactual, we follow the following procedure

1. Add to the original coefficient vector a multivariate normal draw according to the estimated variance-covariance matrix from the regression.
2. Compute the static residuals $\widehat{Z'_{i,t}\gamma}\left(\hat{A}+\delta\hat{A},\hat{\beta}+\delta\hat{\beta},\hat{\rho}+\delta\hat{\rho},\hat{\tau}+\delta\hat{\tau}\right)$. By construction, the dynamic baseline forecast is equal to the observed Y.
3. Compute the dynamic forecast

$$\hat{Y}^{d'}_{i,t-1}\left(\hat{A}+\delta\hat{A}\right) + \left(X_{i,t}+\delta X_{i,t}\right)'\left(\hat{\beta}+\delta\hat{\beta}\right) + \left(\hat{\rho}_i+\delta\hat{\rho}_i\right) + \left(\hat{\tau}_t+\delta\hat{\tau}_t\right) + \widehat{Z'_{i,t}\gamma}\left(\hat{A}+\delta\hat{A},\hat{\beta}+\delta\hat{\beta},\hat{\rho}+\delta\hat{\rho},\hat{\tau}+\delta\hat{\tau}\right) \quad (14)$$

4. Iterate 1-3 as necessary to generate an ensemble of counterfactual dynamics

Relations in the EO93 Database Inventory

See `http://www.oecd.org/eco/outlook/EO93_Database_Inventory.pdf` for additional detail.

Cycle

Ratio of potential and actual real GDP of the total economy

$$\text{IFU3} = \frac{\text{GDPVTR}}{\text{GDPV}}$$

Net Lending

Government net lending, value

$$\text{NLG} = \text{SAVG} - \text{CAPOG}$$

Government saving (net), value

$$\text{SAVG} = \text{YRG} - \text{YPG}$$

Net capital outlays of the government, value (where **IGAA** is government fixed capital formation, appropriation amount)

$$\text{CAPOG} = \text{IGAA} + \text{TKTRG} - \text{TKTRG} - \text{CFKG}$$

Cyclically adjusted government net lending, value

$$\text{NLGA} = \text{YRGA} - \text{YPGA} - \text{CAPOG}$$

Disbursements

Current disbursements, general government, value (where **CGAA** is government final consumption expenditure, appropriation amount)

$$\text{YPG} = \text{CGAA} + \text{SSPG} + \text{YPEPG} + \text{YPOTG}$$

Current disbursements, excluding gross interest payments, general government, value

$$\text{YPGX} = \text{YPG} - \text{GGINTP}$$

Property income paid by government, excluding interest payments, value

$$\text{YPEPGX} = \text{YPEPG} - \text{GGINTP}$$

Note therefore, that

$$\text{YPG} - \text{GGINTP} = \text{CGAA} + \text{SSPG} + \text{YPEPGX} + \text{YPOTG}$$

Cyclically adjusted government current disbursements, general government, value

$$\text{YPGA} = \text{YPGXA} + \text{GGINTP}$$

Cyclically adjusted government current disbursements excluding interest, general government, value

$$\text{YPGXA} = (\text{YPG} - \text{GGINTP}) \times \left(\frac{\text{UNR}}{\text{NAIRU}}\right)^{\text{XYPGEL2}} = \text{YPGX} \times \left(\frac{\text{UNR}}{\text{NAIRU}}\right)^{\text{XYPGEL2}}$$

Receipts

Current receipts, general government value

$$\text{YRG} = \text{TIND} + \text{TY} + \text{YPERG} + \text{SSRG} + \text{TOCR}$$

Cyclically adjusted current receipts, general government, value

$$\text{YRGA} = \begin{cases} \text{TYBA} + \text{TYHA} + \text{TINDA} + \text{SSRGA} + \text{TOCR} + \text{YPERG} & \\ \text{TYA} + \text{TINDA} + \text{SSRGA} + \text{TOCR} + \text{YPERG} & \text{(LUX)} \\ \text{TYBA} + \text{TYHA} + \text{TINDA} + \text{SSRGA} + \text{TOCRML} + \text{YPERGML} & \text{(NOR)} \end{cases}$$

