Peterson Institute for International Economics

Policy Brief

NUMBER PB15-15

SEPTEMBER 2015

Fiscal Tightening and Economic Growth: Exploring Cross-Country Correlations

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Authors' note: We are grateful to William R. Cline, Joseph E. Gagnon, Adam S. Posen, Edwin M. Truman, Steven Weisman, and Justin Wolfers for helpful comments.

The global financial and economic crisis that began in 2008 has rekindled the debate on the impact of fiscal policy on economic growth. At the outset of the crisis the focus—particularly in the United States—was on whether fiscal stimulus (an expansion in the fiscal deficit) boosts economic growth. Since 2011 or so, with the depth of the crisis becoming more severe in some European countries and Greece in particular, the emphasis of the debate has shifted to whether fiscal adjustment (a reduction in the fiscal deficit) curtails economic growth. Academic studies have delved into these issues using novel, sophisticated methods, but no consensus has emerged and the techniques used have proved difficult to communicate to the public at large.[1]

1. For a survey, see Blanchard, Dell'Ariccia, and Mauro 2013 and references therein.

Meanwhile, public discourse has been heavily influenced by simple charts analyzing the correlations between measures of fiscal "austerity" and economic growth for small samples of countries over limited time periods. Academic studies have not further developed this approach, likely because the economics profession emphasizes the tenet that "correlation does not imply causation."[2] Although false correlation is a valid concern, the modest task of analyzing the correlations in the data in a more systematic manner may be worthwhile. The objective of this *Policy Brief* is to analyze the correlations in the data starting from the simplest and gradually building up, in a step-by-step, transparent manner, to multivariate regressions based on various samples of countries for different time periods. The

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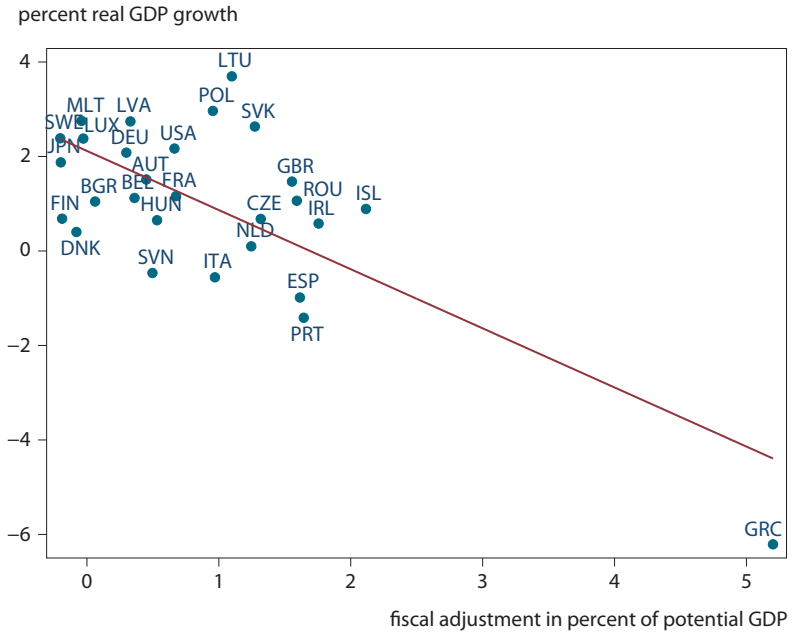
results show that simple correlations are no longer significant when considering slightly longer sample periods and omitting outliers, like Greece, from the sample. In multivariate regressions using broader samples, a tightening of fiscal policy is significantly associated with lower economic growth only in some specifications and estimation samples. On the whole, the data offer partial support to the notion that fiscal choices and output growth are correlated.

LIMITATIONS OF SIMPLE CORRELATIONS

Readers of op-eds and blogs on this topic may be familiar with scatter plot charts similar to the following in figure 1, which report the average annual change in the cyclically adjusted

2. Several studies, reviewed in Mineshima, Poplawski-Ribeiro, and Weber (2014), have sought to address concerns regarding the direction of causality. For the most part, however, such attempts are not fully convincing or are not applicable to the experience of the global crisis, in which fiscal policy has obviously been influenced by the need to boost economic growth or by the adverse impact of the growth decline on countries' ability to finance potential fiscal stimulus.

Figure 1 Economic growth and change in cyclically adjusted primary balance, 2009–13



AUT = Austria, BEL = Belgium, BGR = Bulgaria, CZE = Czech Republic, DNK = Denmark, FIN = Finland, FRA = France, DEU = Germany, GRC = Greece, HUN = Hungary, ISL = Iceland, IRL = Ireland, ITA = Italy, JPN = Japan, LVA = Latvia, LTU = Lithuania, LUX = Luxembourg, MLT = Malta, NLD = Netherlands, POL = Poland, PRT = Portugal, ROU = Romania, SVK = Slovak Republic, SVN = Slovenia, ESP = Spain, SWE = Sweden, GBR = United Kingdom, USA = United States

Note: The sample consists of 28 countries, which include the United States, Japan, and EU members for which the data are available. Average annual real GDP growth (in percent) on the vertical axis; average improvement in the cyclically adjusted primary fiscal balance (in percentage points of annual potential GDP) on the horizontal axis.

