Mathias Doepke (2000) Lecture Notes on Macroeconomics, Northwestern University.

Compulsory reading. Read only the section about "Social Security", which starts on page 38, and stop reading on page 43.

Chapter 2

Fiscal Policy

In the United States, expenditures of federal, state, and local governments make up about 35% of GDP. In many European countries the scale of government activities is even larger. In order to finance these expenditures, the government has to levy taxes on its citizens, or it is forced to issue government debt. In either case the sheer size of the required receipts suggests that taxation, government debt, and government expenditures have a large impact on the economy. In this chapter we are going to analyze the the role of government expenditures in the economy. Throughout most of the analysis, we will not be concerned with the question why the government is spending as much as it does, or what exactly it is doing with its money. Rather, we will take government expenditures as given, and analyze the effects of different ways of financing these expenditures on the economy. We will consider the effects of different income tax schedules, the relative merits of income, consumption, and capital taxation, and the effects of government deficits and government debt.

2.1 Introduction and Terminology

I will start with a discussion of income taxes. Personal income taxes and social security taxes are the major source of income for the U.S. federal government. In the U.S. as in other countries, income tax rates differ with income. The **marginal tax rate** is the tax that has to be paid on one additional dollar of income. In contrast, the **average tax rate** is given by:

$$\text{average tax rate} = \frac{\text{total tax}}{\text{total income}}.$$

We talk about a **progressive** income tax if the marginal tax rate increases with income, whereas a **regressive** income tax has marginal rates declining with income. A **flat tax** is in between progressive and regressive taxation: The marginal tax rate is constant, and therefore equal to the average tax rate. Finally, a **lump-sum tax** is a tax that is independent of anything that can be influenced by the taxpayer, especially his income. For example, a uniform tax of $100 on each American citizen would be a lump sum tax. So would be a tax that is determined by a random number generator: it matters that the tax cannot be influenced by the taxpayer, but it does not need to be identical for everyone.

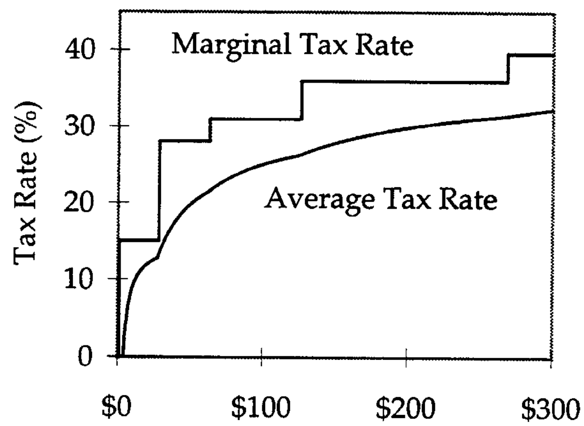

Figure 2.1: U.S. Federal Income Tax

Taxable Income (in 1000)	Marginal Tax in Percent
0-24	15
24-58	28
58-121	31
121-263	36
>263	39.6

Table 2.1: U.S. Federal Income Tax Schedule

The U.S. federal income tax is a progressive tax. Table 2.1 displays the marginal tax rate schedule, and Figure 2.1 shows the marginal tax rate together with the average tax. Note that because the marginal rates are increasing, the average tax rate is always below the marginal rate.

In addition to the federal government, many states also levy income taxes. For example, Illinois has a 3 percent flat tax. The federal government raises social security taxes, which are used to pay for special government programs. Currently, 6.2 percent of income up to $63,000 have to be paid for Social Security, and 1.45% for Medicare. The same amount has to be paid directly by the employers, so that the actual tax rate is 12.4% and 2.9%, respectively.

Corporations pay an income tax of 35% to the federal government. The taxation of corporate income can lead to double taxation: if a corporation transfers its profits as dividends to shareholders, the shareholders have to pay personal income tax on the dividend as well. As a result, the total tax on corporate profits can be as high as 60 percent.

Governments often do not raise enough taxes to pay for all government expenditures. The **budget deficit** is defined as the difference between all government expenditures and all receipts. The deficit has to be financed by borrowing. Therefore the budget deficit in a given year is equal to the increase in **government debt** in that year. Of course, the government has to pay interest on outstanding debt. The **core deficit** or **primary deficit** is defined as the budget deficit minus interest payments on outstanding debt, or:

$$\text{core deficit} = \text{Spending} - \text{interest payments} - \text{receipts}.$$

The core deficit is an interesting variable because it indicates whether receipts were sufficient to pay for the actual expenditures within a year, not counting interest payments which in effect are payments for spending in earlier years. If receipts are bigger than expenditures we speak of a **budget surplus**, and if the budget deficit or surplus is just zero, the government has a **balanced budget**.

2.2 Data

Source	Percent of Total
Personal Income Tax	47%
Social Security Taxes	34%
Corporate Income Tax	12%
Excise Taxes	4%
Custom Duties	1%
Other	2%

Table 2.2: U.S. Federal Receipts by Source

Table 2.2 breaks down the receipts of the U.S. federal government into its main components. Personal income taxes and social security taxes make up more than 80% of the federal budget. In contrast, custom duties, which in earlier years used to be the main source of revenue for the federal government, provide only 1% of federal receipts. Figure 2.2 shows how the importance of different income sources of the federal government changed over time. Recently, social security taxes were the fastest-growing component of federal receipts. State and local governments rely on a different mix of taxes. Both on the state and local level, sales taxes are a major source of revenue, and for communities the property tax is also important.

Table 2.3 shows the relative importance of different spending programs in the U.S. federal budget. With 45% of the total, transfers are the most important spending component.

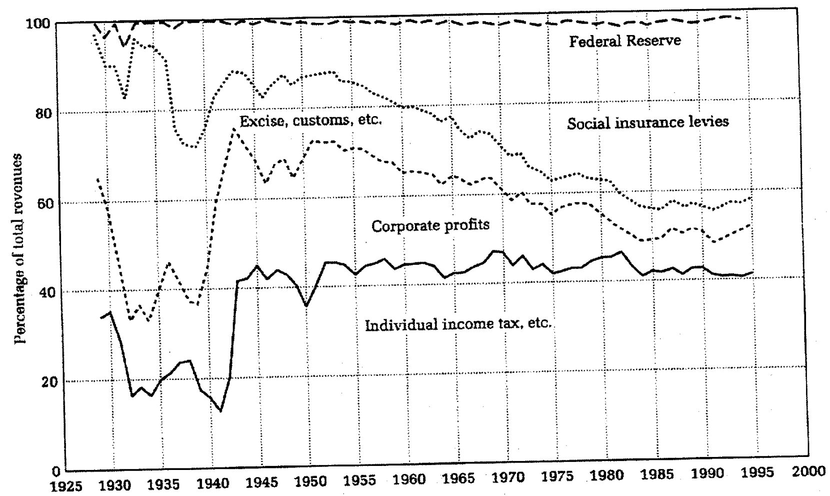

Figure 2.2: Receipts of the Federal Government

Use	Percent of Total
Transfers	45%
Defense	18%
Interest	14%
Grant Aid	12%
Other consumption	9%
Subsidies	2%

Table 2.3: U.S. Federal Spending, 1996

Transfers are direct payments to citizens. The largest components are Social Security pensions and Medicare and Medicaid benefits. Defense comes in second, closely followed by the interest payments on accumulated government debt with 14%. Grant aid are payments to states that are intended for specific purposes, especially in the areas welfare and education. "Other consumption" includes the cost of federal agencies and administrations. With 2% of the total, subsidies make up a relatively small part of the budget.

