Borrowing, Lending, and Budget Constraints

6

Many people despise wealth, but few know how to give it away.

François de La Rochefoucauld

What's the quickest way to become a millionaire? Borrow fivers off everyone you meet.

Richard Branson

6.1 Overview

Borrowing and lending is a fundamental act of economic life. Each of the main economic players identified in the circular flow diagram of Chapter 2 —households and firms of the private sector, the government, and the rest of the world—have their own reasons to borrow and lend. In doing so, they shift income and spending between the present and the future. Borrowing brings future income forward to be spent today. Lending or, more generally, saving, defers the use of current income to some later date.

Expectations of the future motivate borrowing and lending decisions. Those who reasonably expect their incomes to grow will want to borrow and raise their standards of living now instead of waiting. In contrast, the lucky winner of a lottery is likely to save a large fraction of the prize, because it is unlikely to occur again. Firms' investment decisions, which means adding capacity for future production, are a gamble on future demand. Not the present, not the past, but expectations of the future exert the greatest influence on firms' investment decisions—to acquire capital to enable production in years to come.

The shifting of spending over time can be seen as an intertemporal trade. One could think of a lender as a seller of money today, and the borrower as a buyer. Like any trading activity, there must be both a price linking the present and the future and each actor must face a budget constraint. Indeed, because people are impatient, time has a price. This price is determined by the interest rate.

Similarly, borrowing and lending must be limited by total available resources. In this case, however, the resources are not just current income and wealth, they also involve future income. By the same token, income from lending and commitments to pay back borrowing will gradually emerge in the future. Present and future wealth can be thought of as assets of a household, while present and future commitments are like liabilities. An **intertemporal budget constraint** requires that liabilities be repaid someday, while accumulated assets will eventually be spent.

The intertemporal budget constraint provides a powerful framework for understanding many fundamental aspects of macroeconomics. Because the future is unbounded, it can be rather overwhelming to think about it. For that reason, this chapter adopts two simplifications. First, we reduce the course of time to just two periods, today and tomorrow, the present and the indefinite future. Second, we will continue to employ Robinson Crusoe, already introduced in Chapter 4 to think about the choice between work and leisure, and as a parable for consumer, producer, and include the government, all at once. These steps will make abstract and complex considerations a bit easier to handle.

6.2 Thinking About the Future

6.2.1 The Future Has a Price

Anything of value must have a price. This includes money and goods delivered at future dates. In fact, markets exist for the sole purpose of pricing future deliveries of commodities. These are the stock markets like Euronext or New York Mercantile Exchange (NYMEX), exchange markets, or specialized commodity markets. Such markets exist in many countries, both developed and emerging. An important common feature of asset markets is to place a value on payoffs in the future. This includes company shares, loan repayments, steel deliveries, or foreign currencies. In a sense, asset markets price the future.

Microeconomic principles can be readily used to understand how the future is priced. There is a parallel between *intertemporal* consumption choices (between present and future goods) and *intratemporal* consumption choices (among goods at a particular point in time). When we choose between consuming now or in the future, we effectively decide whether to save or to borrow. As rational households plan spending over time, they take into account their future incomes and needs, and balance these against the interest rate at which they can borrow or save. Similarly, firms need to forecast the profitability of plant and equipment in which they invest. They need a benchmark for that profitability—what could they or their owners have otherwise done with their money? They compare the profit, or return, from those projects with that available from lending their money at some available interest rate, which represents either the cost of funds or, if funds are available, the best alternative use for them.

6.2.2 The Rational Expectations Hypothesis

Expectations about the future are crucial to all this. But how exactly do firms and households form their expectations? Do they get it right or wrong? In this book, we will generally take the modern view that economic agents' forecasts are right *on average*. This is the **rational expectations hypothesis**.

The rational expectations hypothesis does not mean that households and firms never make mistakes, or that they always forecast the future perfectly. It is simply a way to apply the rationality principle to the way economic agents think about the future—we assume that they do not make *systematic* errors. Clearly, alternative assumptions about expectations are possible. In fact, laboratory experiments on human subjects show that we all get sidetracked, sometimes, often responding to emotions rather than to cold calculation. These experiments also show that we have limited ability to process mentally all the information that we have, or should have. So why do we adopt the rational expectations hypothesis? For three reasons:

- First, because there are so many ways of being irrational that there is no clear or obvious alternative.[1]
- Second, standard economic theory is based on the hypothesis that agents 'optimize' in the sense that they behave rationally—that they take the best possible decisions in a logically consistent way. If agents are rational in planning their consumption, work, and production, then they should be rational when thinking about the future.
- Third, even if most people are not fully rational all the time, it is unlikely that they are repeatedly and systematically wrong. If they are, they would most certainly suffer continuous losses. Isn't it natural to expect them to take steps to avoid such errors in the future?

