PIIE PETERSON INSTITUTE FOR INTERNATIONAL ECONOMICS

POLICY BRIEF

16-10 Reducing Government Debt Ratios in an Era of Low Growth

Paolo Mauro and Jan Zilinsky

July 2016

Paolo Mauro *is senior fellow and* **Jan Zilinsky** *is research analyst at the Peterson Institute for International Economics.*

Authors' note: We are grateful to S. Ali Abbas, Olivier Blanchard, William R. Cline, Julio Escolano, Antonio Fatás, Joseph E. Gagnon, Gian Maria Milesi-Ferretti, Ángel Ubide, and Steven Weisman for helpful suggestions.

© Peterson Institute for International Economics.
All rights reserved.

Almost a decade after the onset of the global economic and financial crisis, government debt-to-GDP ratios in the advanced economies have stabilized well above their precrisis levels. Living with high debt is living dangerously: When government debt is large, an increase in interest rates causes a sizable rise in the cost of debt service and therefore in the risk of financial crisis brought about by an interest rate–debt spiral.

Reducing high debt ratios would seem imperative, but doing so poses a daunting challenge, because the range of options for reducing debt is more limited than it once was and economic growth in the next decade is expected to be lower than it was before the global crisis. The low economic growth rate projected for the next decade—as a result of population aging and the lingering effects of the crisis—is a special source of concern, because declines in the long-run economic growth rate have been shown to be an important factor underlying increases in the government debt-to-GDP ratio in a large sample of countries over the past 200 years (Mauro et al. 2015). Fiscal crises (including defaults) in developing and emerging economies have often been brought about by unexpected, long-lasting declines in economic growth rates (Easterly 2001).

Past studies have underestimated—in tone, if not necessarily in substance—the role of economic growth in determining the path of debt ratios. This *Policy Brief* proposes an extended accounting approach that fully recognizes the importance of economic growth in this regard, by keeping track of the impact of growth on the primary fiscal surplus. It analyzes the factors underlying changes in the debt-to-GDP ratio in the post–World War II period for most advanced economies. Drawing on the results, the *Policy Brief* concludes that a gradual but sustained fiscal adjustment through expenditure cuts and revenue increases is the most appropriate means of reducing the chances of debt crisis in the coming decade.

RISE IN GOVERNMENT DEBT RATIOS

General government debt ratios in the advanced economies averaged 106 percent of GDP at end-2015, up from 72 percent at end-2007. Fiscal deficits have been reduced from their levels at the height of the crisis. Partly as a result, government debt ratios in most advanced economies are projected to remain broadly stable at their higher, postcrisis levels during the next five years (IMF 2016).

In the presence of high debt ratios, a rise in interest rates causes the government's total borrowing costs—and thus the deficit—to increase substantially. As larger deficits are financed, the debt also swells in subsequent years. Worried investors are likely to demand even higher interest rates before purchasing new debt. A country that started out on a stable debt path may suddenly face refinancing difficulties. The shock that caused interest rates to rise abruptly shifts the economy from a good equilibrium with stable debt and low interest rates to a bad equilibrium with rising debt and high interest rates, potentially ending up in crisis and default. Countless debt crises have been brought about by increases in interest rates, often accompanied by declines in economic growth (Reinhart and Rogoff 2009).

In some cases, such debt crises are "self-fulfilling" (Sachs 1984, Cole and Kehoe 1996), that is, prompted by changes in investor behavior. Examples have occurred recently. A sudden loss of confidence in Italy and Spain triggered a spike in sovereign bond spreads (vis-à-vis Germany), leading to a temporary interest rate–debt spiral in late 2011 and mid-2012. Measures by the European Central Bank calmed the markets, following President Mario Draghi's "Whatever It Takes" speech (July 26, 2012). Although default was avoided, higher borrowing costs were transmitted to the private sector, further dampening economic activity.

Some economists (e.g., Elmendorf and Sheiner 2016) have argued that today's low interest rates provide room to postpone fiscal tightening. In most advanced economies, nominal interest

rates are extraordinarily low, and real interest rates are somewhat low by historical standards. However, the interest rate–economic growth differential (the interest rate minus the rate of economic growth), which is currently about zero in many countries, is not unusually low by historical standards. Economists focus on this differential because it affects the path of the debt-to-GDP ratio. Moreover, the correlation between global interest rates and aggregate demand observed in historical data is weak (Barro and Sala-i-Martín 1990, Hamilton et al. 2016), and there is no certainty that interest rates will rise only when economic growth picks up. Interest rates occasionally rise suddenly and unpredictably in one or more countries, to levels well in excess of rates experienced by most of the world economy. In modern financial markets, countries often see their borrowing costs surge simply because of perceived similarity with other countries affected by crisis, regardless of economic fundamentals (Mauro, Sussman, and Yafeh 2002).

A gradual but sustained fiscal adjustment through expenditure cuts and revenue increases is the most appropriate means of reducing the chances of debt crisis in the coming decade.

It might also be argued that an interest rate–debt spiral and subsequent default is inconceivable in countries that issue their own currency. In the post–World War II era, the only advanced-country default occurred in Greece, which does not have its own currency. However, defaults also occurred in the post–World War II era in large emerging economies (e.g., Russia in 1998) and in the pre–World War II era in economies that are now advanced (e.g., Italy in 1926) despite the prevalence of a domestic currency. And even if default were less likely in economies with their own central bank, it is not clear that reducing the real value of debt by surprising investors with a bout of high inflation would be less disruptive than outright default.

One cannot rule out the possibility that debt tolerance may have increased in the aftermath of the global economic and financial crisis. Debt is high almost everywhere, and investors appear to feel that there are too few safe assets, as evidenced by low interest rates, especially in countries widely considered to be safe havens. Moreover, as a share of GDP, the stock market capitalization of the G-7 countries roughly doubled between the 1980s and the 2010s.[1] As the volume of risky assets rises, demand for safe assets could increase, too. However, notions of what constitutes a safe haven are ultimately based on investors' perceptions, which occasionally change abruptly.