The projected total receipts of the federal government in 1999 are 1,742.7 billion dollars. With a projected GDP of about 8.1 trillion dollars, this implies that the size of the federal government is about 21.5% of GDP. Including state and local governments, total U.S. government spending is about 35% of GDP. As Figure 2.3 shows, government spending as a fraction of GDP has been higher in the past. Within World War II, government purchases alone (not counting transfers etc.) amounted to 45% of GDP. The graph also shows that while government purchases as a fraction of GDP have been relatively stable after the war, transfer payments have increased steadily.

Figure 2.4 shows that the U.S. government is relatively small, if compared to other indus-

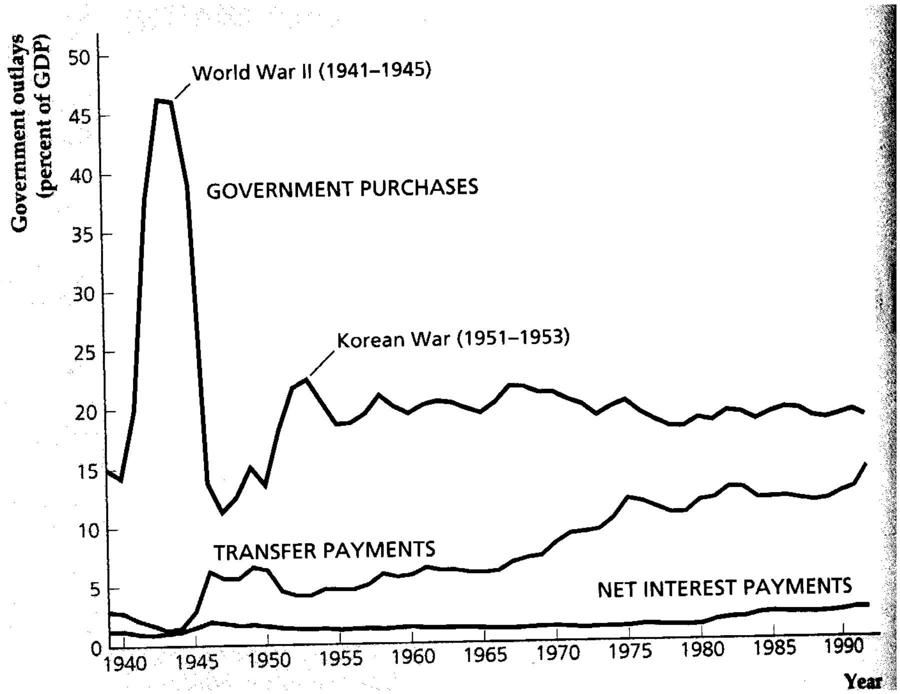

Figure 2.3: U.S. Government Spending

Table 16.1 Government Spending in Seven Industrialized Countries, Percentage of GDP, 1990

Country	Central Government	All Government
Italy	37.6%	48.1%
France	20.5%	46.3%
Canada	22.2%	44.0%
Germany	14.7%	42.6%
United Kingdom	29.9%	38.1%
United States	17.4%	34.6%
Japan	13.9%	26.2%

Source: OECD, *National Accounts, 1978–1990*. All data are from 1990, except those for the United States, which are from 1989. Data for the "Central government" in the United States, Japan, Germany, France, and the United Kingdom exclude social security payments, but these payments are included in the "All Government" category. Data for "Central Government" in Canada and Italy include some social security benefits.

Figure 2.4: Government Spending

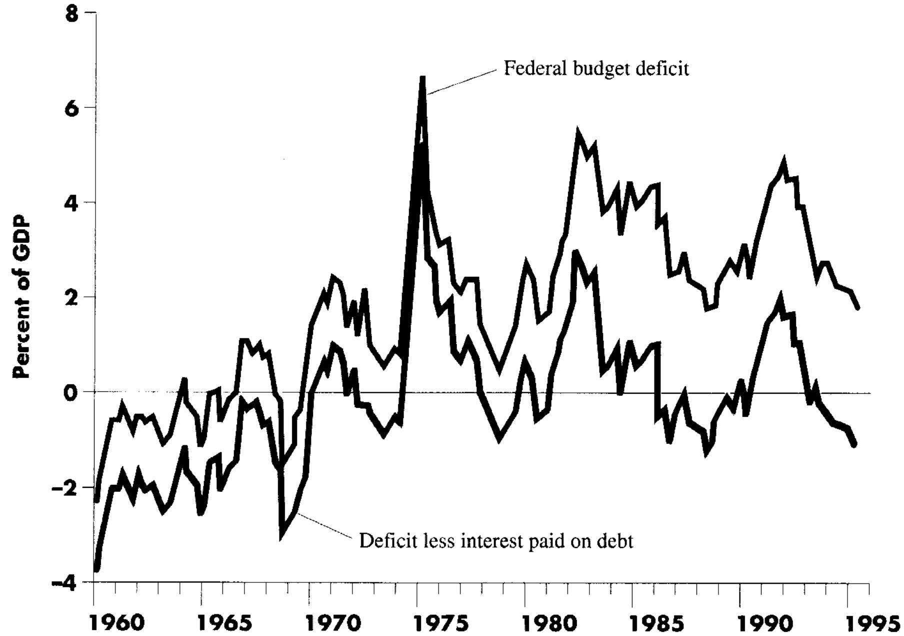

FIGURE 20-1 U.S. BUDGET DEFICITS WITH AND WITHOUT INTEREST PAID ON THE DEBT, 1960–1996

Figure 2.5: The Federal Budget Deficit

trialized countries. In most Western European countries the government share is above 40%, in Sweden it is close to 60%. However, one has to keep in mind that a large part of government spending consists of transfers, especially in contries with a high government share. A high government share does not imply that the government takes an important role in the production of the national income, because pure redistribution also raises the government share.

Figure 2.5 shows the federal budget deficit since 1960. Two sharp rises in the deficit stand out: One in the 1970s, which was related to the oil price shocks and the ensuing recession, and another one in the 1980s, which was related to the tax cuts and spending programs by the Reagan administration. Because the difference between the deficit and the core deficit is given by interest payments, the gap between the two rose when in the 1980s government debt and therefore interest payments sharply increased. The core deficit turned into a surplus in the early 1990s, and, not yet visible on the graph, recently also the overall deficit turned into a surplus.

Figure 2.6 shows the debt of the U.S. government as a fraction of GDP since the founding of the union. The initially outstanding debt from the Revolutionary War was mostly paid off by 1830. The next three debt spikes were all war-related. The government debt reached a peak of about 100% of GDP at the end of World War II. Afterwards, relative to GDP, debt declined until the Reagan administration.

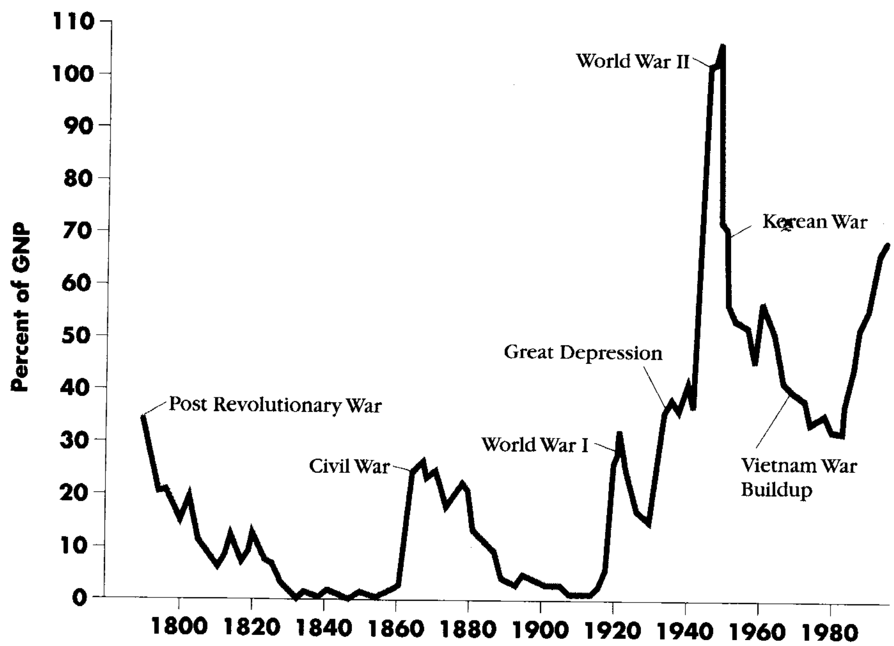

FIGURE 20-2 THE U.S. DEBT-TO-INCOME RATIO IN HISTORICAL PERSPECTIVE.