Source: Authors' estimates using data from the International Monetary Fund's *World Economic Outlook*, April 2015 vintage.

primary balance (CAPB) as a share of GDP on the horizontal axis, and the average real GDP growth rate over the past few years on the vertical axis.[3] Figure 1 is modeled after a chart by Paul Krugman published in the *Guardian*[4] but is intended to be representative of many such exercises by authors discussing the potential link between fiscal policy and economic growth.[5] The data for figure 1 are drawn from the April 2015 vintage of the International Monetary Fund's *World Economic Outlook* (WEO) database. Figure 1 matches Krugman's chart fairly closely, though not exactly because the list of countries and the estimated coefficients are not provided in his article, and the data may have been slightly revised since it was published. The immediate visual impression is strongly suggestive of a correlation between "fiscal austerity" and economic growth. Indeed, the estimated slope coefficient in a simple regression is –1.25: An additional annual fiscal "tightening" (increase in the CAPB) equivalent to 1 percentage of GDP, on average, over the sample period is associated with a further decline in the average real GDP growth rate by 1.25 percentage points. The standard error is 0.24 and the coefficient is statistically significant (at the 1 percent level).

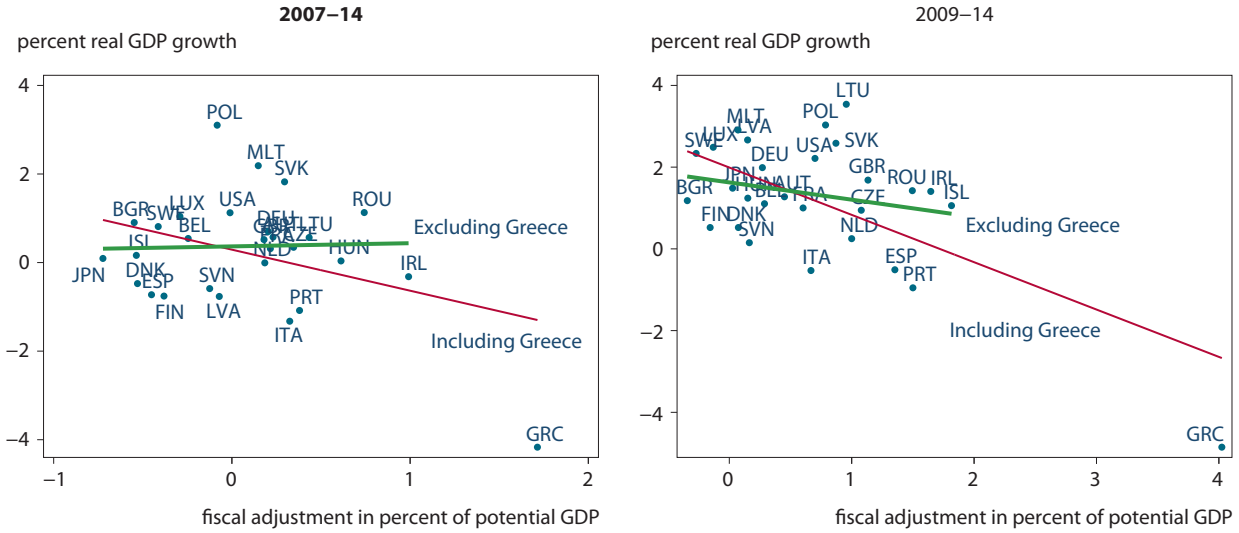
Analysis based on the simple relationship in figure 1 is incomplete for five reasons. First, it is reasonable to ask whether the patterns in the data hold up when they are assessed over alternative time periods. Second, as outliers in the visual rela-

3. The cyclically adjusted primary balance measures the fiscal policy stance (or the discretionary fiscal policy contribution to demand). It is estimated as the primary fiscal balance (revenues minus noninterest expenditures) that would prevail if output were equal to its potential level (i.e., when the output gap is zero).

4. Paul Krugman, chart 2 in "The Austerity Delusion," *Guardian,* April 29, 2015, http://www.theguardian.com/business/ng-interactive/2015/apr/29/the-austerity-delusion (accessed August 19, 2015).

5. Other recent examples include, among many others, Yanis Varoufakis, "Austerity Is the Only Deal-Breaker," *Project Syndicate*, May 25, 2015, http://www.project-syndicate.org/commentary/greece-government-reforms-by-yanis-varoufakis-2015-05 (accessed August 19, 2015); Salim Furth, "Stimulus or Austerity? Fiscal Policy in the Great Recession and European Debt Crisis," *Heritage Foundation*, June 9, 2014, http://www.heritage.org/research/reports/2014/06/stimulus-or-austerity-fiscal-policy-in-the-great-recession-and-european-debt-crisis#_ftn1 (accessed August 19, 2015); and Paul De Grauwe and Yuemei Ji, "Panic-driven austerity in the Eurozone and its implications," *Vox*, February 21, 2013, http://www.voxeu.org/article/panic-driven-austerity-eurozone-and-its-implications (accessed August 31, 2015).

Figure 2 Economic growth and change in cyclically adjusted primary balance, 2007–14 and 2009–14



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Note: Average annual real GDP growth (in percent) on the vertical axis; average improvement in the cyclically adjusted primary fiscal balance (in percentage points of annual potential GDP) on the horizontal axis.

Source: Authors' estimates using data from the International Monetary Fund's *World Economic Outlook*, April 2015 vintage.

tionship (Greece in the case above) are clearly influential, it is useful to explore whether the relationship holds up when outliers are excluded. While some might argue that Greece is an informative case exactly because it experienced the most fiscal adjustment, others might rebut that it may have other unique features that a simple correlation does not take into account. Third, it is important to be transparent in how the sample of countries was selected. Fourth, what happens when one takes other determinants of economic growth into account? Fifth, and most thorny: Fiscal variables are strongly affected by economic growth. Despite attempts to construct "cyclically adjusted" fiscal variables, there are still reasonable concerns whether such variables adequately capture the direction of causality between the fiscal deficit and economic growth. It is often argued that if countries undertake fiscal stimulus when their growth is slow, the observed correlation between fiscal stimulus and economic growth will underestimate the true causal relationship between stimulus and growth. Yet this reasoning assumes that financing will be available to a government regardless of the economic growth rate. In the initial stages of the global economic and financial crisis, low projected economic growth heightened concerns about fiscal sustainability in several countries (e.g., Italy), making it difficult for them to undertake fiscal stimulus. Thus, while concerns about the direction of causality are warranted, the magnitude and sign of resulting bias are not fully understood.