CAPTURING THE LINK BETWEEN ECONOMIC GROWTH AND THE GOVERNMENT DEBT RATIO USING AN EXTENDED ACCOUNTING APPROACH

Analyzing the factors underlying large changes in public debt ratios during past episodes can provide clues about whether and by how much public debt will be reduced in the period ahead. An extended accounting method permits fuller recognition of the role of economic growth in determining changes in debt ratios.[2]

The traditional accounting identity divides the change in the government debt-to-GDP ratio into four components:

$$d_t - d_{t-1} = \left(\frac{r_t}{1+g_t}\right) d_{t-1} - \left(\frac{g_t}{1+g_t}\right) d_{t-1} - p_t + f_t \qquad (1)$$

where d is the debt-to-GDP ratio, r is the real interest rate, g is the real growth rate, p is the primary surplus (the fiscal surplus excluding interest payments on the government's debt), and f is the "stock-flow residual" (the statistical discrepancy between the left-hand side [the actual change in the debt ratio] and the sum of the factors on the right-hand side) (see, e.g., Escolano 2010).[3] More precisely, r is the implicit interest rate on the existing debt stock (the ratio of the interest bill paid by the government on all outstanding debt divided by the stock of debt at the end of the previous year). The first term on the right-hand side reflects the interest cost of financing the debt; the second term reflects the erosion of the debt ratio that stems from the growth of output (the denominator in the debt ratio). The difference between the interest rate and the rate of economic growth is a key determinant of changes in the debt-to-GDP ratio.

This standard decomposition does not do full justice to the role of economic growth in reducing the debt ratio. Most economists analyzing this decomposition mention that economic growth strongly affects the primary surplus but stop short of quantifying the effect, even though the mechanism through which it operates is simple: Economic growth increases tax revenues, reducing the fiscal deficit.[4]

1. According to data from the World Bank's *World Development Indicators*.

2. Evidence for reverse causality (from high debt ratios to low economic growth) is weak (Panizza and Presbitero 2014).

3. Such a discrepancy may result from a host of factors, such as changes in the exchange rate, privatizations and sales of other public assets, and debt bailouts of entities that are not part of the general government (banks, state-owned enterprises).

4. The same mechanism underlies standard calculations of the "cyclically adjusted" fiscal deficit. However, the approach proposed in this *Policy Brief* recognizes that growth affects the primary surplus and thus the debt ratio through both cyclical factors and changes in the long-run (or "potential") growth rate of the economy.

A more complete accounting of the impact of growth on the debt ratio recognizes that the primary surplus (as a share of GDP) itself depends on economic growth. Absent policy action, it is reasonable to assume that revenues rise in line with nominal GDP whereas primary expenditures rise in line with the GDP deflator.[5] For example, a neutral policy approach would be for the government to raise civil servants' wages and pensions in line with inflation.[6] Under that assumption, the primary surplus as a share of GDP would equal

$$p_t = p_{t-1} + e_{t-1}\left(\frac{g_t}{1+g_t}\right) + m_t \tag{2}$$

where e is the ratio of primary expenditures to GDP, the multiplicative component reflects the erosion of the primary expenditure to the GDP ratio stemming from real economic growth, and m is the effect of policy measures (obtained as a residual). If the primary surplus rises by more than implied by the expenditure ratio erosion term, policy measures (tax hikes or real expenditure cuts) must account for the difference.

Of course, higher revenues resulting from economic growth give governments the option to spend more: Increases in revenues are often accompanied by additional expenditures. But raising expenditures (as opposed to reducing the debt) is a policy choice enabled by economic growth. It is therefore appropriate to consider the erosion of the primary expenditure to GDP ratio attributable to economic growth as part of the overall contribution of economic growth to reducing the debt ratio.

It may also be argued that at some point it would become both economically and politically untenable for governments to fail to increase real primary expenditures against the background of rapid, prolonged economic growth. For example, in a booming economy with rapidly growing real private sector wages, it would eventually become difficult for the public sector to retain civil servants if their wages lost competitiveness vis-à-vis the private sector. Rapid economic growth would also eventually create its own demands for additional infrastructure spending (e.g., to accommodate rising use of transportation services). Governments can resist these pressures for several years, however. There is therefore no reason why rapid economic growth should not permit a sustained decline in the ratio of primary expenditure to GDP. In this light, the method proposed constitutes a helpful benchmark for assessing the impact of economic growth on the debt ratio.[7]

In the exercises that follow, an extended accounting of the factors determining the evolution of the debt-to-GDP ratio will be given by the following identity:

$$\begin{aligned} d_t - d_{t-1} = &\left(\frac{r_t}{1+g_t}\right) d_{t-1} - m_t - p_{t-1} + f_t \\ &- \left(\frac{g_t}{1+g_t}\right)(d_{t-1} + e_{t-1}) \end{aligned} \tag{3}$$

where the last multiplicative term represents the extended contribution of economic growth (the growth rate multiplied by not just the debt ratio but also the expenditure ratio).

This extension is quantitatively important. To see why, consider the example of a country in which the debt-to-GDP ratio is 80 percent and primary expenditure is equivalent to 40 percent of GDP. The additional contribution of economic growth through expenditure erosion is equivalent to half of the growth contribution in the traditional accounting approach. The relative importance of the additional contribution becomes even greater when examining the cumulative change in the debt ratio over several years, because the larger primary fiscal surplus (flow) stemming from economic growth affects the debt ratio (stock) every intervening year.

The change in the debt ratio between year 0 and year N equals

$$\begin{aligned} d_N - d_0 = &\sum_{i=1}^{N}\left(\frac{r_i}{1+g_i}\right) d_i - N(\tau_0 - e_0) - \sum_{i=1}^{N}\sum_{t=1}^{i} m_t \\ &- \sum_{i=1}^{N}\left(\frac{g_i}{1+g_i}\right) d_i - e_0 \sum_{i=1}^{N}\sum_{t=1}^{i} \frac{g_i}{\prod_{t=1}^{i}(1+g_t)} + \sum_{i=1}^{N} f_t \end{aligned} \tag{4}$$