(Source: Congressional Budget Office, from material cited in James R. Barth and Stephen O. Morrell, "A Primer on Budget Deficits," Federal Reserve Bank of Atlanta Economic Review, August 1982; DRI/McGraw-Hill Macroeconomic Database.)

Figure 2.6: Government Debt in the Long Run

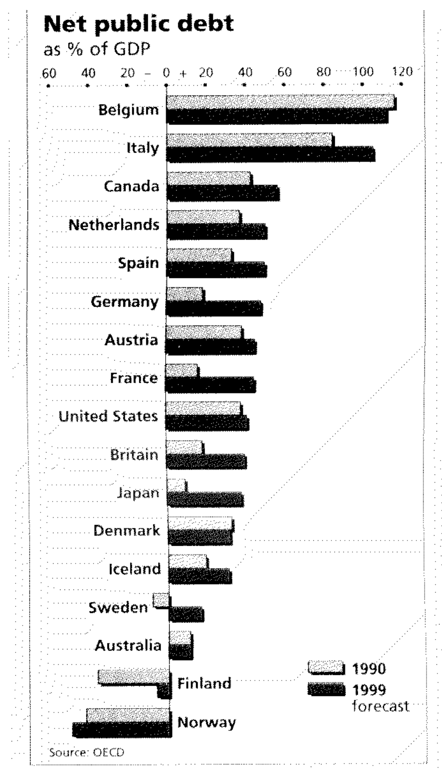

Figure 2.7: Government Debt

Figure 2.7 shows total government debt as a fraction of GDP for a number of industrialized countries. Both Belgium and Italy have outstanding debt in excess of GDP. The Norwegian government, on the other hand, is a net creditor. This reflects the accumulated income from oil in the North Sea. The Norwegian oil reserves are projected to run out soon, and the Norwegian government is preparing for that moment by running large surplusses as long as the oil money keeps flowing.

2.3 Policy Analysis

In this section, we will examine the effects of different ways of financing government expenditures. We will begin with an analysis of taxation. Afterwards, the analysis will be extended to account for government deficits and public debt.

Income Taxes

With the exception of lump-sum taxes, which are hardly ever used for polictical reasons, all taxes are distortionary. This means that apart from transferring wealth from taxpayers to the government, taxes affect the economy in a way that leads to inefficient outcomes. The main reason is that taxes distort price signals. We know from the First Welfare Theorem that outcomes in a market economy (without taxation) are efficient. This efficiency is reached because optimization on the part of firms and consumers causes marginal rates of substitution to be equalized across consumers, and marginal rates of substitution to be equalized to marginal rates of transformation in production. This end is achieved through the price system. For example, consumer maximization implies that the wage equals the marginal rate of substition between consumption and leisure, and firm optimization implies that the wage equals the marginal product of labor. Since there is just one wage for firms and consumers, in consequence the marginal rate of substitution between consumption and leisure equals the marginal product of labor, and outcomes are efficient. Now imagine that an income tax is introduced. With the income tax, the marginal rate of substitution will be equal to the after-tax wage, while the marginal product of labor will be equal to the wage before taxes. Firms and households "see" a different wage, thus the marginal rate of substitution no longer equals the marginal product of labor. Therefore outcomes are inefficient. While this basic distortion effect cannot be avoided, the government can choose which goods or actions are to be taxed at which rate. Below, we will analyze the effects of different forms of taxation.

We will start with the income tax. Consider a simple example with one consumer and one firm. The consumer has the utility function:

$$u(c, l^s) = 2\sqrt{c} - l^s,$$

and the firm has the linear production function:

$$f(l^d) = l^d.$$

I will first compute the equilibrium when there is no government. In this case, the consumer's budget constraint is simply $c = wl^s$, and the maximization problem is:

$$\max_{l^s} \left\{ 2\sqrt{wl^s} - l^s \right\},$$

which gives the first-order condition:

$$\frac{\sqrt{w}}{\sqrt{l^s}} - 1 = 0,$$

or:

$$l^s = w.$$

The firm maximizes profits:

$$\max_{l^d} \left\{ l^d - wl^d \right\},$$

which gives:

$$w = 1.$$

As long as the wage equals one, any labor demand yields the same profit (zero) for the firm. Since $w = 1$, we also get that $l^s = 1$, and labor demand equals one as well, since the labor market has to clear.

Now a government steps into the world and, for unknown reasons, intends to spend an amount g. I will compare two possibilities to finance g, a lump-sum tax and a proportional income tax. With the lump-sum tax t, the budget constraint of the consumer is:

$$c = wl^s - t.$$

The new maximization problem is:

$$\max_{l^s} \left\{ 2\sqrt{wl^s - t} - l^s \right\},$$

which gives the first-order condition:

$$\frac{w}{\sqrt{wl^s - t}} - 1 = 0,$$

or:

$$l^s = w + \frac{t}{w}.$$

From the firm's problem, we know that the wage is still going to satisfy $w = 1$. The government's budget constraint is:

$$g = t,$$

spending has to equal taxes. We therefore get:

$$l^s = 1 + g.$$

Consumption is given by:

$$c = wl^s - t = 1 + g - t = 1,$$

thus consumption is still the same after the advent of the government. The consumer simply works longer to satisfy the needs of the government. In this economy, the marginal rate of substitution between consumption and leisure still equals the marginal product of labor: The labor-leisure choice is not distorted.

As an alternative, the government can choose a proportional income tax τ to finance g. In this case, the budget constraint of the household is:

$$c = (1 - \tau)wl^s,$$

and the maximization problem is:

$$\max_{l^s} \left\{ 2\sqrt{(1-\tau)wl^s} - l^s \right\},$$

which gives the first-order condition:

$$\frac{\sqrt{(1-\tau)w}}{\sqrt{l^s}} - 1 = 0,$$

or:

$$l^s = (1 - \tau)w.$$

Since we have $w = 1$ from the firm's problem, labor supply is given by:

$$l^s = 1 - \tau.$$

Thus the higher the tax, the lower the labor supply of the consumer. Notice that the result was opposite with the lump-sum tax: there the consumer worked more to satisfy the needs of the government. The results are different because a proportional income tax effectively lowers the wage, as seen by the consumer. Since the tax drives a wedge between the wage paid by the firm and the after-tax wage as received by the consumer, the incentives to work are distorted. The marginal rate of substitution between consumption and leisure no longer equals the marginal product of labor, which leads to inefficiencies.

We still have to determine how high the tax needs to be set to pay for g. The government budget constraint is given by:

$$g = \tau w l^s.$$

Plugging in the optimal labor supply and $w = 1$, this is:

$$g = \tau(1 - \tau).$$

This gives a quadratic formula for τ with the solutions:

$$\tau = \frac{1}{2} \pm \sqrt{\frac{1}{4} - g}.$$

Thus for a given g there are actually two different tax rates that satisfy the government budget constraint. I will come back to this point later.