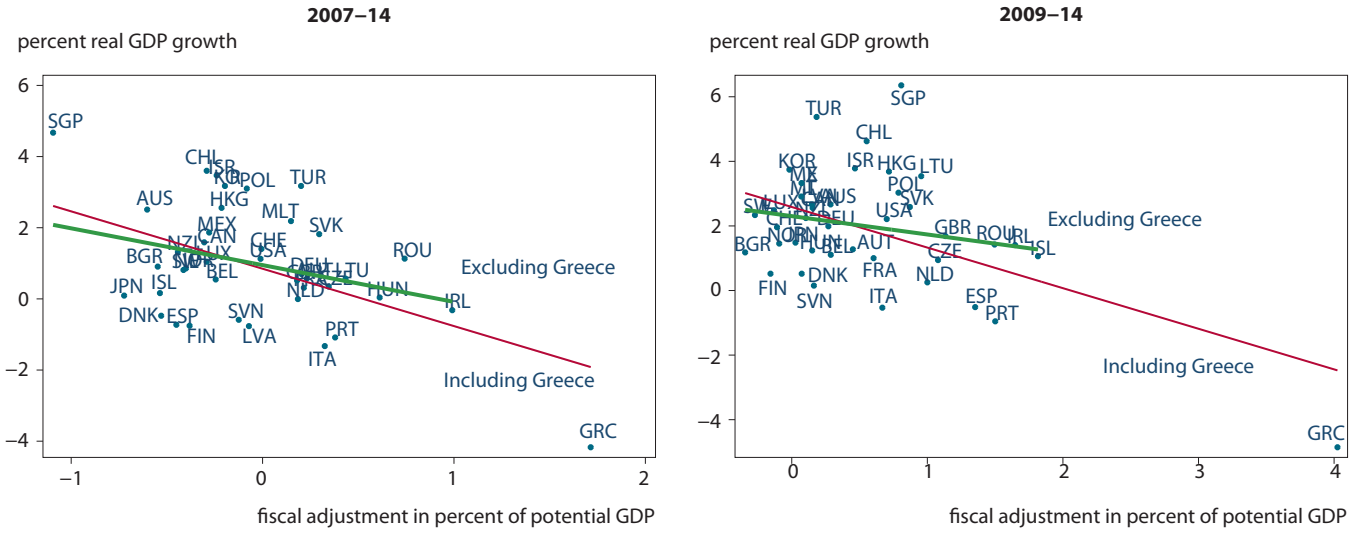
In the absence of valid instruments or controlled experiments, this last concern may have deterred systematic analysis of cross-country correlations between fiscal policy and growth during the crisis. Nevertheless, given that these simple correlations have understandably influenced public opinion, they merit more analysis than has been undertaken so far. To that end, the remainder of this *Policy Brief* explores the correlation by examining the first four concerns noted above.

1. Alternative Sample Periods

The first step is to reproduce the simple scatter plot shown in figure 1 for alternative sample periods: 2009–14, to bring the sample period up to date by one additional year, and 2007–14, to encompass countries' policy responses during the initial stages of the global economic and financial crisis (shown in figure 2). Indeed, extending the time frame is important because several countries undertook major fiscal stimulus in 2008 and 2009. For example, Spain reduced its CAPB by 9.9 percentage points of potential GDP between 2007 and 2009—the largest fiscal stimulus among sizable economies in the Organization for Economic Cooperation and Development (OECD). Accordingly, using the change in the structural fiscal deficit between 2009 and 2014 exaggerates Spain's fiscal tightening, because much of it was the reversal of its initial stimulus.

With these slightly longer sample periods, the estimated slope coefficient is somewhat smaller, at –1.16 for 2009–14, still statistically significant at the 1 percent level (the standard error is 0.28), and –0.93 for 2007–14, significant at the 5 percent level (the standard error is 0.45).

Figure 3 Economic growth and change in cyclically adjusted primary balance, for advanced, OECD, and EU economies



OECD = Organization for Economic Cooperation and Development

Note: Average annual real GDP growth (in percent) on the vertical axis; average improvement in the cyclically adjusted primary fiscal balance (in percentage points of annual potential GDP) on the horizontal axis. See appendix A for all countries included in sample.

Source: Authors' estimates using data from the International Monetary Fund's World Economic Outlook, April 2015 vintage.

2. The Role of Outliers and Influential Observations

The outlier position of Greece in the scatter plots suggests that the empirical association between fiscal policy and economic growth may depend on whether Greece is included in the sample. The case of Greece is important not only in its own right but also because it is the most extreme and thus may provide information for other cases. That said, there are many unique features to the case of Greece. In particular, Greece has experienced greater uncertainty than other countries in the sample, both in the political sphere, with episodes of street violence and several changes in government, and in its economic policies, with protracted negotiations over reform policies (including fiscal adjustment) and stop-go cycles in their implementation. Indeed, it may be argued that greater political and economic uncertainty has dampened investment, job creation, and economic growth in Greece. It is thus reasonable to analyze the extent to which the empirical association depends on the special case of Greece.