There is an even better and subtler justification for rational expectations. We are ultimately interested in how prices, interest rates, incomes, and spending interact on the marketplace. It is often enough that a few well-informed agents behave rationally to drive the markets. If trade unions act on behalf of their members, it suffices that their expectations will be correct on average. In financial markets, all that is required is that a number of professional traders are well informed and have sufficient resources at their disposal. If they perceive that prices are too low compared with their valuation, they will buy, forcing prices upwards. If prices are too high, they will sell. Less well-informed customers end up accepting the market prices because it is foolish to ignore them and possibly too costly to try to do better.[2]

As a short cut, this book will frequently use a simplified version of rational expectations

[1] Some alternatives to rational expectations are presented formally in the WebAppendix to this chapter.

[2] This point highlights an important tension between rationality of individual behaviour and aggregate outcomes. We will see in Chapter 7 that financial markets can be susceptible to problems when too many people blindly believe the signal thought to be contained in prices.

known as perfect foresight. Perfect foresight simply assumes that people anticipate the future correctly. The difference with rational expectations is that we ignore uncertainty. Perfect foresight can be thought of as an exploration of what the world would be like if the future was in fact perfectly known. Of course, no one thinks that this is realistic but, as with rational expectations, if surprises are sometimes good and sometimes bad, perfect foresight is a reasonable starting point.

6.2.3 The Parable of Robinson Crusoe

This chapter sets up the intertemporal budget constraint facing households, firms, the government, and the nation as a whole. We return to Robinson Crusoe as our representative household, already familiar to us from Chapter 4. As we deal with the infinite future, it is convenient to collapse time into two periods, 'today' and 'tomorrow', where tomorrow is a metaphor for the future. And beyond tomorrow? Crusoe is rescued and will no longer need to concern himself with the economics of his island!

6.3 The Household's Intertemporal Budget Constraint

6.3.1 Consumption and Intertemporal Trade

Let's start by imagining that Crusoe's island does not even have coconut trees. Rather, the coconuts simply wash up on the beach. The number of coconuts that he (rationally) expects to have today and tomorrow is his exogenous **endowment**. This endowment includes both present and future resources. Using subscripts to denote the relevant period in which they become available, we can represent his endowment of Y_1 coconuts today and Y_2 coconuts tomorrow by point A in Figure 6.1.

Until Robinson learns how to plant coconuts, he has no choice but to consume what nature gives him. Since coconuts cannot be carried over to the next period, Crusoe's consumption is also given by point A. This is the **autarky** point. A household or a country operates in autarky when it does not trade and consumes its endowment.

If we bend the story a little and allow for neighbouring islands inhabited by other economic agents, trade is possible. Because Crusoe's coconuts are just as good as his neighbours', we might not expect to observe any trade between them. Yet Crusoe may well be interested in **intertemporal trade**, or exchanging resources across time. He might lend his neighbours some coconuts today, if he expects to find only a few tomorrow, or if he prefers to consume more tomorrow. On the contrary, if today's 'harvest' is abnormally low or if Crusoe is impatient, he could borrow coconuts now and repay later when times are better.

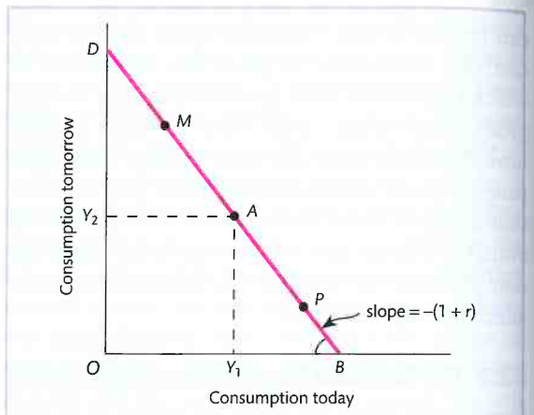

Fig. 6.1 Endowment, Wealth, and Consumption
Resources available today and tomorrow—the endowment—determine wealth and available consumption choices along the budget line *BD*. In the figure, the same level of wealth (*OB*) is attainable by a professional athlete (point *P*) or a university student (point *M*).

The rest of the chapter will explore borrowing and lending, and the role of financial markets will follow. As a way of moving away from autarky, borrowing and lending is just like selling or buying goods and services. In a way, it is like buying or selling the command over goods in the future. Yet banking and financial markets suffer from reputation problems, and the recent financial and credit crisis hasn't improved matters. Box 6.1 explores some of these reservations and possible reasons for them.