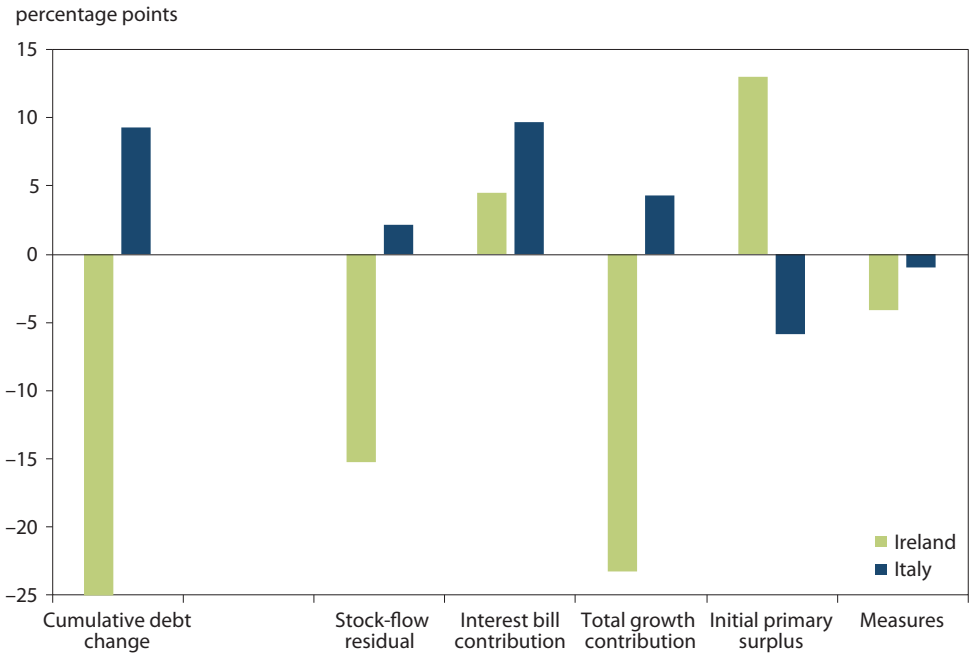
where τ_0 is the revenue-to-GDP ratio in year 0 (see the appendix for the derivation of the extended accounting method). The increase in the debt ratio is given by the interest cost term minus the initial primary surplus (N times) minus the fiscal policy adjustment measures (which affect the primary surplus in the year they are undertaken and in each following year) minus the

5. We assume that the elasticity with respect to GDP is 1 for revenues and 0 for expenditures. A more refined analysis would recognize that some expenditures (e.g., unemployment benefits) are negatively associated with economic growth; it would also allow different taxes to have different elasticities with respect to GDP, or consider changes in various revenue bases (such as consumption for consumption taxes and house prices for property taxes). These coarse assumptions work reasonably well when considering large panels of countries using historical data (Fatás and Mihov 2012). To simplify the analysis, we also ignore population growth, which is projected to be low in the countries analyzed.

6. An alternative, perhaps less realistic, approach would be to define a neutral policy as one in which the government allows revenues to rise in line with nominal GDP but keeps nominal expenditures fixed, that is, does not let nominal spending rise with inflation (see the corresponding identities in appendix). However, the relationship between inflation and the primary fiscal balance is far more tenuous than the relationship between economic growth and the primary balance. The impact of inflation on debt changes is thus adequately captured by the traditional approach, in which it operates through its effect on the interest rate–growth differential, as high inflation reduces real interest rates far more than it affects real economic growth.

7. Alternative benchmarks might be based on "no policy measures" scenarios in which the government keeps real expenditures constant for no more than, say, three years and then lets expenditures grow again in line with nominal GDP, or increases expenditures at a rate equal to the GDP deflator inflation plus a fixed proportion of the real growth rate.

Figure 1 Cumulative contributions to changes in government debt-to-GDP ratios between end-2012 and end-2015 in Ireland and Italy



Note: The change in the debt-to-GDP ratio is attributed to the various components in equation (4).
Source: IMF, *World Economic Outlook* database, April 2016.

traditional growth term (the erosion of the debt ratio) minus the additional growth term (erosion of the expenditure ratio, with increasing effects on the primary surplus as time goes by) plus the cumulative stock-flow residual.

Comparison between Ireland and Italy in 2012–15 (figure 1) illustrates the importance of economic growth in determining changes in the debt-to-GDP ratio as well as the quantitative relevance of the extended accounting. The two countries had approximately the same general government debt-to-GDP ratio (about 120 percent of GDP) at end-2012; three years later, Ireland's debt ratio had fallen to 95 percent of GDP whereas Italy's stood at 132 percent. The difference is attributable primarily to the differences in average annual real economic growth (4.8 percent in Ireland and –0.3 percent in Italy).[8] Italy also faced higher interest rates than Ireland. These factors more than offset the larger initial primary deficit experienced by Ireland in 2012.

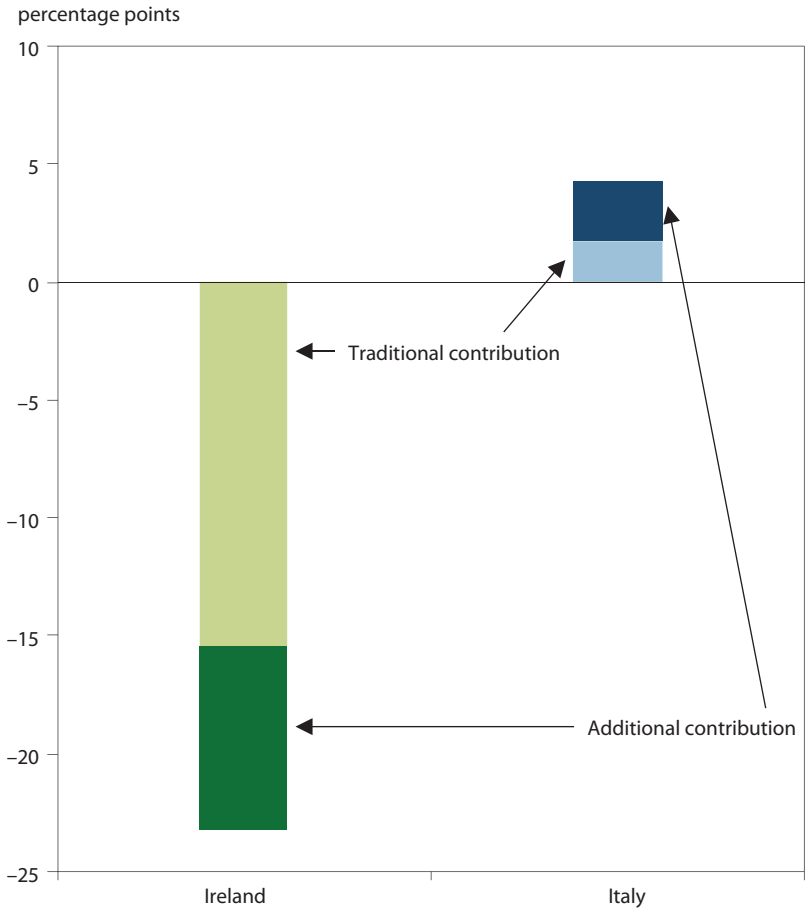
Figure 2 breaks down the contribution of economic growth into its traditional component and the additional component proposed here. The additional component is equivalent to 8 percentage points of annual GDP for Ireland (half as large as the traditional component) and 3 percentage points for Italy (larger than the traditional component).