If Greece is excluded from the sample, the empirical association between fiscal tightening and growth becomes weaker and, in some cases, no longer statistically significant. The slope coefficient becomes less negative at –0.61 for 2009–13 (compared with –1.25 in figure 1), –0.42 for 2009–14, and 0.07 for 2007–14 (the latter two shown in figure 2, red line). It is statistically significant at the 10 percent level for 2009–13. It is not statistically significant for 2009–14 or, a fortiori, 2007–14.

3. Countries Included in the Sample

Many previous analyses of the association between fiscal adjustment and economic growth have focused on the euro area, the European Union, or Europe as a whole, with the addition of the United States and, in some cases, a few additional large advanced economies.[6] Although examining those economies most visibly affected by the global economic and financial crisis may be a natural starting point, it is equally important to find out why some countries felt little impact from the crisis. More generally, it is good practice to start from as large a sample of countries as possible, subject to data availability, and to reduce the sample based on transparent criteria.

The remainder of this *Policy Brief* uses a sample that includes all economies that are members the OECD, or are defined as advanced by the International Monetary Fund's (IMF) *World Economic Outlook*, or are members of the European Union, for which data are available on economic growth and the cyclically adjusted primary balance from the April 2015 vintage of the IMF's *World Economic Outlook* database. This selection yields a sample of 40 economies (see appendix table A.1).

The negative correlation between fiscal adjustment and economic growth is stronger when considering this broader sample, as shown in figure 3. With slope coefficients of –1.61

6. In some publications, the sample of countries cannot be retraced.

(0.45) for 2007–14 and –1.26 (0.33) for 2009–14 (both significant; standard errors in parentheses), it might seem that extending the sample strengthens the evidence in favor of an association between fiscal policy choices and GDP growth.

If Greece is excluded from the sample, the slope of the line of best fit (in green) for 2007–14 becomes less steep, at –1.03 (0.53), and becomes at best marginally significant. For 2009–14, the slope without Greece is –0.57 (0.44) and no longer statistically significant.

If Greece is excluded from the sample, the slope of the line of best fit becomes less steep.

In addition to checking whether the correlation is robust when including or excluding one country, "robust" regressions are estimated in which observations are given a lower weight in the estimation if they have excessive influence. Those cases that are extremely influential[7] are dropped by the algorithm altogether. In robust regression for 2007–14, the estimated slope coefficient amounts to –1.57 and remains significant. (Turkey is down-weighted the most; Greece, Chile, and Spain lose 17 to 18 percent of their weights in this specification.) For 2009–14, however, the coefficient falls to –0.59 and it is no longer significant. (The robust regression puts zero weight on Greece; only 25 percent of the observation for Singapore is retained. Turkey, Chile, Italy, and Portugal are each down-weighted by at least one fourth.)

4. Multivariate Regressions—Controlling for Factors Other than Fiscal Policy

In assessing the empirical association between fiscal policy and economic growth, the following additional factors are important to consider:

1. *The interaction of trading partners' economic growth and the exports share in GDP*. Real GDP growth in trading partners may be expected to foster export growth, and its impact will be greater on countries with higher shares of exports in total GDP. For most economies this variable is largely exogenous, at least for relatively small countries whose growth does not impact their partners much. The variable is constructed as follows: For each country *i*, trading partner growth is calculated as the weighted average of the real GDP growth rates of all its trading partners, where the weights are given by the share of each partner's exports in country *i*'s total exports, based on data for 2007 from the IMF's *Direction of Trade Statistics* database. Trading partner growth is then multiplied by the share of country *i*'s goods exports in country *i*'s GDP in 2007, drawn from the World Bank's *World Development Indicators* database.
2. *Economic growth prior to the crisis*. On average, countries that were growing faster during the decade prior to the global crisis (in 1999–2007) may be expected to keep growing at a relatively fast pace after the crisis. A counterargument might point to the possibility of boom-bust cycles. Regardless of which hypothesis one believes, it seems reasonable to allow for the possibility that precrisis growth may correlate with growth after the crisis.
3. *Real interest rates*. Several countries experienced spikes in the cost of sovereign borrowing for significant parts of the post-crisis period because of perceived default risk. Such increases in real interest rates spilled over into the cost of borrowing for firms and households, thereby curtailing aggregate demand. Average real interest rates are computed by subtracting average inflation in a given time period from average government bond rates (obtained from the IMF's *International Financial Statistics,* the OECD, and Eurostat).
4. *Real effective exchange rate*. Much emphasis has been placed on a country's ability to improve its competitiveness and on the difficulties specific to currency union members to do so. To capture this factor, some regressions include the change in the real effective exchange rate based on the consumer price index (end-December 2007 or 2009 to end-December 2014, drawn from the IMF's *International Financial Statistics* and IMF staff reports).

Additional factors might be considered to determine the slope coefficient in the empirical association between economic growth and fiscal adjustment. For example, economic theory suggests that the impact of fiscal stimulus (or adjustment) on domestic aggregate demand is weaker in highly open economies: In the event of a boost to government expenditure, most of the additional demand for goods and services would be met through imports rather than domestic production. This possible factor suggests using an interaction term such as fiscal adjustment multiplied by trade openness.[8] For most of the remainder

7. Meaning observations with Cook's distance greater than one; see appendix B for details on the procedure.

8. A case could also be made for including an interaction term between fiscal adjustment and the output gap, based on the reasoning that fiscal stimulus is likely to be more effective (or fiscal adjustment more deleterious) when the economy has spare capacity and interest rates are unlikely to increase as fiscal policy becomes more expansionary. For example, using quarterly data going back to the 1970s for a panel of six large advanced economies, Baum,

of this *Policy Brief*, such interaction terms are not included, because they were found to be either statistically insignificant (particularly for 2007–14) or fragile when influential observations (usually Greece and Singapore) were excluded.