Cyclically adjusted total direct taxes, value (LUX)

$$\begin{aligned} \text{TYA} &= \text{TY} \times \left[\text{XALPHA} \times \text{IFU3}^{\text{XTYEL}} + (1 - \text{XALPHA}) \times \text{IFU3}_{-4}^{\text{XTYEL}}\right] \\ &= \text{TY} \times \frac{1}{2}\left(\text{IFU3}^{1.6} + \text{IFU3}_{-4}^{1.6}\right) \end{aligned}$$

and for other countries, $\text{TYA} = \text{TYBA} + \text{TYHA}$.

Cyclically adjusted direct taxes on businesses, value

$$\text{TYBA} = \begin{cases} \text{TYB} \times \left[\text{XALPHA} \times \text{IFU3}^{\text{XTYBEL}} + (1 - \text{XALPHA}) \times \text{IFU3}_{-4}^{\text{XTYBEL}}\right] & \\ \text{TYBML} \times \frac{1}{2}\left[\text{IFU3}^{1.4} + \text{IFU3}_{-4}^{1.4}\right] & \text{(NOR)} \end{cases}$$

Cyclically adjusted direct taxes on households, value

$$\text{TYHA} = \text{TYH} \times \left[\text{XALPHA2} \times \text{IFU3}^{\text{XTYHEL}} + (1 - \text{XALPHA2}) \times \text{IFU3}_{-4}^{\text{XTYHEL}}\right]$$

Cyclically adjusted taxes on production and imports, value

$$\text{TINDA} = \text{TIND} \times \text{IFU3}^{\text{XTINDE}} = \text{TIND} \times \text{IFU3}$$

Cyclically adjusted social security contributions received by general government, value

$$\text{SSRGA} = \text{SSRG} \times \text{IFU3}^{\text{XSSRGE}}$$

Constructing Derived Counterfactuals

Suppose, counterfactually, higher CGAA and IGAA. Suppose further that this both raises GDPV to GDPV' and lowers UNR to UNR'. Then

$$\text{IFU3}' = \frac{\text{GDPV}}{\text{GDPV}'}\text{IFU3} < \text{IFU3}$$

Counterfactual Disbursements

Define cyclically adjusted non-consumption primary disbursements as

$$\text{YPGXA} - \text{CGAA} \times \left(\frac{\text{UNR}}{\text{NAIRU}}\right)^{\text{XYPGEL2}} = (\text{YPGX} - \text{CGAA}) \times \left(\frac{\text{UNR}}{\text{NAIRU}}\right)^{\text{XYPGEL2}}$$

Holding non-consumption primary disbursements constant on a cyclically adjusted basis, then,

$$\text{YPGX}' - \text{CGAA}' = (\text{YPGX} - \text{CGAA}) \times \left(\frac{\text{UNR}}{\text{UNR}'}\right)^{\text{XYPGEL2}}$$

Note that $\text{XYPGEL2} < 0$ so as UNR falls, these disbursements also fall, creating a drag on the economy (though presumably outweighed by the stimulus effect of increased CGAA– otherwise UNR would not fall.)

Counterfactual Receipts

In general, a cyclically adjusted component of government receipts is given by

$$T_A = T \times \left[X_\alpha \times \text{IFU3}^{X_Y} + (1 - X_\alpha) \times \text{IFU3}_{-4}^{X_Y}\right]$$

Thus, holding the component constant on a cyclically adjusted basis, the counterfactual component would be

$$T' = T \times \frac{X_\alpha \times \text{IFU3}^{X_Y} + (1 - X_\alpha) \times \text{IFU3}_{-4}^{X_Y}}{X_\alpha \times \text{IFU3}'^{X_Y} + (1 - X_\alpha) \times \text{IFU3}'^{X_Y}_{-4}}$$

The only difficulty in this presentation is that XTYBEL is not reported in Table A5-1 of the Database Inventory along with the other parameters and therefore must be estimated for each country.