IMPACT OF THE GLOBAL CRISIS ON GOVERNMENT DEBT RATIOS

The rise in debt ratios in advanced economies associated with the global economic and financial crisis is largely attributable to slow (and in some cases negative) economic growth and the policy response it triggered. Between end-2007 and end-2015, the average debt-to-GDP ratio of the nine G-20 advanced economies (Australia, Canada, France, Germany, Italy, Japan, South Korea, the United Kingdom, and the United States) rose by 31.6 percentage points of GDP (table 1). Interest costs accounted for 12.5 percentage points of this increase. Economic growth stemmed the increase by just 11.0 percentage points of GDP—about evenly split between the traditional (4.8 percentage points) and the additional (6.2 percentage points) contributions. The initial (2007) primary surplus made a small contribution to reducing the debt ratio (5.8 percent of GDP); policy measures made a major contribution to its increase (32.1 percent of GDP). (Recall that the measures are defined as the difference between the observed change in the primary surplus and the primary surplus that would have obtained if the revenue-to-GDP ratio and the absolute level of real expenditures had remained constant—that is, if the expenditure-to-GDP ratio had been eroded by real economic growth in countries in which GDP grew between 2007 and 2015 or automatically

8. The data are from the April 2016 vintage of the International Monetary Fund's *World Economic Outlook* database. They do not include the major upward revision to GDP released by the Irish Statistical Office in mid-July 2016. That revision would strengthen the point made here, though at the time of writing it remained to be seen whether the increase in GDP signaled a potential increase in tax revenues. For a discussion of the sizable negative stock-flow residual for Ireland, see International Monetary Fund Country Report No. 15/77, Annex 2.

Figure 2 Traditional and additional growth contributions to changes in debt-to-GDP ratios between end-2012 and end-2015 in Ireland and Italy



Note: The "traditional" growth contribution (lighter shade) is the third term from the right in equation (4), which measures the debt ratio erosion from growth. The "additional" contribution (darker shade) from expenditure ratio erosion is the second term from the right in equation (4).
Source: IMF, *World Economic Outlook* database, April 2016.

raised by negative economic growth where it did not.) The traditional approach indicates that the primary deficit (equivalent to the combined effect of the initial primary surplus in 2007, the policy measures, and the additional expenditure erosion from growth) averaged 20.1 percent of GDP during 2007–15.

Letting primary expenditures rise more rapidly than the GDP deflator—and thus accepting a much-expanded primary deficit—may well have been the right policy choice, perhaps preventing an even more prolonged recession. The decline in growth combined with the policy response resulted in a sizable rise in debt ratios, however.

Average figures mask wide variation across individual country experiences. For example, in both Australia (where growth was solid) and Italy (where it was negative), the debt ratio rose by about 30 percentage points between 2007 and 2015. But the increases stemmed from different sources. Italy's large primary surplus in 2007 (the largest of the nine countries analyzed) would have yielded a sizable reduction in the debt ratio (23.8 percent of GDP). However, negative growth implied a massive positive contribution (9.6 + 22.6 = 32.2 percent of GDP) to the debt ratio (on top of a large contribution from the interest bill, equivalent to 24.5 percent of GDP). Policy measures led the primary surplus to worsen slightly less than would have been predicted on the basis of the negative growth, implying a small negative contribution to the debt ratio (6.5 percent of GDP).

In contrast, Australia's strong growth performance would have led the debt ratio to decline by 34.1 percentage points, absent other factors. Most of the beneficial growth impact came through erosion of the expenditure ratio (29.6 percent of GDP) rather than erosion of the very low debt ratio (4.5 percent of GDP in 2007). Expansionary policy measures increased the debt ratio by the equivalent of 62.8 percent of GDP.

Differences in the two countries' policy choices may have been appropriate in light of Italy's large and Australia's much smaller initial debt. But the quantitative impact on debt ratios of differing economic growth performance is striking. The accounting relationships are correct regardless of potential causal

Table 1 Sources of changes in debt-to-GDP ratios in selected advanced economies before and after the global crisis (percentage points)

Economy	Change in debt ratio	Stock-flow residual	Interest contribution	Traditional growth contribution	Additional growth contribution	Initial primary balance	Measures	Primary surplus
Change in debt ratio between end-2007 and end-2015								
Japan	65.0	–11.1	22.5	–3.9	3.6	16.9	37.1	57.6
United Kingdom	45.8	2.6	9.1	–7.2	–1.4	10.7	31.9	41.2
United States	41.8	–0.9	9.5	–10.8	–7.2	6.4	44.8	44.0
Italy	32.8	6.5	24.5	9.6	22.6	–23.8	–6.5	–7.8
France	32.6	3.2	12.1	–3.2	–3.3	0.6	23.2	20.6
Australia	27.1	3.4	5.3	–4.5	–29.6	–10.3	62.8	22.8
Canada	24.6	4.6	17.4	–10.1	–14.6	–19.0	46.3	12.7
Germany	7.4	12.6	8.6	–5.4	–6.6	–21.8	20.1	–8.4
South Korea	7.3	13.3	3.4	–7.6	–19.3	–11.5	28.9	–1.9
Average	31.6	3.8	12.5	–4.8	–6.2	–5.8	32.1	20.1
Median	32.6	3.4	9.5	–5.4	–6.6	–10.3	31.9	20.6
Change in debt ratio between end-2000 and end-2007								
Japan	45.6	10.1	33.6	–19.0	–10.7	30.1	1.6	20.9
South Korea	12.6	34.6	3.9	–5.5	–8.4	–38.6	26.6	–20.4
United States	7.9	6.6	8.4	–9.5	–17.5	–27.5	47.4	2.4
France	6.8	3.3	10.2	–7.8	–21.4	–9.5	32.1	1.2
Germany	5.0	–3.6	15.3	–5.9	–9.7	–30.4	39.2	–0.9
United Kingdom	2.9	–0.1	7.3	–7.0	–22.3	–44.1	69.1	2.7
Italy	–5.4	–0.3	16.2	–8.3	–11.1	–38.0	36.0	–13.0
Australia	–9.8	4.0	7.0	–3.0	–26.8	–9.0	18.0	–17.9
Canada	–15.6	18.2	21.2	–13.2	–21.7	–70.4	50.2	–41.9
Average	5.6	8.1	13.7	–8.8	–16.6	–26.4	35.6	–7.4
Median	5.0	4.0	10.2	–7.8	–17.5	–30.4	36.0	–0.9