The results of multiple regressions controlling for the factors above are reported in table 1, for 2007–14 and 2009–14. For each sample period, three estimation approaches are used: ordinary least squares (OLS), OLS excluding Greece from the sample, and robust regressions. The estimated coefficient on the change in the CAPB ranges between –0.7 and –1.4 and is statistically significant in 8 of the 12 estimated regressions. The main factor affecting the magnitude and statistical significance of the coefficient on the CAPB is whether Greece is included in the sample: When Greece is excluded, the coefficient ranges between –0.7 and –0.8. Trading partner growth interaction with the exports share is positive and significant in 9 out of 12 specifications. Precrisis growth is positively associated with growth and significantly so in half of the specifications. Real interest rates (included in specifications 6 through 12) display the expected negative sign but for the most part are not statistically significant. The change in the real effective exchange rate (specifications 6 through 12) is not significantly related to growth in these estimations. Appendix C reports the results of multivariate regressions that include an interaction term between fiscal adjustment and trade openness.

Multiple regressions controlling for all of the above factors have two potential drawbacks. First, some of the right-hand-side explanatory variables may be correlated with each other, introducing possible multicollinearity. Second, in view of the small size of the sample, there is a case for conserving degrees of freedom.

To reduce the impact of these potential drawbacks, a battery of multiple regressions is run in which the change in the CAPB is always included on the right hand side, as well as all possible combinations of the variables from the list above (plus a dummy variable for membership in the European Union). This approach is in the spirit of the "extreme bounds analysis" made popular by Levine and Renelt (1992) in the context of the cross-country economic growth regressions literature.

To summarize the large number of estimated regressions, table 2 reports the largest and smallest estimated coefficients for the fiscal adjustment variable, along with the standard errors and the list of controls in the corresponding specification. The coefficient in the base case (the regression with fiscal adjustment alone) is also reported for the sake of comparison. A battery of 42 regressions is estimated for each of the following samples, estimation periods, and estimation techniques: 2009–14 robust regressions, 2009–14 OLS, 2009–14 OLS excluding Greece, 2007–14 robust regressions, 2007–14 OLS, and 2007–14 OLS excluding Greece. In all cases, the most negative estimated coefficient on fiscal adjustment ("low") is statistically significant, with the point estimates ranging between –0.86 and –1.61. However, the least negative estimated coefficient on fiscal adjustment ("high") ranges between +0.35 and –0.25 in five estimation approaches out of six and is not statistically significant in those cases; it amounts to –0.85 for 2009–14 OLS including Greece and is statistically significant in that case.

To sum up, a "robust" empirical association (one that passes the extreme bounds analysis test) emerges between fiscal adjustment and economic growth only if one focuses on 2009–14 and if one includes Greece in the sample of countries. In all other cases (2009–14 robust regressions, 2009–14 OLS excluding Greece, 2007–14 robust regressions, and 2007–14 OLS), the extreme bounds analysis concludes that the empirical association between fiscal adjustment and economic growth is "fragile."

Among nonfiscal, right-hand-side variables, the interaction of trading partner growth with the exports-to-GDP share is significant in almost all specifications, though this result holds less strongly when small, highly-open Asian economies are omitted. Past output growth is often positively and significantly correlated with post-2009 economic growth, though the depth of the initial output loss in 2008–09 may have been larger for countries that grew rapidly prior to 2007, leading to the absence of significant correlation between growth in 1999–2007 and 2007–14. Other variables such as real interest rates and the change in the real effective exchange rate are seldom significant in the estimated regressions. The EU dummy is significant in most cases. The key result of fragility for the fiscal adjustment coefficient holds even when the EU dummy is omitted from the analysis.

INTERPRETING THE MIXED RESULTS ON THE CORRELATION BETWEEN FISCAL POLICY AND GROWTH

The results of the cross-country regressions suggest that the link between fiscal adjustment and economic growth is not straightforward, and the evidence is not conclusive. Economic growth—since the beginning of the global economic and financial crisis as well as since the trough in 2009—is negatively and significantly associated with the increase in the cyclically adjusted primary balance in some but not all specifications.

Interestingly, there are almost no instances in which fiscal adjustment—or deficit reduction—and economic growth are positively associated in the cross-country regressions consid-

Poplawski-Ribeiro, and Weber (2012) find that the fiscal multiplier is significantly larger when the output gap is negative. This *Policy Brief* does not include such an interaction term, because of the lack of reliable estimates of the output gap for a sufficient number of economies during the Great Recession.

Table 1 Multivariate regressions of economic growth on fiscal policy and additional economic variables