Box 6.1 Neither a Borrower nor a Lender Be: Economics and the Sociology of Credit

In a well-known scene from Shakespeare's *Hamlet*, Polonius gives his son Laertes some parting advice: 'Neither a borrower, nor a lender be: For loan oft loses both itself and friend, and borrowing dulls the edge of husbandry.' In other famous plays, such as *The Merchant of Venice*, Shakespeare gives lenders a pretty tough time. Is it morally wrong to borrow (or to lend)? And what is wrong with charging interest, if borrower and lender freely agree to it? Although the economic arguments against autarky are convincing, many important religions of the world—including Islam, Christianity, and Judaism—have banned lending at a positive interest rate at one time or another in their histories. Why the ambivalence?

Perhaps it is because lenders have an unconditional claim on the resources of individual borrowers in an inherently risky world. If the fortunes of a borrower go south, those of the lender do not—that is, unless the borrower declares bankruptcy. Perhaps it is because borrowers appear to be in a poor bargaining position, often seeking credit when all else has failed. Perhaps it is because individuals are frustrated when their bank won't give them the loan they think they deserve, because the credit officer deems them 'too risky', which they feel is insulting. And the market has ways of dealing with individual risks which are distasteful to many. One is charging higher interest rates, which appears opportunistic since 'risky' poor people pay more than the 'safer' rich. Stories abound in the USA and the UK of indebted families with credit card debt paying interest rates of 30% per annum and more. Then there is loan-sharking, illegal and possibly violent enforcement mechanisms, and 'payday loans', which amount to selling one's own wage packet in advance at effective annual interest rates sometimes in excess of 600%.

And yet, borrowing and lending is as natural as breathing. Even when lending at interest is prohibited, as in many Islamic countries today, the market always manages to find ways around the ban, for example by declaring loans to be 'equity stakes' which participate in profits and losses of the enterprise. In the end, the fundamental truth is that the market for loans exists because there are gains from trade: different degrees of patience, different wants, different opportunities, and different information.

6.3.2 The Real Interest Rate

Crusoe and his neighbours must agree on the terms of repayment: how much should he pay (or receive) tomorrow for one coconut borrowed (lent) today? This is what we call the **real interest rate** and denote by r. The real interest rate is taken by Crusoe as given or exogenous; it is 'real' because Crusoe and his neighbours do not use money. Borrowing 100 coconuts will require paying back $100(1 + r)$ tomorrow—the principal of 100 plus interest payments of $100r$. If the real interest rate is 3%, or 0.03, interest payments will be 3 coconuts. Another, equivalent way of thinking of this transaction is that Crusoe agrees to sell $100(1 + r)$ coconuts tomorrow for the price of 100 today. Similarly, if Crusoe takes the other role and lends 100 coconuts today, he will receive $100(1 + r)$ coconuts tomorrow; to buy $100(1 + r)$ coconuts tomorrow he must save 100 coconuts today. The relevant intertemporal trade involves swapping $1/(1 + r)$ coconuts today for each coconut tomorrow. We can say that a coconut tomorrow is worth $1/(1 + r)$ coconuts today.[3]

The price of tomorrow's consumption in terms of today's, $1/(1 + r)$, is called an **intertemporal price**. As the real interest rate r is positive, $1/(1 + r)$ is less than 1, which means that goods tomorrow are cheaper—or less valuable—than goods today. The real interest rate measures the cost of waiting. Valuing future goods in terms of goods today (here, dividing by the interest factor, 1 plus the real interest rate) is called **discounting**. Discounting is a very important concept in both economics and business. It helps explain the inverse relationship

[3] As a simplifying assumption, we have assumed that the interest rate is the same, whether one is borrowing or lending. The world is more complicated, but the logic is unchanged, when we consider different rates of interest for borrowers and lenders. Section 6.5 provides more details.

Box 6.2 Discounting and Bond Prices

Discounting is used in economics and finance to value future incomes or expenditures in terms of income today. It is frequently used to put a value on financial assets and liabilities (debts). It asks: what is the amount of money required today, given an interest rate, to generate some payment or payments in the future? By valuing a coconut tomorrow only as worth $1/(1+r)$ coconuts today, Robinson Crusoe has successfully applied discounting to a practical problem.

Let us consider a simple bond that pays €100 in one year's time. (This type of bond is called a *pure discount* bond.) If the interest rate given by the market is 5%, what is the value of this bond today? It is the amount that, if invested now, yields €100 next year. If that amount is B, then it must be true that $B(1 + 0.05) = 100$, so $B = 100/(1.05) = €97.24$. Similarly, the value of a two-year discount bond must be discounted twice, once for each year. From next year's viewpoint, the second-year €100 is worth 100/1.05. From this year's viewpoint, this is worth $[(100/1.05)]/1.05$ or $100/(1.05)^2 = €90.70$. The further into the future the payout is, the more heavily any amount is discounted, and the lower is the price of a discount bond. A n-year €100 discount bond is worth $100/(1+r)^n$ today.