To see how the different tax schemes affect the utility of consumer, assume as a numerical example that $g = 0.25$. Under a lump-sum tax, the necessary tax is $t = .25$, and we have $l^s = 1.25$, $c = 1$. Plugging these values into the utility function, we see that the utility of the agent is given by 0.75. Under the proportional income tax, from the above formula, we see that the required tax is $\tau = .5$. Using the formula for labor supply, we get that labor supply is $l^s = 0.5$, and consumption therefore $c = (1 - \tau)l^s = 0.25$. The resulting utility is 0.5. Since utility numbers have only an ordinal interpretation, you should interpret the absolute differences. The point is that utility is lower under proportional income taxation. This is a general result: proportional income taxes distort the labor-leisure choice, while lump-sum taxes do not. Lump-sum taxation always gives higher utility to the consumer.

With the proportional tax, for a given amount of government spending there can be two different tax rates giving the same revenue. The reason is that with a proportional tax, revenue might actually fall, even while tax rates rise. This is because consumers respond to higher taxation by working less, i.e., they substitute leisure for labor after the price change. If this substitution effect outweighs the effect of higher tax rates, revenue will fall. In our example, tax revenues R are given by:

$$R = \tau w l^s = \tau(1 - \tau) = \tau - \tau^2.$$

Figure 2.8 shows tax revenues as a function of the tax rate. Indeed, if the tax rate exceeds 0.5, revenues start to fall. This phenomenon is also known as the “Laffer Curve,” after the economist who first pointed out the possibility that higher taxes could actually lower revenue.

From the point of view of a benevolent government, you never want to be on the downward sloping part of the Laffer curve. In that region, it is possible to lower taxes, give more utility to the consumers, and at the same time get higher tax revenues, which is an unambiguous Pareto improvement. Whether actual tax systems ever place us on the

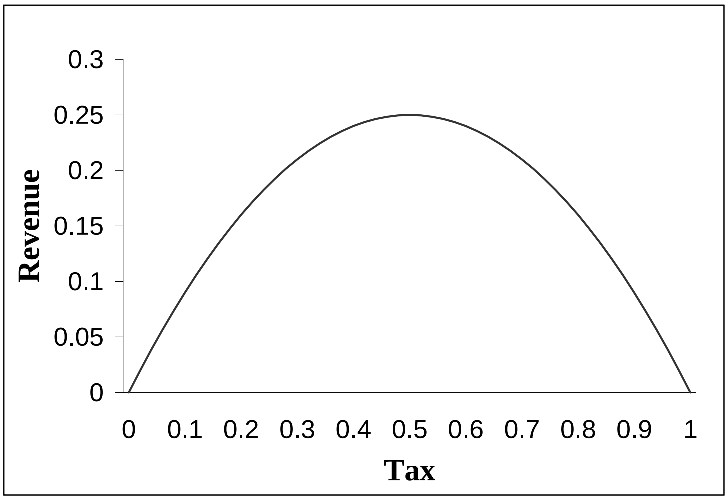

Figure 2.8: The Laffer Curve

downward-sloping portion of a Laffer curve is an empirical question. There is some evidence that total tax revenue from high income groups actually increased after the Reagan tax cuts in the 1980s, which would indicate the presence of a Laffer curve. In the past, marginal income tax rates in the U.S. could be as high as 91%, which almost surely leads to smaller revenue among high-income individuals. In Sweden, even today marginal taxes can be as high as 80%. Lowering this tax rate would provide incentives for people to work more and therefore pay more taxes. If Sweden lowered its top income tax rate, the fall in revenue would certainly be very small because of these substitution effects, and it is possible that revenue would actually increase.

Capital Taxation

So far, we have only considered a tax on labor income. In the real world, consumers have income both from labor and capital. In this section, we are going to explore the relative merits of capital taxation.

As an example, consider a model with an infinitely-lived consumer. For simplicity, I will assume that there is no labor, capital is the only factor of production. In this world, the government has a choice between taxation of consumption expenditures and capital income. The consumer maximizes a discounted sum of utility from consumption:

$$\max \left\{ \sum_{t=0}^{\infty} \beta^t \ln(c_t) \right\}.$$

The government levies a proportional tax τ_c on consumption expenditures and a tax τ_k on income from capital. Given these taxes, the flow budget constraint of the consumer at time t is given by:

$$(1+\tau_c)c_t + k_{t+1} = [1+(1-\tau_k)r_t]k_t.$$

Notice that only the interest on savings, but not the principal is taxed. Savings are denoted as k_{t+1} since savings are used as capital in the production function. The production function is given by:

$$y_t = Ak_t.$$

The firm's problem is to maximize profits in each period:

$$\max_{k_t}\{Ak_t - r_t k_t\}.$$

The first-order condition for this problem gives us an expression for the interest rate:

$$r_t = A.$$

The production function is linear in capital, and does not change over time. Capital does not depreciate in this model, thus including undepreciated capital total output available in period t is given by $(1+A)k_t$. Output can be used for consumption, for savings, or for government expenditures. The resource constraint is therefore given by:

$$c_t + k_{t+1} + \tau_c c_t + \tau_k A k_t = (1+A)k_t.$$

Here we use already $r_t = A$ for the interest rate. This can also be written as the familiar breakdown of output into consumption, investment, and government expenditures:

$$\underbrace{c_t}_{C_t} + \underbrace{k_{t+1} - k_t}_{I_t} + \underbrace{\tau_c c_t + \tau_k A k_t}_{G_t} = \underbrace{Ak_t}_{Y_t}.$$

In this model, the government has access to two different taxes, and the question is which of the two, or which mix, should be used to finance government spending. This question can be settled by solving for the equilibrium of the economy, and then comparing the effects of the two taxes.

The Lagrangian for the utility maximization problem of the household is given by:

$$L = \sum_{t=0}^{\infty}\left\{\beta^t \ln(c_t) + \lambda_t([1+(1-\tau_k)r_t]k_t - (1+\tau_c)c_t - k_{t+1})\right\}.$$

The first-order condition with respect to c_t is given by:

$$\frac{\beta^t}{c_t} - \lambda_t(1+\tau_c) = 0,$$

and the first-order condition with respect to k_{t+1} is:

$$-\lambda_t + \lambda_{t+1}(1 + (1 - \tau_k)r_{t+1}) = 0.$$

Isolating the λ_t and λ_{t+1}, we get:

$$\lambda_t = \frac{\beta^t}{(1 + \tau_c)c_t}, \tag{2.1}$$

and:

$$\frac{\lambda_t}{\lambda_{t+1}} = 1 + (1 - \tau_k)r_{t+1}. \tag{2.2}$$

Using (2.1) and $r_{t+1} = A$ in (2.2), we get:

$$\frac{\beta^t(1 + \tau_c)c_{t+1}}{\beta^{t+1}(1 + \tau_c)c_t} = 1 + (1 - \tau_k)A,$$

or:

$$\frac{c_{t+1}}{c_t} = \beta[1 + (1 - \tau_k)A].$$

The last equation determines the growth rate of consumption (c_{t+1}/c_t) as a function of parameters and taxes. Notice that the consumption tax canceled and does not enter the equation, while the capital income tax has a negative effect on the growth rate of consumption.