	Annual growth, 2007–14			Annual growth, 2009–14			Annual growth, 2007–14			Annual growth, 2009–14		
	OLS	OLS, excluding Greece	Robust	OLS	OLS, excluding Greece	Robust	OLS	OLS, excluding Greece	Robust	OLS	OLS, excluding Greece	Robust
Fiscal adjustment (5- or 7-year)	−1.43**	−0.76	−1.33*	−1.37***	−0.82*	−0.84*	−1.23	−0.76	−0.71	−1.10***	−0.81*	−1.11**
	(0.45)	(0.51)	(0.50)	(0.27)	(0.36)	(0.39)	(0.63)	(0.60)	(0.58)	(0.30)	(0.36)	(0.31)
Trading partner growth interaction with exports as share of GDP	0.21	0.24*	0.21	0.27*	0.26*	0.26*	0.38	0.51*	2.59**	0.34*	0.37*	0.36*
	(0.12)	(0.12)	(0.14)	(0.11)	(0.10)	(0.11)	(0.23)	(0.22)	(0.76)	(0.16)	(0.16)	(0.17)
Prior annual growth (1999–2007)	0.17	0.16	0.18	0.41**	0.39**	0.38**	0.14	0.13	0.039	0.42**	0.36*	0.37*
	(0.14)	(0.13)	(0.15)	(0.13)	(0.13)	(0.13)	(0.14)	(0.13)	(0.13)	(0.14)	(0.14)	(0.14)
Percent change in real effective exchange rate (relevant period)							0.0030	0.0012	0.032	0.018	0.021	0.023
							(0.03)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Average real interest rate (relevant period)							−0.025	0.20	−0.20	−0.19	−0.080	−0.18
							(0.19)	(0.19)	(0.18)	(0.13)	(0.15)	(0.14)
Constant	0.016	0.15	−0.020	0.71	0.59	0.61	0.079	−0.22	−0.39	0.91	0.75	0.96
	(0.54)	(0.51)	(0.60)	(0.52)	(0.50)	(0.54)	(0.72)	(0.67)	(0.73)	(0.52)	(0.52)	(0.54)
Number of countries	40	39	40	40	39	39	39	38	38	39	38	39
R-squared	0.359	0.260	0.299	0.564	0.423	0.383	0.362	0.308	0.446	0.629	0.475	0.603

Notes: Statistical significance: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors in parentheses. OLS is ordinary least squares. Robust regressions either exclude or reduce the weight of observations that would have excessive influence on the estimated relationship, based on Cook's distance; see appendix B. For countries included in sample, see appendix A. Fiscal adjustment is the increase in the cyclically adjusted primary balance over 5 years (2009–14) or 7 years (2009–14), as indicated in the columns.

Sources: International Monetary Fund's *World Economic Outlook* and *International Financial Statistics*, Organization for Economic Cooperation and Development Analytical Database, Eurostat, and authors' calculations.

Table 2 Extreme bounds analysis: Multivariate regressions with all possible combinations of regressors

Variable		β	t	Countries	R-squared	Variables
Fiscal adjustment (2009–14)						
Robust regression	high:	–0.02	–0.1	37	0.40	Trading partner growth * exports/GDP, REER change, real interest rate, EU dummy
	low:	–1.33	–4.9	40	0.57	Trading partner growth * exports/GDP, past growth, REER change
	base:	–0.59	–1.3	39	0.05	
OLS	high:	–0.81	–3.2	39	0.74	Trading partner growth * exports/GDP, past growth, real interest rate, EU dummy
	low:	–1.35	–5.2	40	0.60	Trading partner growth * exports/GDP, past growth, REER change
	base:	–1.26	–3.8	40	0.28	
OLS, excluding Greece	high:	–0.25	–0.7	38	0.53	Trading partner growth * exports/GDP, REER change, real interest rate, EU dummy
	low:	–0.86	–2.4	39	0.46	Trading partner growth * exports/GDP, past growth, REER change
	base:	–0.57	–1.3	39	0.04	
Fiscal adjustment (2007–14)						
Robust regression	high:	–0.17	–0.4	40	0.49	Trading partner growth * exports/GDP, REER change, real interest rate, EU dummy
	low:	–1.57	–3.2	40	0.21	
	base:	–1.57	–3.2	40	0.21	
OLS	high:	–0.11	–0.2	39	0.51	Trading partner growth * exports/GDP, REER change, real interest rate, EU dummy
	low:	–1.61	–3.6	40	0.25	
	base:	–1.61	–3.6	40	0.25	
OLS, excluding Greece	high:	+0.35	+0.6	38	0.52	Trading partner growth * exports/GDP, real interest rate, REER change, EU dummy
	low:	–1.03	–2.0	39	0.10	
	base:	–1.03	–2.0	39	0.10	

OLS = ordinary least squares; REER = real effective exchange rate

Notes: For each sample period and estimation technique, multivariate regressions of economic growth are run on the change in the cyclically adjusted primary balance and all possible combinations of the other regressors. "High" ("low") is the highest (lowest) estimated slope (β) coefficient on the change in the cyclically adjusted primary balance among all such regressions; also reported are the corresponding *t-statistic*, number of countries, R-squared, and list of other regressors in the same regression. For countries included in sample, see appendix A.

Sources: International Monetary Fund's *World Economic Outlook* and *International Financial Statistics*, Organization for Economic Cooperation and Development Analytical Database, Eurostat, and authors' calculations.

ered in this study, which thus does not provide support to the "expansionary fiscal consolidations" hypothesis. According to the expansionary fiscal consolidations hypothesis,[9] fiscal adjustment improves the government's credibility regarding fiscal matters, thereby reducing the risk premium on its borrowing and increasing private investment and growth. A formal test of this hypothesis would focus only on countries with high risk premia—too small a sample for the approach used here—and the intention of this *Policy Brief* is not to diminish the value of fiscal adjustment in countries where fiscal and debt sustainability are at risk and financing conditions are overly expensive or simply unavailable.

The empirical association between fiscal adjustment and economic growth often hinges on whether Greece is included in the sample. Considering simple scatter plots between economic growth and the changes in the CAPB for 2007–14 or 2009–14, the slope coefficient is in the order of –0.9 to –1.6 when Greece is included and +0.3 to –1.0 when Greece is excluded. In the latter cases, the coefficient is seldom significantly different from zero. In multivariate regressions controlling for factors such as the role of trading partners' growth, past growth, real interest rates, and the change in the real effective exchange rate, the estimated coefficient on the change in the CAPB ranges between –0.7 and –1.4 and is often statistically significant. When Greece

9. See, for example, Alesina and Ardagna (1998) and Giavazzi and Pagano (1990).

is excluded, the coefficient ranges between –0.7 and –0.8. A more stringent "extreme bounds analysis" in which large numbers of regressions are estimated (for all possible combinations of the set of control variables) reveals that the empirical association between growth and the CAPB is "fragile," that is, many specifications can be found in which the association is not statistically (or economically) significant.