Note: The sample consists of the nine advanced economies in the G-20, ordered by rise in the debt ratio. The change in the debt ratio equals the sum of columns 3 to 8, as shown in equation (4). The primary surplus is reported for ease of reference; it is the sum of columns 6 through 8. The table shows debt ratio changes between the end of 2007 and the end of 2015 and between the end of 2000 and the end of 2007. Flow variables (economic growth, interest bill etc.) relate to 2008–15 in the top panel and 2001–07 in the bottom panel. As is well known, the identities do not hold for the median.

Sources: IMF, *World Economic Outlook* database, April 2016; Mauro et al. (2015).

links between the various factors, but the interpretation of the findings should not ignore such links. Differences in economic growth may well stem in part from differing fiscal policies.[9]

The much lower rise in debt ratios precrisis (end-2000 to end-2007) than during the crisis and its aftermath (end-2007 to end-2015) stemmed primarily from stronger economic growth and a larger initial primary surplus. The traditional growth contribution was almost twice as large in 2000–07 (8.8 percentage points) than in 2007–15 (4.8 percentage points), but in both periods its contribution was small compared with other factors. The bigger difference comes from the expenditure ratio erosion terms, which accounted for 16.6 percentage points in 2000–07 but just 6.2 percentage points in 2007–15. After correcting for the expenditure erosion term, the contribution of policy measures is similar in the two periods (35.6 percentage points before the crisis and 32.1 percentage points after the crisis), despite the massive fiscal stimulus several countries adopted during the crisis. Countries started out in 2000 with sizable primary surpluses, which they allowed to shrink in subsequent years, even though they would have automatically increased as strong growth eroded the expenditure ratio.

9. Indeed, some authors (e.g., Fatás and Summers 2016) argue that the adverse impact of fiscal tightening on economic growth during the global financial crisis, especially in some countries in the euro area, may even have led debt ratios to increase rather than decrease. Their evidence is based on a small number of observations, however, and a few countries heavily influence the empirical association between economic growth and fiscal policies during the global crisis (Mauro and Zilinsky 2015). In addition, fiscal policy choices depend on financing conditions; spikes in interest rates, for example, prevented several euro area governments from undertaking fiscal stimulus, whereas the United States and Japan were able to finance fiscal expansion at low interest rates.

WHAT FACTORS ACCOUNT FOR THE LARGEST CHANGES IN GOVERNMENT DEBT RATIOS?

Evidence Based on the Traditional Accounting Approach

By using the traditional approach to identify the most important factors behind changes in debt ratios, Abbas et al. (2014) and other researchers have uncovered several policy-relevant lessons from history. First, wars (especially the two world wars) accounted for some of the largest debt ratio increases. Massive spending and the resulting primary deficits were the key drivers; the interest rate–growth differential was not unusually large.

Second, the debt ratio increase associated with the Great Depression of the 1930s occurred largely as a result of low economic growth. Fiscal policy was not expansionary: The increase in the primary deficit was limited, particularly as a share of GDP (the size of the state, measured by expenditures as a share of GDP, was one-fourth what it is today), and stemmed primarily from a decline in revenues associated with low economic growth.

Third, stock-flow residuals made a sizable contribution to rising debt ratios during the 1970s and 1980s in several advanced economies where exchange rate depreciations led to increases in the domestic currency value of debts denominated in foreign currency. Banking crises were an additional factor underlying large residuals.

Fourth, the interest rate–growth differential was the primary factor behind the declines in debt ratios in the aftermath of World War II; primary surpluses were less important. Real interest rates were often negative, as a result of "financial repression combined with a steady dose of inflation" (Reinhart and Sbrancia 2015). The cost of government borrowing was kept artificially low through capital controls and various instruments presented as prudential regulation, including floors on pension fund holdings of government bonds and caps on bank deposit rates to boost demand for government securities.

Fifth, conventional fiscal adjustment (large primary surpluses) and strong economic growth accounted for the large debt ratio reductions during periods of global financial integration (before World War I and after 1980).

Evidence Based on the Extended Accounting Approach

We use the extended approach to decompose the largest changes in the debt ratio drawing from 22 advanced economies since 1950.[10] The sample consists of the advanced economies for which all data are available continuously since 1950. The results show that economic growth was the most significant factor, followed by the stock-flow residual and the interest bill contribution (table 2).

The factors underlying the greatest changes are highly diverse: For example, some of the largest increases stemmed primarily from positive stock-flow residuals associated with exchange rate depreciations (e.g., Denmark 1975–85, Greece 1983–93), whereas others occurred despite a negative residual (Japan 2007–14). On average, however, most factors contributed to the difference in the way one would expect based on the identities presented above. The exception was policy measures, whose contribution to debt ratio changes was positive and similar in magnitude during both sets of episodes. Primary surpluses were a major contributing factor to large debt reductions, just as primary deficits were a key factor in large debt increases. But inspection of the additional growth term reveals that strong growth underlies the ability to run primary surpluses and weak growth accounts for primary deficits. In an extreme case (Ireland 1993–2003), economic growth was so strong that it essentially gave policymakers the option to erode the expenditure ratio to the point that all debt could have been eliminated. Understandably, policymakers chose not to do so, but growth gave them enormous flexibility in making policy choices regarding expenditure increases versus debt reduction.