The reason is that the capital income tax distorts the intertemporal margin. By taxing capital income, investing in capital becomes less attractive compared to immediate consumption. The consequence is that the capital stock grows slower than it would have otherwise, which after some time leads to permanently lower consumption. Of course, the growth rate of consumption is not a sufficient measure of welfare in this economy, but it can be shown that it is indeed optimal to set the capital tax to zero and use only consumption taxation. This result holds in a variety of models, and also when capital income taxes are compared to taxes on labor income. It is particularly harmful to distort the intertemporal margin because of the negative effects on capital accumulation. Even when no lump-sum taxes are available, it turns out that it is better to use no capital income taxes at all, and raise all revenue with taxes on consumption or labor income.

Budget Deficits and Government Debt

So far, we have assumed that the government balances the budget every period, i.e., there are no budget deficits and no government debt. In the real world, governments make liberal use of debt to finance expenditures. In the United States, the total outstanding government debt is about 3.4 trillion dollars, or about 45% of GDP. In the media, government debt receives a lot of attention and is often portrayed as a major problem. One concern is that government debt leaves the burden of financing current government expenditures to future generations. Another fear is that government debt "crowds out" private investment, in the sense that private savings that are spent on government bonds are not available for private investment. While some of these points appear convincing on the surface, a more careful analysis casts doubts on their validity. For example, while it is true that future generations will have to pay for government debt, it is also true that most government debt is in hands of American people. Future generations will inherit government bonds from their parents. Paying off bonds that they own themselves is not a net burden to future generations. Also, while government debt absorbs some private saving, government debt also means that taxes are lower than they would have been if the budget were balanced. Lower taxes imply higher savings, and therefore private investment is not necessarily crowded out.

We can see that it is possible to argue both for and against negative effects from government debt, without a clear guidance which view is correct. To understand government debt better, we need a formal model to organize these different thoughts. The approach I will take is to present a model in which government debt indeed does not matter, i.e., whether government expenditures are financed via taxes or via debt does have any real consequences. By doing this, we can spell out which assumptions are needed to argue that government debt is irrelevant. By examining the necessary assumptions, we can then determine to which degree debt matters in the real world.

How do we construct a model in which debt does not matter? The main feature that we need is that consumers perfectly anticipate that current debt will have to be paid by taxes in the future. This anticipation effect will induce the consumers to do just enough extra savings to accommodate the government debt. David Ricardo was the first economist to point out that debt is irrelevant if taxpayers anticipate the future taxation implied by budget deficits. For that reason, models in which debt does not matter are also said to exhibit "Ricardian Equivalence." We need three assumptions to build a model in which Ricardian equivalence holds. First, consumers need to be infinitely lived. Second, capital markets need to be perfect, i.e., there is a single interest rate for borrowing and lending, and there are no borrowing restrictions. Third, the government must be able to levy lump-sum taxes.

I will present a simple version of such a model in which the government spends a constant amount g each period. This assumption is just for simplification, it is not important for the main result. The government can use lump-sum taxes τ_t to finance expenditures, or it can issue government bonds b_{t+1} which will have to be paid back in the subsequent period. I assume that at the beginning of time there is no outstanding debt, i.e., $b_0 = 0$. For technical reasons, we also need to assume that borrowing cannot be extended without limit, i.e., there has to be some number B such that $b_t \leq B$ for all t. Since B can be arbitrarily large, this is not a restrictive assumption. For simplification, I assume that the interest is a constant r in every period. The budget constraint of the government at time t is then given by:

$$g + (1 + r)b_t = \tau_t + b_{t+1}.$$

On the left hand side are the expenditures, which consist of new spending g and payments plus interest on government bonds b_t that were issued in the previous period. On the right hand side are receipts, which stem from lump-sum taxes τ_t and newly issued debt b_{t+1}.

Even if the government uses debt to finance expenditure, at some point it still will have to pay off the debt. Another way of stating this is that the present value of taxes has to equal the present value of expenditures, no matter which exact sequence of taxes and bond issues is used. To see this formally, we can solve the budget constraint at time 1 for b_1 to get:

$$b_1 = \frac{\tau_1 - g + b_2}{1 + r}.$$

Plugging this expression into the time 0 budget constraint (notice that $b_0 = 0$), we get:

$$g = \tau_0 + b_1 = \tau_0 + \frac{\tau - g + b_2}{1 + r},$$

or:

$$\left(1 + \frac{1}{1 + r}\right) g = \tau_0 + \frac{\tau_1}{1 + r} + \frac{b_2}{1 + r}.$$

Solving the period 2 budget constraint for b_2 yields:

$$b_2 = \frac{\tau_2 - g + b_3}{1 + r}.$$

Using this expression, we get:

$$\left(1 + \frac{1}{1 + r} + \frac{1}{(1 + r)^2}\right) g = \tau_0 + \frac{\tau_1}{1 + r} + \frac{\tau_2}{(1 + r)^2} + \frac{b_3}{(1 + r)^2}.$$

Going on in the same way for n periods, we get:

$$\sum_{t=0}^{n} \frac{1}{(1 + r)^t} g = \sum_{t=0}^{n} \frac{1}{(1 + r)^t} \tau_t + \frac{b_{n+1}}{(1 + r)^n}.$$

As n tends to infinity, the last term tends to zero, and we get:

$$\sum_{t=0}^{\infty} \frac{1}{(1 + r)^t} g = \sum_{t=0}^{\infty} \frac{1}{(1 + r)^t} \tau_t.$$

The left-hand side is the present value (as of time 0) of total government expenditures in all periods, while the right-hand side is the present value of all taxes. Thus regardless of the use of government debt, the present value of taxes has to be equal to a given number, the present value of expenditures.

Let us now turn to the representative household. The household has preferences defined over infinite streams of consumption. The exact form of the utility function is irrelevant for this analysis. Let us assume that the household has an income of w_t in period t. This income can be used either for consumption c_t or savings s_{t+1}. In addition, the household has to pay the lump-sum tax τ_t. The time t budget constraint is given by:

$$c_t + s_{t+1} = w_t + (1+r)s_t - \tau_t.$$

The household has no initial assets, i.e., $s_0 = 0$. Depending on the use of government debt, the sequence of taxes τ_t differs. We need to show that the decisions of the household will not be affected by the exact path of taxes, as long as the present value of taxes is constant. To show this, we will proceed in a similar way as above. The time 1 budget constraint can be solved to give:

$$s_1 = \frac{c_1 + s_2 - w_1 + \tau_1}{1+r}.$$

Plugging this into the time 0 budget constraint gives:

$$c_0 + \frac{1}{1+r}c_1 + \frac{s_2}{1+r} = w_0 + \frac{1}{1+r}w_1 - \left[\tau_0 + \frac{1}{1+r}\tau_1\right].$$

As above, we can now solve the time 2 budget constraint for s_2, and plug in again. Continuing for n periods in this way gives:

$$\sum_{t=0}^{n} \frac{1}{(1+r)^t}c_t + \frac{s_{n+1}}{(1+r)^n} = \sum_{t=0}^{n} \frac{1}{(1+r)^t}w_t - \left[\sum_{t=0}^{n} \frac{1}{(1+r)^t}\tau_t\right].$$

As for the government, we have to assume that there is some upper bound for household borrowing and lending. In that case, the second term on the left-hand side converges to zero, and we get:

$$\sum_{t=0}^{\infty} \frac{1}{(1+r)^t}c_t = \sum_{t=0}^{\infty} \frac{1}{(1+r)^t}w_t - \left[\sum_{t=0}^{\infty} \frac{1}{(1+r)^t}\tau_t\right].$$

Thus the present value of consumption expenditures has to equal the present value of income, minus the present value of taxes. We know from the government budget constraint that the present value of taxes equals the present value of government expenditures. Using this, the household budget constraint can be written as:

$$\sum_{t=0}^{\infty} \frac{1}{(1+r)^t}c_t = \sum_{t=0}^{\infty} \frac{1}{(1+r)^t}w_t - \left[\sum_{t=0}^{\infty} \frac{1}{(1+r)^t}g\right].$$

Notice that this budget constraint is the only actual constraint that the household is facing. For any consumption sequence that satisfies the equation above, there is a savings sequence that satisfies the period-by-period budget constraints. Also notice that neither taxes nor government debt enter this budget constraint: The timing of taxes or the use of debt do not matter, only the present value of expenditures is important. Since debt does not even enter the decision problem of the only household in this economy, it does not have any real consequences: The optimal consumption allocation will be completely unaffected by the use of government debt. The reason is that the household has perfect foresight and anticipates that any current debt will be paid off later. Therefore if more debt is issued, the household will raise savings by exactly the same amount, in order to offset any effects on consumption.