The policy choice between fiscal stimulus and fiscal adjustment will remain a difficult balancing act.

On the whole, considering these findings, the evidence is mixed: Those who hold a prior that fiscal adjustment is harmful for growth may find their beliefs confirmed, whereas those who believe a prior that the link is weak may find the evidence unconvincing (even aside from valid concerns about causality). To the extent that the case of Greece involves unique features beyond large fiscal adjustment, the data reveal that drawing conclusions from empirical associations that include this specific case requires caution.[10] Indeed, the results raise an interesting paradox: Taking at face value the coefficients estimated including Greece in the sample, one might attribute more than one half to almost all of Greece's output drop over the past few years to fiscal adjustment; however, using coefficients estimated excluding Greece, the share of the output drop in Greece that could be attributed to fiscal adjustment ranges from nil to one half.

While keeping in mind important caveats because of the challenges in establishing causality, should these mixed results make policymakers more or less reluctant to undertake fiscal adjustment in the years ahead? For countries facing a prolonged recession that are able to finance fiscal stimulus without incurring excessive borrowing cost increases, relaxing fiscal policy may be reasonable even if its impact on growth is uncertain; conversely, it seems reasonable to eschew fiscal tightening during prolonged recessions, even if the evidence on its adverse impact on output is mixed. For countries facing financing constraints, fiscal stimulus may be too expensive or altogether precluded, and fiscal adjustment may be the only feasible course of action. The policy choice between fiscal stimulus and fiscal adjustment will remain a difficult balancing act and will often be constrained by market and financing conditions.

10. One can argue that the case of Greece involves an especially high degree of uncertainty —with adverse effects on investment and job creation—because of political difficulties in implementing its adjustment program and the constant stop-go nature of the related negotiations. Other unique features include Greece's relatively high structural rigidities and its unusually low degree of trade openness, with exports of goods and services equivalent to 22 percent of GDP in 2010—both factors that reduce Greece's ability to rebound from economic crisis.

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APPENDIX A

Table A.1 Economies included in samples for figure 3, regression tables, and appendix figures

Australia	AUS	Latvia	LVA
Austria	AUT	Lithuania	LTU
Belgium	BEL	Luxembourg	LUX
Bulgaria	BGR	Malta	MLT
Canada	CAN	Mexico	MEX
Chile	CHL	Netherlands	NLD
Czech Republic	CZE	New Zealand	NZL
Denmark	DNK	Norway	NOR
Finland	FIN	Poland	POL
France	FRA	Portugal	PRT
Germany	DEU	Romania	ROU
Greece	GRC	Singapore	SGP
Hong Kong	HKG	Slovak Republic	SVK
Hungary	HUN	Slovenia	SVN
Iceland	ISL	Spain	ESP
Ireland	IRL	Sweden	SWE
Israel	ISR	Switzerland	CHE
Italy	ITA	Turkey	TUR
Japan	JPN	United Kingdom	GBR
Korea	KOR	United States	USA

Note: Includes economies that are members of the Organization for Economic Cooperation and Development (OECD), defined as advanced by the International Monetary Fund's (IMF) *World Economic Outlook*, or members of the European Union, and for which data are available on economic growth and the cyclically adjusted primary fiscal balance from the April 2015 vintage of the IMF's *World Economic Outlook* database.

APPENDIX B

A REFRESHER ON THE ROBUST REGRESSION METHOD

When researchers wish to examine a statistical relationship between two variables, they often need to choose how extreme values ("outliers") will be treated. Without any adjustment, the slope of the ordinary least squares (OLS) regression line could be overly influenced by one or a few observations.

A possible solution is to put lower weight on those variables that have "excessive influence" on the model. One measure of the influence of any data point is known as Cook's distance (D):

$$D_i = \frac{\sum_{j=1}^{n}(\hat{Y}_j - \hat{Y}_{j(i)})^2}{p\ MSE}$$

The first term in the numerator is the prediction for observation j from a regression that preserves the whole sample. The second term is the prediction for the same point j when observation i is omitted from the sample. The number of fitted parameters is denoted by p and MSE is the mean square error of the model (i.e., the average of the squared difference between predicted values and observed values).

There is no hard rule for exclusion of observations, but a commonly used approach is to eliminate those observations that have $D > 1$. This approach is used in this study, first calculating D for each observation when the sample is complete, and then iterating again when the extreme observations are dropped, and putting lower weight on those observations that have large absolute residuals (as long as $D < 1$). With this method, the final model is the output of iteratively reweighted least squares that seeks to maintain efficiency close to OLS while lowering the influence of extreme observations.