REDUCING THE LIKELIHOOD OF DEBT CRISIS

Some factors that made it possible to reduce government debt ratios in the past are not likely to be present during the next decade. A surprise bout of inflation is difficult to imagine in view of the challenges central banks in the largest advanced economies have faced in trying to bring inflation back to its 2 percent target level. Moreover, estimates that take account of the composition of existing debt suggest that inflation would be unlikely to reduce debt ratios significantly (Abbas et al. 2014; Hilscher, Raviv, and Reis 2014). And even if it were possible to gradually raise inflation and maintain it at a high level for several years while keeping nominal interest rates low, investors would move their funds to other countries. The strategy of "financial repression" (Reinhart and Sbrancia 2015) used by advanced economies in the 1950s–60s, when international capital markets were essentially closed, is thus no longer available.

In addition, economic growth prospects appear weaker than they were before the crisis. Given the crucial role that economic growth plays in curbing debt ratios, this trend is particularly worrisome.

On the positive side, interest rates are at historically low levels—even in real terms for several large advanced economies. Quantitative easing has contributed to reducing real rates, including long-term rates on government borrowing. While

10. We consider uninterrupted increases and decreases that lasted less than 10 years; in cases in which the increase or decrease exceeded 10 years, we selected the 10-year period with the steepest change.

Table 2 Sources of largest changes in debt-to-GDP ratios in selected advanced economies since 1950
(percentage points)

Economy	Period	Debt ratio change	Stock-flow residual	Interest bill contribution	Traditional growth contribution	Additional growth contribution	Initial primary balance	Measures	Primary surplus
Largest increases									
Japan	1995–2005	99.2	38.7	44.4	–16.0	–15.6	11.1	36.5	32.0
Ireland	2006–2012	96.6	21.1	14.8	–0.8	–1.5	–21.1	84.0	61.4
Greece	2003–2011	77.7	12.1	18.9	13.6	–22.5	23.5	32.1	33.1
Portugal	2003–2013	74.3	16.6	20.9	4.6	–13.8	20.6	25.5	32.3
Iceland	2007–2011	67.8	33.8	–0.04	4.3	5.5	–20.7	44.9	29.8
Japan	2007–2014	66.1	–9.4	25.6	–2.7	3.9	14.8	33.9	52.6
Greece	1983–1993	65.5	62.3	–24.3	–6.4	–24.5	34.2	24.1	33.9
Belgium	1977–1987	64.6	20.5	38.9	–15.7	–48.3	20.6	48.4	20.7
Denmark	1975–1985	64.1	72.7	20.9	–7.9	–60.4	0.8	38.1	–21.5
Spain	2007–2014	63.8	1.7	15.1	3.7	10.8	–21.7	54.1	43.2
Mean		74.0	27.0	17.5	–2.3	–16.6	6.2	42.2	31.8
Median		66.9	20.8	19.9	–1.8	–14.7	12.9	37.3	32.7
Largest decreases									
United Kingdom	1951–1961	–83.0	–1.8	–16.9	–37.6	–29.7	–58.6	61.5	–26.8
Ireland	1993–2003	–63.3	15.4	7.0	–46.4	–129.8	–38.9	129.4	–39.3
New Zealand	1968–1974	–46.9	6.1	–18.5	–18.9	–21.6	–16.8	22.7	–15.7
Belgium	1996–2006	–39.2	–1.7	39.7	–25.1	–55.7	–44.4	48.1	–52.1
Denmark	1997–2007	–37.9	3.5	19.5	–9.6	–51.4	–44.2	44.3	–51.3
New Zealand	1992–2002	–34.5	2.2	22.7	–16.2	–71.3	–6.4	34.6	–43.2
Spain	1997–2007	–29.9	8.1	7.3	–20.0	–70.3	–6.8	51.8	–25.2
Sweden	1958–1966	–27.9	–12.6	–1.9	–9.3	–37.5	10.3	23.2	–4.0
Iceland	2011–2015	–27.5	–15.5	5.9	–9.2	–9.5	11.6	–10.8	–8.7
Switzerland	1951–1961	–22.2	3.0	2.7	–11.1	–13.9	–9.1	6.3	–16.8
Mean		–41.2	0.7	6.7	–20.3	–49.1	–20.3	41.1	–28.3
Median		–36.2	2.6	6.4	–17.5	–44.4	–13.0	39.5	–26.0

Note: The largest increases and decreases were identified through an iterative search from a sample consisting of the 22 advanced economies for which all data were continuously available since 1950.

Sources: IMF, *World Economic Outlook* database, April 2016; Mauro et al. (2015).

such policies could remain in place for several years, however, an increase in real rates cannot be ruled out, particularly if market participants lose confidence in an economy's ability to grow or service its debts.

Putting these factors together, the most likely and desirable approach to reduce the risk of debt crisis in the next 10 years is gradual fiscal adjustment through expenditure cuts and revenue increases.[11] The pace of adjustment should be sustained but gradual, because spending cuts will be difficult given the aging of the population, and aggressive fiscal tightening to cut debt ratios quickly would potentially endanger a global economic recovery that is still fragile. Policymakers should recognize that their economies may be facing lower long-run growth rather than a temporary slowdown and respond by improving their primary surpluses sooner rather than later.[12]

At best, debt ratios will thus decline slowly. The probability of debt crises will remain significant—and higher than before the crisis—for several years. We can expect to live dangerously for the next decade or so.

11. It seems unlikely that fiscal multipliers would be so large as to imply that a generalized fiscal stimulus would bring about a decline in debt ratios, particularly in economies where unemployment is approximately at its long-run average levels, though additional infrastructure investment may pay for itself under certain circumstances (IMF 2014).

12. In addition, governments should consider issuing growth-indexed bonds (Blanchard, Mauro, and Acalin 2016). By requiring lower debt service when economic growth is weak, such bonds reduce the extent to which adverse shocks to economic growth result in rising debt ratios. The case for such bonds is strengthened by this *Policy Brief*'s finding that economic growth determines changes in debt ratios to an even greater extent than usually recognized.

APPENDIX A EXTENDED ACCOUNTING FOR CHANGES IN THE DEBT-TO-GDP RATIO

This appendix provides a refresher on the derivation of the traditional accounting of the debt-to-GDP ratio and derives the extended accounting in which the "no policy measures" benchmark is to keep real expenditures constant. It also considers a variant in which "no policy measures" is defined as no change in nominal expenditures.

