17
Government Debt and Deficits

Tools: Government budget constraint; debt dynamics.

Key Words: Government budget; government debt and deficits; primary deficit/surplus; the debt-to-GDP ratio; hidden liabilities.

Big Ideas:

- Government spending must be paid for, either now through taxes, or in the future.
- Current debt must be balanced by future primary surpluses.
- Changes in the ratio of debt to GDP have three sources: interest, growth, and primary deficits.

The first principle of government finance is that governments must finance spending with taxes. Issuing debt postpones this obligation but does not eliminate it. If a government doesn't collect enough tax revenue now, it must collect it later — or face default. Since investors like to be repaid, they pay close attention to government debt and deficits. If they're too large, investors may demand higher yields or even stop buying government securities altogether. The consequences of this sequence of events are never pretty.

Debt finance poses a *time-consistency* problem because (i) governments have an incentive to issue debt and tax future generations who do not vote today; and (ii) future governments may decide to inflate away or repudiate past debt. Countries with good governance solve this problem either through sound budget policy or institutional design. Countries with poor governance, not so much.

17.1 Government revenues, expenses, and debt

We start with a quick overview of government spending and revenue decisions — what is conventionally called *fiscal policy* .

Countries differ in the size of government relative to the economy, in the sources of tax revenues, and in their expenditures. Governments everywhere purchase goods and services (schools, police, courts, roads, military), transfer money to individuals (social insurance, health care), and collect revenue (largely through taxes). The distinction between purchases and transfers is important. Only purchases show up in the expenditure identity. Transfers are, nevertheless, a large part of total expenses in many economies, particularly developed economies. Governments also pay interest on outstanding government debt, an expense we track separately.

We'll look at data for each of these in class. As a rule, government spending and revenue are a larger fraction of GDP in rich countries than in poor ones. Rich countries also spend more on transfers. There is, however, a lot of variation at all levels of development.

We put these elements together in a relation we'll call the *government budget constraint*. On the expense side, we label government purchases of goods and services G, transfers V, and interest payments iB (the product of the government debt B and whatever interest rate i the government pays on it). On the revenue side, we label tax revenue T. (Note: T is tax revenue, not the tax rate.) By convention, all of these things are nominal: they're measured in local currency units. The government budget constraint is, then,

$$G_t + V_t + i_t B_{t-1} - T_t \quad = \quad B_t - B_{t-1}. \tag{17.1}$$

Here, B_{t-1} is the amount of debt outstanding at the end of period $t-1$. The left-hand side of (17.1) is the government deficit, the right the change in the quantity of debt. The equation says, in essence, that any surplus or deficit is matched by a change in the quantity of debt. A government deficit is financed by issuing more debt.

The elements of equation (17.1) are often used to generate summary measures of fiscal policy. The most common are ratios of the government deficit and government debt to GDP. We'll look at both, as well as the connection between them.

17.2 Debt and (primary) deficits

Governments need to finance their spending with taxes. It's not quite true — governments have other sources of revenue — but it's close enough to be

worth remembering. Issuing debt allows a government to postpone taxes, just as a credit card allows an individual to postpone paying for purchases, but does not eliminate the obligation. Delay, in fact, comes with a cost: We need to pay the original obligation, plus interest. In the rest of this section, we make the same point more formally.

We're going to take our budget constraint, equation (17.1), and use it to relate debt to past and future deficits. To make things a little simpler, define the *primary deficit* D as the deficit net of interest payments (sort of an "EBITDA" number):

$$D_t = G_t + V_t - T_t.$$

(This is sometimes reported with the opposite sign and called the primary budget balance or surplus.) With this simplification, (17.1) can be expressed as

$$B_t = (1+i)B_{t-1} + D_t \tag{17.2}$$

or

$$B_{t-1} = B_t/(1+i) - D_t/(1+i). \tag{17.3}$$

They're the same equation, but the first one looks backward from t to $t-1$, and the second looks forward from $t-1$ to t. We'll put both to work. The i in these equations is the *nominal interest rate* that the government pays on its debt. We'll assume it is constant for now — it makes the math simpler — but allow it to change in the next section.

Equation (17.2) tells us where the debt came from. If we substitute over and over again, back to some period $t-n$, we have

$$\begin{aligned} B_t &= D_t + (1+i)B_{t-1} \\ &= D_t + (1+i)[(1+i)B_{t-2} + D_{t-1}] \\ &= D_t + (1+i)D_{t-1} + (1+i)^2 D_{t-2} + \cdots + (1+i)^n B_{t-n}. \end{aligned}$$

In words: The current debt is the debt we started with n periods ago plus the current value of past deficits plus accumulated interest. It's like your credit card bill: Your current balance consists of past shortfalls plus accumulated interest.