How realistic are these results? Do they imply that government debt does not matter in the real world? We can find the answer for this question by examining the assumptions that were needed to get the result. The first assumption is that people live forever. Obviously, this assumption is not literally satisfied in the real world. What really matters, however, is that taxpayers care about future taxes, regardless how far in the future they are to be paid. That it is true of people who live forever, but it is also true if people have finite lifetimes, but care for their children. A dynasty of finitely lived people where the utility of each child enters the utility of the parent is for our purposes identical to a single person who lives forever. As an example, assume that the government considers lowering taxes today by $1,000. The additional government debt will be paid off 50 years later by raising taxes at that time. In response to this change, an infinitely lived person would raise savings by $1,000 today, and earn just enough interest to pay the extra taxes 50 years from now. A person who dies within the next 50 years but cares about his child will also raise savings by $1,000, and leave a higher bequest so that the child can pay the extra taxes in 50 years. A finitely lived consumer who does not care about children, however, will simply consume more. The important question therefore is whether people care about their children in a sufficient amount. The evidence on this is not quite conclusive, but it is certainly the case that parents care and leave bequests to their children.

The second assumption is that capital markets are perfect. Real-world capital markets are not perfect. However, what matters here is that the borrowing rate for the government equals the lending rate for the households. Since households are free to buy the very bonds that the government uses to finance its spending, these interest rates are at least potentially the same. To be sure, there are many other capital market imperfections in the real world, but they are not relevant for Ricardian equivalence.

Finally, we need to assume that the government has access to lump-sum taxation. Clearly, this assumption is not satisfied in the real world. Almost all actual taxes used by governments are not lump-sum, and therefore distortionary. This implies that government debt matters to the degree that distortions will vary over time, depending on the path of government debt and taxes.

Given this discussion, what can we say about the effects of government debt? To the extent that people look into the future and care about their children, the effects of government debt are probably small, or at least much smaller as portrayed in the media. High government debt does imply higher taxation in the future, however, and since real-life taxes are distortionary, this taxation will have negative effects. We saw earlier that the distortion caused by taxes increases with the level of taxation. In order to minimize distortions, it is therefore best to keep tax rates as low as possible. Over time, it is best to keep tax rates stable. From the point of view of optimal policy it is therefore best to use government debt to distribute tax distortions evenly over time. Consider the situation of a government that has a large expenditure today, like a war. If this expenditure had to be financed by taxes alone, tax rates and therefore distortions would have to be very high. By using government debt, it is possible to distribute the tax distortions over a longer period of time. That is just what many governments have done in wartimes in the past. Consider Figure 2.6, which shows U.S. government debt as a fraction of GDP. Each major war (the Revolutionary War, the Civil War, World War I and World War II) was financed to a considerable amount by issuing debt that was paid of in subsequent years. This policy led to smaller tax distortions during the war relative to a policy that would finance all expenditures by taxes.

Summing up, we see that government debt does not matter in a world with people who have perfect foresight, perfect capital markets, and lump-sum taxation. In the real world, taxes are distortionary, and therefore government debt matters because in influences the time path of taxation and therefore distortion. An optimal policy would be designed such that tax rates are roughly constant over time, in order to keep distortions low. However, the main conclusion is that debt does not matter much, if compared to the effects of government spending. In other words, it is much more important how much the government spends, as opposed to how it finances the expenditures. The same is true for households: If Joe Average decides to buy a car, it does not make much of a difference whether he pays cash or credit. If he decides to pay cash, he is still free to get a loan from the bank for other expenditures, and if he pays credit, he is still free to save more to be prepared for future payments. On the other hand, it is very important which car he buys: regardless of financing, buying a Mercedes S 600 will have a much bigger impact on his future consumption opportunities than buying a Honda Civic.

Social Security

So far, we have taken government expenditures as given, and concentrated on the question how the government should finance expenditures. In this section, we will link the analysis of spending and financing in connection with one of the most important government programs, the pension system. Most industrialized countries are projected to run into serious difficulties in financing public pensions within the next 30 years or so. In fact, it is clear that most pension systems will have to be reformed if they are to survive. In this section, we will be mostly concerned with comparing two different modes of financing pensions, the fully-funded system and the pay-as-you-go system.

In a **fully-funded** pension system, the contributions of each cohort are invested in bonds or equity. The benefits for each cohort are drawn from the returns on investing the contributions of that same cohort. At any point in time, the social security system owns a capital stock that is large enough to cover the future obligations of the system. In contrast, in a **pay-as-you-go** system contributions are paid out to currently retired people immediately. The system does not maintain a capital stock. The benefits of each cohort are paid by the contributions of future cohorts. Consequently, the solvency of a pay-as-you-go pension system crucially depends on the number of people who pay contributions relative to the number of people who receive benefits. Fertility rates, life expectancy, immigration, labor force participation rates, and the retirement age are all important variables that affect the solvency of the system. In contrast, in a fully-funded system the return on the invested contributions is important, while the system is relatively immune to demographic change.

To start, we will analyze pension systems from an individual perspective. That is, we take wages and taxes as given and examine the effects on the behavior of an individual. Later, we will extend the model to analyze the aggregate and long-run effects of different pension systems.

Consider a world with overlapping generations of people who live for two periods each. At each point in time, there are young people who were just born, and old people who were born in the previous period. The young people work and receive a fixed income y_t, and the old people are retired. There is a perfect credit market with interest rate r. The income grows at a constant rate g, so that we have:

$$y_{t+1} = (1 + g)y_t,$$

and the number N_t of people who are born in period t grows at rate n:

$$N_{t+1} = (1 + n)N_t.$$

Consumption of generation t when young will be denoted c_t^t, while consumption of the same generation when old is denoted c_{t+1}^t. In other words, superscripts refer to the time of birth, while subscripts denote the current period. The utility function of a member of the time-t generation is given by:

$$u(c_t^t, c_{t+1}^t) = \ln(c_t^t) + \ln(c_{t+1}^t).$$

For simplicity, we abstract from discounting. In other words, the consumer values both periods of life equally.

As a benchmark case, we will first determine the savings of a young person at time t under the assumption that there is no social security system at all. In this case, the budget constraint in the first period of life is given by:

$$c_t^t = y_t - s_t,$$

where s_t is savings of a member of generation t, and the budget constraint in the second period is:

$$c^t_{t+1} = (1 + r)s_t.$$

The consumer does not work when old, and there is no social security system, therefore all income is from returns on own saving. Plugging these constraints into the utility function yields the following maximization problem:

$$\max_{s_t} \{\ln(y_t - s_t) + \ln((1 + r)s_t)\}.$$

The first-order condition for this problem is:

$$-\frac{1}{y_t - s_t} + \frac{1}{s_t} = 0,$$

which gives the solution:

$$s_t = \frac{y_t}{2}.$$

Thus regardless of the interest rate, young workers will save half of their income. Plugging the optimal savings back into the budget constraint gives us the optimal consumption values:

$$c^t_t = \frac{y_t}{2},$$

and:

$$c^t_{t+1} = \frac{(1 + r)y_t}{2}.$$

We are now going to contrast this outcome to the two different pension schemes.