TRADITIONAL ACCOUNTING

The traditional accounting is derived as follows (omitting the stock-flow residual for simplicity). Debt today (D_t) equals debt last year (D_{t-1}) plus the interest cost of the debt (the average nominal interest rate on the debt, i_t, times the debt stock last year) minus the primary surplus P_t (the difference between revenues and noninterest expenditures):

$$D_t = D_{t-1} + i_t D_{t-1} - P_t.$$

GDP increases at the nominal growth rate γ_t:

$$Y_t = Y_{t-1}(1 + \gamma_t).$$

From these two identities, it can be shown that the change in the debt-to-GDP ratio (d_t) is given by the following three terms, which reflect the interest cost of borrowing, the erosion of the debt ratio as GDP (the denominator) rises, and the primary surplus as a share of GDP (p_t):

$$d_t - d_{t-1} = \left(\frac{i_t}{1+\gamma_t}\right) d_{t-1} - \left(\frac{\gamma_t}{1+\gamma_t}\right) d_{t-1} - p_t.$$

The real economic growth rate (g_t), the GDP deflator inflation (π_t), and the real interest rate (r_t) are related to the nominal growth rate and nominal interest rate as follows:

$$1 + \gamma_t = (1 + \pi_t)(1 + g_t)$$
$$1 + i_t = (1 + \pi_t)(1 + r_t).$$

The change in the debt ratio can thus be rewritten as follows:

$$d_t - d_{t-1} = \left(\frac{r_t}{1+g}\right) d_{t-1} - \left(\frac{g_t}{1+g_t}\right) d_{t-1} - p_t.$$

EXTENDED ACCOUNTING

"No Policy Measures" as Fixed Real Expenditures

We define a "no policy measures" scenario as one in which government revenues rise in line with nominal GDP whereas primary expenditures rise in line with the GDP deflator:

$$T_t = T_{t-1}(1 + \gamma_t)$$
$$E_t = E_{t-1}(1 + \pi_t).$$

Recalling that the primary surplus is the difference between revenues and primary expenditures, we can show that the primary surplus (as a share of GDP) this year equals the primary surplus ratio last year plus a term that reflects the erosion of the expenditure-to-GDP ratio that stems from real economic growth plus the impact of any policy measures m_t (obtained as a residual from the benchmark of no action):

$$p_t = p_{t-1} + e_{t-1}\left(\frac{g_t}{1+g_t}\right) + m_t.$$

Substituting the expression above for p_t into the traditional accounting yields the extended accounting

$$d_t - d_{t-1} = \left(\frac{r_t}{1+g_t}\right) d_{t-1} - m_t - p_{t-1} - \left(\frac{g_t}{1+g_t}\right)(d_{t-1} + e_{t-1})$$

where the last multiplicative term is the growth contribution, including the impact of economic growth through the erosion of both the debt ratio (the traditional term) and the expenditure ratio (the additional term).

Moving to a multiyear setting and considering the change from year 0 to year N, we can apply the traditional accounting to the change from year 0 to year 1, from year 1 to year 2, and so on. Summing up those changes, the change in the debt ratio from 0 to N equals

$$d_N - d_0 = \Sigma_{i=1}^{N}\left(\frac{r_i}{1+g_i}\right)d_{i-1} - \Sigma_{i=1}^{N}\left(\frac{g_i}{1+g_i}\right)d_{i-1} - \Sigma_{i=1}^{N} p_i.$$

In a "no policy measures" scenario defined as above, the primary surpluses in years 0 and i equal

$$P_0 = T_0 - E_0$$
$$P_i = T_0(1+\gamma_1)\ldots(1+\gamma_N) - E_0(1+\pi_1)\ldots(1+\pi_N).$$

The primary surplus as a ratio to GDP in year i under that scenario would equal

$$p_i = \tau_0 - e_0\prod_{t=1}^{i}\left(\frac{1}{1+g_t}\right)$$

where τ_0 and e_0 are the revenue and expenditure ratios to GDP in year 0. In the "no policy measures" scenario, the primary surplus as a share of GDP in year i is thus the difference between the initial revenue ratio and the initial expenditure ratio divided by the product of all the $(1 + g_t)$ terms, for $t = 1\ldots i$.

Under this scenario, the summation of the primary surplus ratios for years 1 to N would then equal

$$\Sigma_{i=1}^{N} p_i = N\tau_0 - e_0\Sigma_{i=1}^{N}\prod_{t=1}^{i}\left(\frac{1}{1+g_t}\right).$$

Substituting the summation of the primary surplus ratios into the expression for the change in the debt ratio from year 0 to year N, and allowing for policy measures yields

$$d_N - d_0 = \sum_{i=1}^{N}\left(\frac{r_i}{1+g_i}\right)d_{i-1} - \sum_{i=1}^{N}\left(\frac{g_i}{1+g_i}\right)d_{i-1} - \sum_{i=1}^{N}\sum_{t=1}^{i} m_t - N\tau_0 - e_0\sum_{i=1}^{N}\prod_{t=1}^{i}\left(\frac{1}{1+g_t}\right)$$

where the double-summation term for the policy measures reflects the fact that policy measures affect the primary surplus not only in the year in which they are undertaken but also in every subsequent year.

The same expression can be rewritten as follows:

$$d_N - d_0 = \sum_{i=1}^{N}\left(\frac{r_i}{1+g_i}\right)d_{i-1} - \sum_{i=1}^{N}\left(\frac{g_i}{1+g_i}\right)d_{i-1} - \sum_{i=1}^{N}\sum_{t=1}^{i} m_t - Np_0$$
$$- e_0\sum_{i=1}^{N}\left[1 - \prod_{t=1}^{i}\left(\frac{1}{1+g_t}\right)\right]$$

where p_0 is the primary surplus in year 0 and the last term reflects the gradual erosion of the expenditure ratio.

An equivalent expression is

$$d_N - d_0 = \sum_{i=1}^{N}\left(\frac{r_i}{1+g_i}\right)d_{i-1} - \sum_{i=1}^{N}\left(\frac{g_i}{1+g_i}\right)d_{i-1} - \sum_{i=1}^{N}\sum_{t=1}^{i} m_t - Np_0 - e_0\sum_{i=1}^{N}\sum_{t=1}^{i}\frac{g_i}{\prod_{t=1}^{i}(1+g_t)}$$

which is presented in the main text as equation (4). The stock-flow residual is added here for empirical application.