Equation (17.3) tells us what we need to do in the future to service the current debt. If we substitute repeatedly, we find

$$\begin{aligned} B_{t-1} &= B_{t+1}/(1+i)^2 - [D_t/(1+i) + D_{t+1}/(1+i)^2] \\ &= B_{t+2}/(1+i)^3 - [D_t/(1+i) + D_{t+1}/(1+i)^2 + D_{t+2}/(1+i)^3] \\ &= B_{t+n-1}/(1+i)^n - [D_t/(1+i) + \cdots + D_{t+n-1}/(1+i)^n]. \end{aligned}$$

If we assume that debt can't grow faster than the interest rate forever, then, as we continue to substitute, the first term goes to zero. [The technical condition is $B_{t+n}/(1+i)^n$ approaches zero as n approaches infinity. It amounts to not allowing the government to run a Ponzi scheme, paying off old debt by issuing new debt, forever.] The relation then becomes

$$\begin{aligned} B_{t-1} &= -[D_t/(1+i) + D_{t+1}/(1+i)^2 + D_{t+2}/(1+i)^3] + \cdots] \\ &= -\text{Present Discounted Value of Primary Deficits} \\ &= \text{Present Discounted Value of Primary Surpluses.} \end{aligned} \tag{17.4}$$

In words: The current government debt must be matched by the present discounted value of future primary surpluses. As we said at the start, all spending must be financed by tax revenue — eventually. It's not enough to shrink the deficit. Eventually we have to run surpluses, measured net of interest payments.

Analysis of this sort often uses the term *sustainable*. We say the debt is sustainable if current debt is balanced by plans for future surpluses, as in equation (17.4). If not, we say the government's budget is *unsustainable*. In this case, we can paraphrase the economist Herbert Stein: "Something must change, so it will."

17.3 Debt dynamics

Investors watch government debt and deficits for signs that a government may not honor its debts. Even a hint of this can change the rate at which the government borrows or even its ability to access capital markets. In practice, it's common to look at them as ratios to GDP. In such ratios, we measure both numerator and denominator in local currency units, so we have (for example) the ratio of the nominal debt to nominal GDP.

So how does the debt-to-GDP ratio change from one period to the next? There's a useful decomposition of changes into components due to the real interest rate, GDP growth, and the primary deficit. It's a little complicated, so we'll work our way up to it.

Recall that debt evolves according to

$$B_t = D_t + i_t B_{t-1} + B_{t-1}, \tag{17.5}$$

where D_t is the primary deficit and $D_t + i_t B_{t-1}$ is the total deficit. You should recognize this as equation (17.2) in slightly different form. Here's how it looks with real numbers.

Example (US, 2013). Consider US government debt and deficits in 2013, expressed in trillions of US dollars:

Government debt, year end 2012	B_{t-1}	13.015
Total deficit, 2013	$D_t + i_t B_{t-1}$	1.233
Primary deficit, 2013	D_t	0.693

The numbers are estimates from the April 2014 edition of the IMF's World Economic Outlook database. Given these numbers, use what we know about debt dynamics to compute debt B_t at the end of 2013. How much interest was paid on debt? What is the interest rate i_t paid on the debt?

Answer. Year-end debt follows from equation (17.5): $B_t = 1.233 + 13.015 = 14.248$. Interest payments are the difference between the two deficit numbers: $i_t B_{t-1} = D_t + i_t B_{t-1} - D_t = 1.233 - 0.693 = 0.540$. The implied interest rate on the debt is the ratio of interest payments to debt: $i_t B_{t-1}/B_{t-1} = 0.540/13.015 = 0.0415 = 4.15\%$.

Now back to the dynamics of the debt-to-GDP ratio. The bottom line is the equation

$$\frac{B_t}{Y_t} \approx \frac{B_{t-1}}{Y_{t-1}} + (i_t - \pi_t)\frac{B_{t-1}}{Y_{t-1}} - g_t \frac{B_{t-1}}{Y_{t-1}} + \frac{D_t}{Y_t}. \tag{17.6}$$

Circle this, it's important. It gives us three sources of change in the ratio of debt to GDP. The first is the real interest on the debt, which accumulates as long as the debt and real interest rate are positive. The second is the growth of the economy, which reduces the ratio by increasing the denominator. The third is the primary deficit. Each makes a contribution to changes in the debt-to-GDP ratio.