Under the fully-funded pension system, contributions are invested in the credit market. We will assume that there is a proportional payroll tax τ to finance pensions. Since the pension system has access to the same credit market with interest rate r, the contributions of a young worker with income y_t are τy_t, while the old-age benefits are $(1 + r)\tau y_t$. Therefore the budget constraints are now given by:

$$c^t_t = (1 - \tau)y_t - s_t,$$

and:

$$c^t_{t+1} = (1 + r)s_t + (1 + r)\tau y_t.$$

The new maximization problem is:

$$\max_{s_t} \{\ln((1 - \tau)y_t - s_t) + \ln((1 + r)[s_t + \tau y_t])\}.$$

The first-order condition for this problem is:

$$-\frac{1}{(1-\tau)y_t - s_t} + \frac{1}{s_t + \tau y_t} = 0,$$

which gives the solution:

$$s_t = \frac{y_t}{2} - \tau y_t.$$

Thus the young worker simply lowers his own saving by the amount of the social security contribution. This makes intuitive sense: In a fully-funded system, social security is identical to forced savings. It is optimal to just offset the forced saving in order to realize the same optimal consumption values. Since the worker just offsets social security savings, consumption is unchanged:

$$c_t^t = \frac{y_t}{2},$$

and:

$$c_{t+1}^t = \frac{(1+r)y_t}{2}.$$

Thus fully-funded social security and no social security are identical in this model. Of course, this outcome depends on some simplifying assumptions that we made. For example, in real life the time of death is unknown. Social security provides insurance against the possibility of a long life, because benefits are always paid up until the end. This insurance motive does not play a role in our model, since everyone dies at the same time anyway.

Let us now move to the pay-as-you-go social security system. Contributions are still given by τy_t. Benefits, however, no longer depend on interest rate r, since the contributions are not invested. Instead, every retiree gets a share of the contributions of the young generations. The retirement benefit b_t for a person born at time t is given by total contributions $N_{t+1}\tau y_{t+1}$ of generation $t+1$, divided by the number of people born at time t:

$$b_t = \frac{N_{t+1}\tau y_{t+1}}{N_t}.$$

Since income and population grow at constant rates, we have $N_{t+1}/N_t = 1+n$ and $y_{t+1} = (1+g)y_t$. Using these expressions, we can express the retirement benefits as a function of the income when young:

$$b_t = (1+n)(1+g)\tau y_t.$$

Thus the actual return on the social security contributions is $(1+n)(1+g)$. Depending on the parameters, this return may be higher or lower than the interest rate $1+r$, which determines the return in the fully-funded system. Given the retirement benefit, the budget constraints of the consumer are given by:

$$c_t^t = (1-\tau)y_t - s_t,$$

and:

$$c_{t+1}^t = (1 + r)s_t + (1 + n)(1 + g)\tau y_t.$$

The new maximization problem is:

$$\max_{s_t} \left\{ \ln((1 - \tau)y_t - s_t) + \ln((1 + r)s_t + (1 + n)(1 + g)\tau y_t) \right\}.$$

The first-order conditions for this problem is:

$$-\frac{1}{(1 - \tau)y_t - s_t} + \frac{1 + r}{(1 + r)s_t + (1 + n)(1 + g)\tau y_t} = 0,$$

which gives the solution:

$$s_t = \frac{y_t}{2} - \tau y_t - \frac{(1 + n)(1 + g) - (1 + r)}{2(1 + r)}\tau_t y_t.$$

The solution is identical to the one we had before, apart from the last term. The last term depends on the difference between the return on social security, $(1 + n)(1 + g)$, and the return on savings, $1 + r$. If the return on social security is greater, savings decline relative to the fully-funded system. Plugging the optimal savings into the budget constraints, we get the following optimal consumption values:

$$c_t^t = \frac{y_t}{2} + \frac{(1 + n)(1 + g) - (1 + r)}{2(1 + r)}\tau_t y_t,$$

and:

$$c_{t+1}^t = \frac{(1 + r)y_t}{2} + \frac{(1 + n)(1 + g) - (1 + r)}{2}\tau_t y_t.$$

Thus if we have:

$$(1 + n)(1 + g) > 1 + r,$$

consumption is higher in both periods compared to the fully-funded system. All generations could benefit to a switch to a pay-as-you-go system, because growth in population and wages is so high that it is more efficient to have future generations pay for pensions, instead of saving for them.

Unfortunately, in the real world returns on social security usually turn out to be lower than market interest rates. In the United States, the average annual return on social security payments for current high school graduates is estimated to be around 1.7%. This compares to an average real interest rate of 2.5% on long-term bonds and about 8% on investments in S&P 500 stocks. Given these returns, the young generations should prefer a fully-funded system, since it will give them higher lifetime consumption and utility.

Old people, on the other hand, would prefer to keep the pay-as-you-go system, because they are the ones profiting now. However, our analysis so far is not yet sophisticated enough to determine which pension system is better. We worked out how an individual consumer will adjust savings in the two different systems, taking incomes and interest rates as given. In the real world, we have to allow for the possibility that the social security system might affect aggregate savings and investment, which in turn would have an effect on incomes and interest rates. An analysis that accounts for investment is more complicated, however, and therefore we will have to simplify the model in other dimensions. Stop reading here. The model that comes next has not been covered in classes

Consider a model in which people live for two periods. They work when young, but they do not consume, and they consume when old, but do not work. Every period a new young generation is born, and for simplicity I assume that all generations are of equal size. A consumer born at time t has the following preferences over labor l_t when young and consumption c_{t+1} when old:

$$u(c_{t+1}, l_t) = 2\sqrt{c_{t+1}} - l_t.$$

The consumer has to pay a proportional social security tax τ on labor income in the first period. Since there is no consumption in the first period, all after-tax income will be saved:

$$s_t = (1 - \tau)w_t l_t.$$

In what follows b_t will denote retirement benefits per dollar earned in the first period. Depending on the pension system, b_t will take different values. Consumption in the second period is then given by:

$$c_{t+1} = (1 + r_{t+1})s_t + b_t w_t l_t.$$

Using the last two equations in the utility function leads to the following optimization problem:

$$\max_{l_t} \left\{ 2\sqrt{[(1 + r_{t+1})(1 - \tau) + b_t]w_t l_t} - l_t \right\}.$$

The first-order condition for this problem is:

$$\frac{\sqrt{[(1 + r_{t+1})(1 - \tau) + b_t]w_t}}{\sqrt{l_t}} - 1 = 0,$$

which gives:

$$l_t = [(1 + r_{t+1})(1 - \tau) + b_t]w_t, \tag{2.3}$$

and:

$$s_t = (1 - \tau)[(1 + r_{t+1})(1 - \tau) + b_t]w_t^2. \tag{2.4}$$

There is a single firm in the economy that produces the consumption good using the production function:

$$y_t = 2\sqrt{k_t l_t}.$$

The profit-maximization problem is given by:

$$\max_{k_t, l_t} \left\{ 2\sqrt{k_t l_t} - r_t k_t - w_t l_t \right\}.$$

The first-order conditions imply that factor prices equal marginal products:

$$r_t = \sqrt{\frac{l_t}{k_t}}, \tag{2.5}$$

and:

$$w_t = \sqrt{\frac{k_t}{l_t}}. \tag{2.6}$$

Equations (2.3) to (2.6) characterize equilibria under any social security system. I will now analyze what this implies for the long-run behavior of the economy under the two different pension system.