YPERG and TOCR are not adjusted, so primary receipts are given by

$$\text{YRGX}' = \text{TIND}' + \text{TY}' + (\text{YPERG} - \text{GGINTR}) + \text{SSRG}' + \text{TOCR}$$

Counterfactual Primary Deficits

Net capital outlays have no cyclical adjustment, so assuming that government consumption of fixed capital (CFKG) is effectively unchanged, then

$$\text{CAPOG}' - \text{IGAA}' = \text{CAPOG} - \text{IGAA}$$

and therefore primary net lending is given by

$$\text{NLGX}' = \text{YRGX}' - \text{YPGX}' - \text{IGAA}' - (\text{CAPOG} - \text{IGAA})$$

In other words, the increase in primary net lending is given by

$$\Delta\text{NLGX}' = \big(\text{YRGX}' - \text{YRGX}\big) - \big(\text{YPGX}' - \text{YPGX}\big) - \big(\text{IGAA}' - \text{IGAA}\big)$$

Counterfactual Net Lending

One-quarter of new debt is financed short-term, and three-quarters long-term. Thus, the rate on new debt is

$$r = \frac{1}{400}\left(\text{IRS} + 3 \times \text{IRL}\right)$$

If we assume primary deficits are accumulated in the middle of every quarter, then at the end of the first quarter, an increase in the primary net lending ΔNLGX results in additional net debt

$$\Delta\text{GNFL}_1 = -\frac{1}{4}\left(1+\frac{1}{8}r\right)\Delta\text{NLGX}$$

after two quarters,

$$\Delta\text{GNFL}_2 = \left(1+\frac{1}{4}r\right)\Delta\text{GNFL}_1 - \frac{1}{4}\left(1+\frac{1}{8}r\right)\Delta\text{NLGX}$$

and after three quarters and by year's end

$$\Delta\text{GNFL}_3 = \left(1+\frac{1}{4}r\right)\Delta\text{GNFL}_2 - \frac{1}{4}\left(1+\frac{1}{8}r\right)\Delta\text{NLGX}$$

$$\Delta\text{GNFL} = \left(1+\frac{1}{4}r\right)\Delta\text{GNFL}_3 - \frac{1}{4}\left(1+\frac{1}{8}r\right)\Delta\text{NLGX}$$

If we define the quarterly increase in net borrowing

$$\delta \equiv -\frac{1}{4}\left(1+\frac{1}{8}r\right)\Delta\text{NLGX}$$

and the quarterly gross interest rate as

$$R_1 \equiv \left(1+\frac{1}{4}r\right)$$

then the concurrent-year impact on net borrowing is given by

$$\Delta\text{GNFL} = \left(1+R_1+R_1^2+R_1^3\right)\delta = \frac{R_1^4-1}{R_1-1}\delta = -\frac{1}{4}\frac{\left(1+\frac{1}{4}r\right)^4-1}{\frac{1}{4}r}\left(1+\frac{1}{8}r\right)\Delta\text{NLGX}$$

or

$$\Delta\text{GNFL} = \left[1-\left(1+\frac{1}{4}r\right)^4\right]\left(\frac{1}{r}+\frac{1}{8}\right)\Delta\text{NLGX}$$

for a first-year effective interest rate

$$r_{\text{eff}} = \left[\left(1+\frac{1}{4}r\right)^4-1\right]\left(\frac{1}{r}+\frac{1}{8}\right)-1 \approx \frac{1}{2}r$$

Thus, the impact on debt n years in the future of an increase in concurrent net lending is

$$\Delta\text{GNFL} \approx -\left(1+r\right)^n\left(1+r_{\text{eff}}\right)\Delta\text{NLGX}$$

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