It's not required, but if you're interested in where this comes from, here are the details. We divide equation (17.5) by nominal GDP Y_t to get

$$\frac{B_t}{Y_t} = \frac{D_t}{Y_t} + (1 + i_t)\frac{B_{t-1}}{Y_t}.$$

In the last term, note that the denominator is Y_t, not Y_{t-1}. If the growth rate of real GDP is g_t and the inflation rate is π_t, then the growth rate of nominal GDP is approximately $g_t + \pi_t$. Therefore

$$Y_t \approx (1 + g_t + \pi_t)Y_{t-1}.$$

The ratio of debt to GDP then follows

$$\begin{aligned}
\frac{B_t}{Y_t} &\approx \left(\frac{1 + i_t}{1 + g_t + \pi_t}\right)\frac{B_{t-1}}{Y_{t-1}} + \frac{D_t}{Y_t} \\
&\approx [1 + i_t - (g_t + \pi_t)]\frac{B_{t-1}}{Y_{t-1}} + \frac{D_t}{Y_t} \\
&\approx \frac{B_{t-1}}{Y_{t-1}} + (i_t - \pi_t)\frac{B_{t-1}}{Y_{t-1}} - g_t \frac{B_{t-1}}{Y_{t-1}} + \frac{D_t}{Y_t}.
\end{aligned}$$

The second equation is based on the approximation

$$\frac{1+i_t}{1+g_t+\pi_t} \approx 1+i_t-g_t-\pi_t,$$

good for small values of i_t, g_t, and π_t. A simpler version is $1/(1+x) \approx 1-x$ for small x. All you need to know is that the right side is simpler than the left. After rearranging terms, we're left with (17.6), as promised.

This is a mechanical analysis, but a useful one. By looking at the components of equation (17.6), we can get a sense of the origins of past changes in the debt-to-GDP ratio and the potential sources of future changes.

Example (US, 2013, continued). The numbers we saw earlier look this way expressed as ratios to GDP:

Government debt, year end 2012	B_{t-1}/Y_{t-1}	0.8012
Primary deficit, 2013	D_t/Y_t	0.0413
Interest rate	i_t	0.0415
Real GDP growth rate	g_t	0.0188
Inflation rate	π_t	0.0151

What is the ratio of debt to GDP at the end of 2013?

Answer. We apply the formula, equation (17.6):

$$\begin{aligned} B_t/Y_t &= 0.8012 + (0.0415 - 0.0151)0.8012 - (0.0188)0.8012 + 0.0413 \\ &= 0.8012 + 0.0212 - 0.0151 + 0.0413 = 0.8486. \end{aligned}$$

In words: the ratio of debt to GDP rose from 80.1 percent to 84.9 percent, an increase of 4.8 percent of GDP. The primary deficit contributes 4.1 percent of the change and growth drives it the other way by 1.5 percent.

Comment. We have two sets of numbers here that are often expressed as percentages, meaning we multiply them by one hundred. One is the "growth rates": g, i, and π. For them, *it's essential we use numbers, not percentages.* You might verify that we did this in the calculation above. You'd see the same when you calculate a present value in finance. The second set of numbers is the ratios to GDP: B/Y and D/Y. These can be used either as numbers, as in the example above, or percentages, as long as we treat them both the same way. If we use percentages in our example, equation (17.6) becomes

$$\begin{aligned} B_t/Y_t &= 80.12 + (0.0415 - 0.0151)80.12 - (0.0188)80.12 + 4.13 \\ &= 84.86. \end{aligned}$$

Evidently the equation still works when we multiply it by one hundred.

Example (Peru, 2003-2007). Between 2003 and 2007, Peru's debt fell from 47 percent of GDP to 25 percent. Using the numbers in the table below, what happened? What was the primary source of this decline?

	Debt B_t/Y_t	Interest $(i_t - \pi_t)B_{t-1}/Y_{t-1}$	Growth $-g_t B_{t-1}/Y_{t-1}$	Deficit D_t/Y_t
2003	47.1			
2004	44.3	0.2	−2.4	−0.6
2005	37.7	1.1	−3.0	−4.6
2006	33.1	1.0	−2.9	−2.7
2007	30.9	1.1	−2.9	−0.4
2008	25.0	−0.3	−3.0	−2.5
Sum		3.1	−14.3	−10.9

Answer. Between 2003 and 2008, the ratio of debt to GDP fell from 47.1% to 25.0%, a change of −22.1%. What factors were most important? You can see from the final row that growth (−14.3%) and the primary deficit (−10.9%) both played large roles. Interest on the debt pushes us the other way: it raises the ratio of debt to GDP (+3.1%).