I start with the fully-funded pension system. In the fully-funded system, both the savings of the household and the social security contributions are invested. The capital stock in the next period therefore equals the sum of the two:

$$k_{t+1} = (1-\tau) w_t l_t + \tau w_t l_t = w_t l_t. \tag{2.7}$$

Since the social security contributions are invested, they are used by the firm as capital and earn return r_{t+1}. The return b_t on social security is therefore given by:

$$b_t = (1 + r_{t+1})\tau. \tag{2.8}$$

Using (2.8) in (2.3) gives:

$$l_t = [(1 + r_{t+1})(1-\tau) + (1 + r_{t+1})\tau] w_t = (1 + r_{t+1}) w_t.$$

Summing up, equilibrium outcomes under a fully-funded pension system are characterized by the following four equations:

$$k_{t+1} = w_t l_t, \tag{2.9}$$

$$l_t = (1 + r_{t+1}) w_t, \tag{2.10}$$

$$r_t = \sqrt{\frac{l_t}{k_t}}, \tag{2.11}$$

and:

$$w_t = \sqrt{\frac{k_t}{l_t}}. \tag{2.12}$$

We are interested in the long-run, steady state solution to this system, in which all variables are constants $l_t = l$, $k_t = k$, $r_t = r$, and $w_t = w$. Using (2.11) and (2.12) in (2.9) and (2.10) reduces the system to two equations:

$$k = \sqrt{\frac{k}{l}}l \tag{2.13}$$

and:

$$l = \left(1 + \sqrt{\frac{l}{k}}\right)\sqrt{\frac{k}{l}}. \tag{2.14}$$

Equation(2.13) now gives $k = l$, and using this in (2.14) gives $l = 2$. Thus both capital and labor input are equal to 2 under the fully-funded system, and both wage and interest rate are equal to 1. Of course, these numbers do not mean anything until we compare them to outcomes under an alternative arrangement. Let us therefore examine the pay-as-you-go system.

We will concentrate on a steady-state solution. In a steady state, all young generations have the same income. Since social security contributions are transferred directly to retired people and all generations have the same size, the benefit per retiree equals the contribution per worker. Relative to labor income the benefit is given by:

$$b_t = \tau.$$

Therefore labor supply is given by:

How on earth can he say this? Why private funds can be invested and increase the capital stock, but the public funds can not? If there is surplus, will they be left under the mattress?

$$l_t = [(1 + r_{t+1})(1 - \tau) + \tau]w_t.$$

Since the social security benefits are not saved and invested, the capital stock is made up of private savings only:

$$k_{t+1} = (1 - \tau)w_t l_t.$$

Using the last two equations together with our expressions for the wage and the interest rate yields the following system:

$$k_{t+1} = (1 - \tau)w_t l_t, \tag{2.15}$$

$$l_t = [(1 + r_{t+1})(1 - \tau) + \tau]w_t, \tag{2.16}$$

$$r_t = \sqrt{\frac{l_t}{k_t}}, \tag{2.17}$$

and:

$$w_t = \sqrt{\frac{k_t}{l_t}}. \tag{2.18}$$

We are interested in the long-run, steady state solution to this system, in which all variables are constants $l_t = l$, $k_t = k$, $r_t = r$, and $w_t = w$. Using (2.17) and (2.18) in (2.15) and (2.16) reduces the system to two equations:

$$k = (1 - \tau)\sqrt{\frac{k}{l}}l \tag{2.19}$$

and:

$$l = \left[\left(1 + \sqrt{\frac{l}{k}}\right)(1 - \tau) + \tau\right]\sqrt{\frac{k}{l}}. \tag{2.20}$$

Equation (2.19) gives:

$$k = (1 - \tau)^2 l.$$

Using this in (2.20) yields:

$$\begin{aligned} l_t &= \left[\left(1 + \frac{1}{(1 - \tau)}\right)(1 - \tau) + \tau\right](1 - \tau) \\ &= [1 - \tau + 1 + \tau](1 - \tau) \\ &= 2(1 - \tau). \end{aligned}$$

Consequently, the capital stock is given by:

$$k = (1 - \tau)^2 l = 2(1 - \tau)^3.$$

Thus both the capital stock and labor input are lower under the pay-as-you-go system, which translates into lower consumption and utility for all generations. The pay-as-you-go system is inferior because it lowers aggregate savings, which in turn leads to a lower capital stock.

Up to this point, our results indicate that a fully-funded system has a number of advantages compared to a pay-as-you-go system. It leads to higher savings and investment, which is beneficial for the economy in the long run. However, the generation of initial retirees would suffer during a switch to a fully funded system, so from a welfare perspective it is not clear whether one should stick with a pay-as-you-go system that is already in place.

There are some aspects to the social security system that were not discussed so far, but may be also important when evaluating different systems. First of all, our results hinge on the assumptions that the young and the old do not care for each other. When we discussed Ricardian equivalence, we found that government debt does not matter (much) when people are altruistic. The same applies in the world of social security: If people are altruistic, different pension schemes still matter in as much as they lead to tax distortions, but the total effects on aggregate savings would be much reduced.

A main disadvantage of the fully-funded system that was not discussed so far is that it relies on stable financial markets. If events like a war or a hyperinflation wipes out all assets of the system, generations that were just about to retire experience a large welfare loss. Wars and hyperinflations used to be common in many industrialized countries until about 50 years ago, which partially explains why we observe a pay-as-you-go system in most of these countries. On the other hand, a pay-as-you-go system is ill-prepared to handle demographic change like rising life expectancy and falling birth rates. Changes of this kind pose a major challenge for most industrialized nations. Given the demographic developments that can be expected in the next century, it will most likely be impossible to continue pay-as-you-go pensions in the way they are run now. The large baby-boomer generations together with high life-expectancy will lead to a large number of retirees, while low birth rates imply a small number of working people who will have to pay for the pensions. In the short run, a transition to a fully-funded system will be infeasible due to the high cost for currently retired people. The likely solution will be a transition to a mixed system with increasing reliance on private savings, together with a reduction of benefits in the pay-as-you-go system.

2.4 Outlook

Our analysis of Fiscal Policy led to some strong and some weak conclusions. We have good reason to believe that high marginal tax rates hurt consumers and should therefore be avoided wherever possible. Taxation of capital gains inhibits capital accumulation, which leads to larger welfare losses than other forms of taxation. It is therefore advisable to keep interest rates on capital gains low. Our results concerning the effects of government debt were more ambiguous. Under a certain set of assumptions, government debt does not matter at all. However, the necessary assumptions are not satisfied in the real world. As a rule of thump, a debt policy that minimizes tax distortions over time seems advisable. Finally, we found that a fully-funded pension system is superior to a pay-as-you-go system, as long as financial markets can be expected to be stable in the future. A transition to a fully funded system is costly for retired people, however, and therefore a mix of the two systems might be an appropriate compromise.

Our results suffer from one major problem. In all models, we took the behavior of consumers and firms as explained by maximizing behavior. In contrast, we did not model the behavior of politicians at all, implicitly assuming that politicians are willing and capable to carry out the policy recommendations made by economists. This view of politicians is unrealistic. There is an entire literature that tries to understand the behavior of politicians as governed by the same kind of maximizing behavior that we find in firms and consumers. Politicians might maximize their political power, the spending of their specific government agency, or their chances of being reelected. A description of this literature is beyond the scope of this course, but it should be pointed out that the policy recommendations worked out here are not always optimal once the behavior of politicians is accounted for.