APPENDIX C

INTERACTION BETWEEN FISCAL ADJUSTMENT AND TRADE OPENNESS

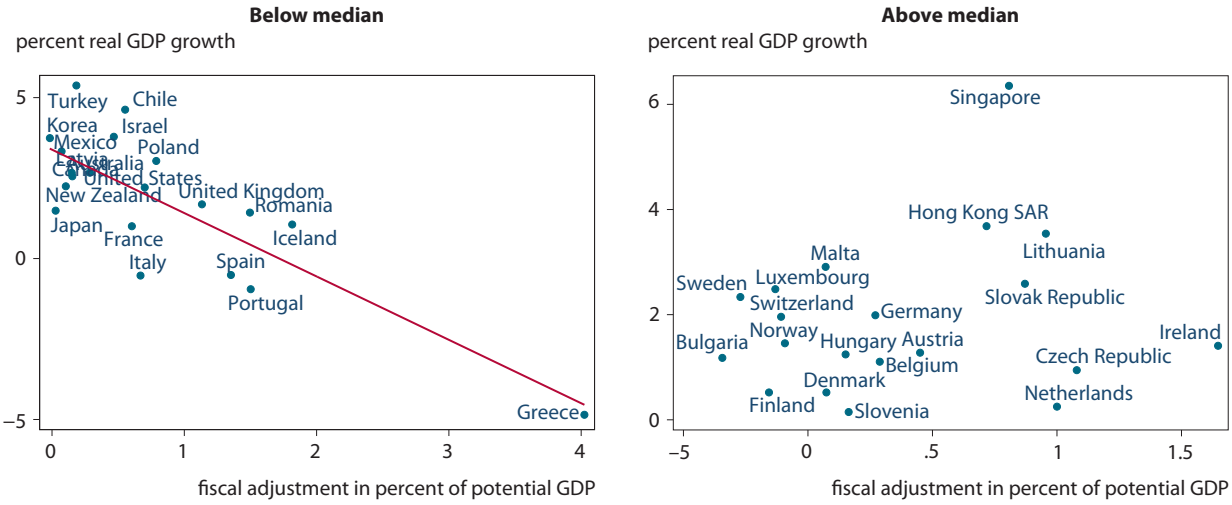
Economic theory suggests that fiscal policy has lower impact on economic growth for economies that are highly open to international trade, as measured by imports (or imports plus exports) as a share of GDP. The notion of trade openness here does not refer to trade restrictions; a large economy such as the United States, for example, is relatively closed in the sense that only a small proportion of its demand is met through imports, whereas smaller countries such as Ireland or Singapore are far more open according to this metric because of the high importance of trade in their economies.

Some simple scatter plots suggest that the empirical association between economic growth and fiscal adjustment is much stronger for relatively open economies than for less open economies. For example, using data for 2009–14, compare the visual relationship for the sample of countries with the sum of imports plus exports, as a share of GDP, above the cross-country median, with the relationship for the sample of countries that are below the median of trade openness by the same metric (figure C.1). The figure on the left suggests a negative slope, whereas the figure on the right indicates no relationship.

Multivariate regression analysis also shows that the interaction term for fiscal adjustment and trade openness is statistically significant with the expected sign (table C.1).

However, the interaction term is fragile to using 2007–14 and to the exclusion of Greece and Singapore from the sample. Thus in the main text of this *Policy Brief*, interaction terms are excluded from the analysis.

Figure C.1 Economic growth and fiscal adjustment for countries above and below sample median for exports-to-GDP ratio, 2009–14



Note: Average annual real GDP growth (in percent) on the vertical axis; average improvement in the cyclically adjusted primary fiscal balance (in percentage points of annual potential GDP) on the horizontal axis. See appendix A for all countries included in sample.

Sources: Authors' estimates using data from the International Monetary Fund's *World Economic Outlook*, April 2015 vintage, and from the World Bank's *World Development Indicators* database.

Table C.1 Dependent variables: Average real growth rate between 2009 and 2014

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Fiscal adjustment	−2.740***	−2.389**	−2.559***	−2.624***	−2.779***	−1.953**	−1.752*	−1.018	−1.449	−1.962*	−1.864*	−0.250
	(0.572)	(0.675)	(0.658)	(0.538)	(0.513)	(0.584)	(0.836)	(0.990)	(0.980)	(0.815)	(0.737)	(0.833)
(Imports + exports)/GDP	−0.381	−0.700	−0.294	−0.329	−0.667	0.0206	−0.276	−0.655	−0.358	−0.254	−0.582	0.405
	(0.427)	(0.537)	(0.444)	(0.401)	(0.396)	(0.411)	(0.443)	(0.521)	(0.471)	(0.428)	(0.405)	(0.427)
Fiscal adjustment x (imports + exports)/GDP	1.802**	1.364	1.774**	1.667**	1.695**	1.176*	1.034	0.303	0.700	1.180	0.972	0.0662
	(0.585)	(0.736)	(0.628)	(0.551)	(0.532)	(0.572)	(0.706)	(0.885)	(0.900)	(0.686)	(0.629)	(0.666)
Trading partner growth x exports/GDP		0.267						0.374				
		(0.272)						(0.278)				
Average real interest rates			−0.114						0.00389			
			(0.135)						(0.157)			
Percent change in real effective exchange rate				0.0506*						0.0415		
				(0.0206)						(0.0222)		
Prior annual growth (1999–2007)					0.434**						0.427**	
					(0.130)						(0.126)	
EU dummy						−1.403**						−1.720**
						(0.476)						(0.481)
Constant	2.765***	2.827***	2.838***	2.768***	1.486*	3.149***	2.539***	2.506***	2.599***	2.594***	1.314*	2.690***
	(0.519)	(0.523)	(0.557)	(0.486)	(0.608)	(0.489)	(0.569)	(0.563)	(0.658)	(0.550)	(0.624)	(0.492)
Observations	40	40	39	40	39	40	38	38	37	38	37	38
R-squared	0.494	0.507	0.498	0.568	0.618	0.594	0.140	0.185	0.113	0.222	0.366	0.381

Note: Statistical significance: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Standard errors in parentheses. Regressions in columns 7–12 exclude Greece and Singapore. For countries included in sample, see appendix A.

Source: Authors' calculations.