17.4 What's missing?

Our summary of debt dynamics, captured in equation (17.6), buries some issues beneath the mathematics.

One issue is the link between the interest rate and the fiscal situation (the debt and deficit). If investors start to worry about a government's willingness to honor its debt, they may demand higher interest rates, which, in turn, raises future debt — and so on. Such credit spreads can rise sharply if the government has not shown sufficient fiscal discipline. (Here, "sufficient" means whatever is needed to reassure investors.) It can also rise because global financial markets place a higher premium on risk, as they did during the 2008-09 financial crisis. Over this period, spreads on emerging market debt of all kinds widened, even in countries with fundamentally sound fiscal positions.

Another issue is the link between growth and deficits. If growth rises, as in Peru (example, above), that reduces the debt-to-GDP ratio through the

impact on g in equation (17.6). But it also generates higher tax revenues and, hence, a lower primary deficit, even if tax *rates* do not change. This, in turn, reduces future debt further. That's one reason that Peru's fiscal situation improved: The economy boomed. Growth, then, is the cure for many problems.

A third issue is hidden government liabilities. The idea behind our analysis is that the primary deficit determines how the debt evolves. In fact, current decisions often involve commitments for future expenditures that don't show up in the current government budget but are nevertheless important. In principle these *hidden liabilities* should show up in the budget when they're incurred, but in practice they don't. Here are some common examples:

- Social security and pensions. Many countries have implicit commitments to pay money to retired people in the future that are not accounted for properly. In the US, for example, the official accounts are based on the current cash flow of social security receipts and payments. In principle, there should be an entry for unfunded pension liabilities, as there is for firms. In many countries, aging populations have made these looming payments a serious concern. Healthcare payments are similar.
- Financial bailouts. We tend to treat these as one-offs, but, in fact, they happen all the time and they're invariably expensive. A country that bails out its banks may find its debt rise sharply.
- Regional governments. Relations between central governments and local authorities differ widely around the world. In the US, the precedent was set in the 1840s for state and local governments to finance their own activities without help from the central government. In other countries, debt problems of regional governments are often passed to the central government. These implicit liabilities of the central government were a concern in Argentina and Brazil in the 1990s and in Spain right now.

A serious analysis of fiscal policy should, therefore, start with equation (17.6) but go on to consider all possible sources of change in its components. It's no different from financial accounting for firms: we need to know what lies behind the numbers.

17.5 How much debt is too much?

How much debt is too much? At what point should investors be concerned? There is, unfortunately, no clear answer. Or rather there is an answer, which is that the quality of governance is more important than the debt numbers. Argentina defaulted with debt of about 40 percent of GDP, but the UK had

debt well over 100 percent of GDP after World War II and didn't generate undue concern. In many cases you're stuck trying to guess how the local politics will play out.

With that warning, here are some rules of thumb:

- Debt. Worry if the government debt is above 50 percent of GDP. This is very rough, but it's a start.
- Deficits. Worry if the deficit is above 5 percent of GDP — and is expected to stay that way. The issue is not so much any particular deficit, but the long-term posture.
- Institutions. Worry if a country's political institutions are weak. An old rule of thumb is that a country's credit rating is more closely connected to the quality of its institutions than to the quantity of debt it's issued. Think to yourself: Argentina is different from the UK, and Germany is different from Greece. The institutions that matter most are those that help contain the time-consistency problem: namely, the risk that a future policymaker will repudiate or inflate away the debt. Relevant institutions would include an independent central bank (to limit inflation), a robust financial system (that promotes market discipline and limits bailouts), and fiscal arrangements that limit debt accumulation or prevent its repudiation (e.g., transparent and comprehensive long-term budgeting, pay-go or balanced budget rules, and legal requirements for prioritizing debt payments).
- Structure of debt. Worry if the debt is primarily short-term or denominated in foreign currency. Even if the debt is stable, countries may find themselves in difficulty if they have to refinance a large fraction of their debt over a short period of time. (Companies are no different; think Lehman Brothers, or Drexel before that.) In late 1994, for example, Mexico had much of its debt in short-term securities. When investors refused to buy new issues, it triggered a crisis. This despite relatively modest debt and deficits.

  Foreign debt has similar risks. Many developing countries issue debt denominated in hard currency (dollars, say, or euros), but it's a mixed blessing. Issuing debt in hard currency reduces currency risk for investors, but if a country's currency collapses, it debt can rise sharply, perhaps increasing the odds of default. We've seen this repeatedly: Mexico in 1994, Korea in 1997, Argentina in 2001, and Iceland in 2008.