"No Policy Measures" as Fixed Nominal Expenditures

A variant of the extended accounting approach is to define a "no policy measures" scenario as one in which government revenues rise in line with nominal GDP whereas primary expenditures remain constant in domestic currency absolute terms. Under this interpretation, which may be less realistic than the first one,

$$p_t = p_{t-1} + e_{t-1}\left(\frac{\gamma_t}{1+\gamma_t}\right) + m_t.$$

Combining the expression for the primary surplus above with the traditional accounting expression presented in terms of the nominal interest rates and nominal economic growth,

$$d_t - d_{t-1} = \left(\frac{i_t}{1+\gamma_t}\right)d_{t-1} - \left(\frac{\gamma_t}{1+\gamma_t}\right)d_{t-1} - p_t$$

the extended accounting would then be

$$d_t - d_{t-1} = \left(\frac{i_t}{1+\gamma_t}\right) d_{t-1} - m_t - p_{t-1} - \left(\frac{\gamma_t}{1+\gamma_t}\right)(d_{t-1} + e_{t-1})$$

where the interest contribution is presented in terms of the nominal interest rate and the last multiplicative term is the growth contribution, including the impact of nominal economic growth through the erosion of both the debt ratio (the traditional term) and the expenditure ratio (the additional term).

REFERENCES

Abbas, S. Ali, Nazim Belhocine, Asmaa El-Ganainy, and Anke Weber. 2014. Current Debt Crisis in Historical Perspective. In *Post-Crisis Fiscal Policy*, ed. Carlo Cottarelli, Philip Gerson, and Abdelhak Senhadji. Cambridge, MA: MIT Press.

Barro, Robert, and Xavier Sala-i-Martín. 1990. World Real Interest Rates. *NBER Macroeconomic Annual*, vol. 5, 16–74. Cambridge, MA: National Bureau of Economic Research.

Blanchard, Olivier, Paolo Mauro, and Julien Acalin. 2016. *The Case for Growth-Indexed Bonds in Advanced Economies Today*. PIIE Policy Brief 16-2. Washington: Peterson Institute for International Economics.

Cole, Harold, and Timothy Kehoe. 1996. A Self-Fulfilling Model of Mexico's 1994–1995 Debt Crisis. *Journal of International Economics* 41, no. 3–4: 309–30.

Easterly, William. 2001. Growth Implosions and Debt Explosions: Do Growth Slowdowns Explain Public Debt Crises? *Contributions to Macroeconomics* 1, no. 1. Berkeley Electronic Press.

Elmendorf, Douglas, and Louise Sheiner. 2016. *Federal Budget Policy with an Aging Population and Persistently Low Interest Rates*. Working Paper 18. Washington: Hutchins Center on Fiscal and Monetary Policy, Brookings Institution.

Escolano, Julio. 2010. *A Practical Guide to Public Debt Dynamics, Fiscal Sustainability, and Cyclical Adjustment of Budgetary Aggregates*. IMF Technical Notes and Manuals. Washington: International Monetary Fund.

Fatás, Antonio, and Ilian Mihov. 2012. Fiscal Policy as a Stabilization Tool. *The B.E. Journal of Macroeconomics* 12, no. 3. Berkeley Electronic Press.

Fatás, Antonio, and Lawrence H. Summers. 2016. *The Permanent Effects of Fiscal Consolidations*. NBER Working Paper 22374. Cambridge, MA: National Bureau of Economic Research.

Hamilton, James D., Ethan S. Harris, Jan Hatzius, and Kenneth D. West. 2016. The Equilibrium Real Funds Rate: Past, Present and Future. Mimeo. University of California at San Diego. Available at http://econweb.ucsd.edu/~jhamilto/USMPF_2015.pdf.

Hilscher, Jens, Alon Raviv, and Ricardo Reis. 2014. *Inflating away the Public Debt? An Empirical Assessment*. NBER Working Paper 20339. Cambridge, MA: National Bureau of Economic Research.

IMF (International Monetary Fund). 2014. Is It Time for an Infrastructure Push? *World Economic Outlook*, September. Washington.

IMF (International Monetary Fund). 2016. *Fiscal Monitor*, April. Washington.

Mauro, Paolo, and Jan Zilinsky. 2015. *Fiscal Tightening and Economic Growth: Exploring Cross-Country Correlations*. PIIE Policy Brief 15-15. Washington: Peterson Institute for International Economics.

Mauro, Paolo, Nathan Sussman, and Yishay Yafeh. 2002. Emerging Market Spreads: Then versus Now. *Quarterly Journal of Economics* 117, no. 2: 695–733.

Mauro, Paolo, Rafael Romeu, Ariel Binder, and Asad Zaman. 2015. A Modern History of Fiscal Prudence and Profligacy. *Journal of Monetary Economics* 76: 55–70.

Panizza, Ugo, and Andrea F. Presbitero. 2014. Public Debt and Economic Growth: Is There a Causal Effect? *Journal of Macroeconomics* 41: 21–41.

Reinhart, Carmen, and Kenneth Rogoff. 2009. *This Time Is Different: Eight Centuries of Financial Folly*. Princeton NJ: Princeton University Press.

Reinhart, Carmen, and Maria Belen Sbrancia. 2015. The Liquidation of Government Debt. *Economic Policy* 30: 291–333.

Sachs, Jeffrey. 1984. *Theoretical Issues in International Borrowing*. Princeton Studies in International Finance 54. Princeton, NJ: Department of Economics, International Finance Section, Princeton University.

© Peterson Institute for International Economics. All rights reserved.

This publication has been subjected to a prepublication peer review intended to ensure analytical quality. The views expressed are those of the authors. This publication is part of the overall program of the Peterson Institute for International Economics, as endorsed by its Board of Directors, but it does not necessarily reflect the views of individual members of the Board or of the Institute's staff or management.

The Peterson Institute for International Economics is a private nonpartisan, nonprofit institution for rigorous, intellectually open, and indepth study and discussion of international economic policy. Its purpose is to identify and analyze important issues to make globalization beneficial and sustainable for the people of the United States and the world, and then to develop and communicate practical new approaches for dealing with them. Its work is funded by a highly diverse group of philanthropic foundations, private corporations, and interested individuals, as well as income on its capital fund. About 35 percent of the Institute's resources in its latest fiscal year were provided by contributors from outside the United States. A list of all financial supporters for the preceding four years is posted at https://piie.com/sites/default/files/supporters.pdf.