Executive summary

1. Countries differ enormously in the magnitude and composition of government spending, taxes, and debt.
2. Government spending must be paid for, either now through taxes or in the future by running primary surpluses.
3. The following factors govern changes in the debt-to-GDP ratio: (a) interest on the debt; (b) GDP growth; and (c) the primary deficit.
4. Institutions that limit the incentive of future governments to inflate away or repudiate the debt can help to promote fiscal discipline.

Review questions

1. Deficits down under. Consider this data for Australia:

	2010	2011
Real GDP growth (annual percent)	2.6	2.9
Inflation (annual percent)	5.2	4.8
Interest rate (annual percent)	5.3	5.9
Government deficit (primary, percent of GDP)	2.9	0.7
Government deficit (total, percent of GDP)	4.1	2.2
Government debt (end of period, percent of GDP)	25.3	

   (a) Why are the primary and total government deficits different?

   (b) What is the government debt ratio at the end of 2011?

   Answer.

   (a) The difference is interest payments on government debt. Apparently in 2011 they amounted to 1.5 percent of GDP.

   (b) We use the debt dynamics equation:

$$\begin{aligned}\frac{B_t}{Y_t} &= \frac{B_{t-1}}{Y_{t-1}} + (i_t - \pi_t)\frac{B_{t-1}}{Y_{t-1}} - g_t\frac{B_{t-1}}{Y_{t-1}} + \frac{D_t}{Y_t} \\ &= 25.3 + (0.059 - 0.048) * 25.3 - 0.029 * 25.3 + 0.7 \\ &= 25.6.\end{aligned}$$

   We used a shortcut here on the interest rate, taking the number from the table (a typical market rate) rather than computing the interest rate paid on government debt.

2. How the US financed World War II. The short answer is that they issued debt, but how did they pay off the debt? Between 1945 and 1974, the ratio of debt to GDP fell from 66 percent to 11 percent. What led to the change? George Hall and Thomas Sargent (source below) computed the following:

	Interest $(i_t - \pi_t)B_{t-1}/Y_{t-1}$	Growth $-g_t B_{t-1}/Y_{t-1}$	Primary Deficit D_t/Y_t
1945-1974	–12.5	–21.6	–20.8

All numbers are percentages.

Answer. If you look at the numbers, they tell you that growth (the same debt looked smaller when GDP grew) and primary surpluses account for most of this. You also see a negative contribution from real interest payments. What does this tell us? With hindsight, we would say that investors lost money in real terms because inflation was higher than they expected when they purchased government debt. If the government had paid (say) a one percent real return, this contribution would have been positive and the 1974 debt level would have been higher. In that sense, the US used inflation to reduce the debt burden.

If you're looking for more

It's too technical for this course, but some of the material on debt dynamics was adapted from Craig Burnside, ed., *Fiscal Sustainability in Theory and Practice*, World Bank, 2005.

More user-friendly (and very good) is George Hall's summary of his work with Thomas Sargent, "How will we pay down the debt?" They describe sources of changes in the US debt position from World War II to 2008.

Most sources of macroeconomic data include the debt, the deficit, and the primary deficit. One of the best sources of data and analysis is the IMF. Their World Economic Outlook database is updated twice a year. Their historical database covers the last 200 years or more. Search: "imf debt database." And their Fiscal Monitor describes the fiscal situations in many countries around the world.

One thing to keep in mind: reported debt numbers, whether from the IMF or other source, are generally inconsistent with reported deficits. It's an embarrassment, to be sure, but true. In our examples, we construct (total) deficits from year-to-year changes in debt. If you ever need to know more about this, get in touch.

Symbols and data used in this chapter

Table 17.1: Symbol table.

Symbol	Definition
G	Government purchases of goods and services
V	Transfers
B	Stock of government debt
T	Tax revenues (not a tax *rate*)
D	Primary deficit ($= G + V - T$)
i	Nominal interest rate
g	Discretely-compounded growth rate of real GDP
π	Inflation rate
$g + \pi$	Discretely-compounded growth rate of nominal GDP
Y	Nominal GDP

Note: In this chapter we have dealt only with *nominal* variables.

Table 17.2: Data table.

Variable	Source
Federal government debt	GFDEBTN
Federal government debt held by the public	FYGFDPUN
Federal government net surplus	FGDEF
Federal interest outlays	FYOINT
Nominal GDP	GDP
Real GDP	GDPC1
GDP deflator	GDPDEF

To retrieve the data online, add the identifier from the source column to http://research.stlouisfed.org/fred2/series/. For example, to retrieve real GDP, point your browser to http://research.stlouisfed.org/fred2/series/GDPC1

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