More generally, given discount rate r, the present value of a stream of payments a_t over n years, $t = 1, \ldots, n$ has present value given by:

$$\frac{a_1}{1+r}+\frac{a_2}{(1+r)^2}+\frac{a_3}{(1+r)^3}+\ldots+\frac{a_n}{(1+r)^n}.$$

Now consider the case of a bond that promises to pay a fixed amount a forever, called a **consol**. Is it possible to put a price on that income stream, even though the payments are infinite? As long as the interest rate is strictly positive, the answer is yes! The price of a consol C which pays the constant amount a each period is simply the present discounted value of its payments $a_1=a_2=a_3=\ldots=a$:

$$C=\frac{a_1}{1+r}+\frac{a_2}{(1+r)^2}+\frac{a_3}{(1+r)^3}+\ldots+\frac{a_n}{(1+r)^n}\ldots$$

$$=\frac{a_1}{1+r}\left[1+\frac{1}{(1+r)}+\frac{1}{(1+r)^2}+\ldots\right]$$

$$=\frac{a_1}{1+r}\left[\frac{1}{1-\frac{1}{1+r}}\right]=\frac{a}{r},$$

where we have applied the well-known formula for a sum of a geometric series to the term in brackets. The price of a consol is inversely related to the interest rate. Other bonds have a finite maturity so the formula is more complicated, but the general principle survives that higher real interest rates imply lower bond prices.

between bond prices and interest rates, as well as the fact that surprising changes in market interest rates often move stock prices in the opposite direction. It explains why borrowers—including governments—love to postpone repayment of loans, and why lenders resist such attempts with vigour. Box 6.2 presents the important concept of discounting more generally.

Intertemporal trade allows Crusoe to choose combinations of consumption today and tomorrow which are different from his autarky point. These combinations are represented by the line BD in Figure 6.1. This line must go through his endowment point A, since he can always choose not to trade at all. At point B Crusoe would forego consumption tomorrow completely. In that case he would borrow fully against his future endowment Y_2, receive $Y_2/(1+r)$ coconuts, and consume $Y_1 + Y_2/(1+r)$ coconuts today. At point D he would fast today and lend all his current endowment Y_1 in order to consume $Y_1(1+r) + Y_2$ coconuts tomorrow. The line BD represents all the possibilities open to Crusoe, in between the extremes just described. It is called the **budget line**. The budget line is the simplest representation of the intertemporal budget constraint. Its slope[4] is given by $-(1+r)$. If the rate of interest increases, the budget line becomes steeper. For a given amount of saving today, more will be available tomorrow.

[4] The slope of the budget constraint is negative and is given by −1 times the ratio OD/OB. From the text we know that $OD/OB = [Y_1(1+r) + Y_2]/[Y_1 + Y_2/(1+r)] = 1 + r$.

6.3.3 Wealth and Present Discounted Values

If Crusoe's income 'from nature' in the first period is Y_1 and he consumes C_1 in the same period, his saving is $Y_1 - C_1$. If $Y_1 - C_1$ is positive, Crusoe is lending; if $Y_1 - C_1$ is negative, he is borrowing. In the second period, consumption C_2 will equal the sum of income Y_2 and $(1+r)(Y_1 - C_1)$, i.e. the interest and principal on his savings from period 1. If saving was negative in the first period, this means paying back principal plus interest. The budget line can be represented formally as:

$$C_2 = Y_2 + (Y_1 - C_1)(1+r). \tag{6.1}$$

This fully describes Crusoe's intertemporal budget constraint. Dividing both sides by $(1 + r)$ and rearranging:

$$C_1+\frac{C_2}{1+r} = Y_1+\frac{Y_2}{1+r} = \Omega. \tag{6.2}$$

present value of consumption = present value of income = total wealth

The left-hand side is the **present discounted value** of consumption. It is the sum of today's and tomorrow's consumption valued in terms of goods today. The right-hand side is equal to the present discounted value of income (his endowment). It is the maximum consumption that Crusoe could enjoy today, given his resources today and tomorrow, and is represented by point B in Figure 6.1. Put differently, OB is the present discounted value of Crusoe's total endowment. In fact, in this situation it represents his total wealth, which we denote by the symbol Ω.

Lending and borrowing enable individuals with the same total wealth but with very different income profiles to enjoy the same menu of possible consumption over both periods. It doesn't matter whether Crusoe is a university student with low current and high future income, as represented by point M in Figure 6.1, or a professional athlete with high current and low future income (point P). As long as these points are on the same budget constraint, the present discounted value of income is the same and intertemporal trade allows income to be shifted across time by borrowing and lending.

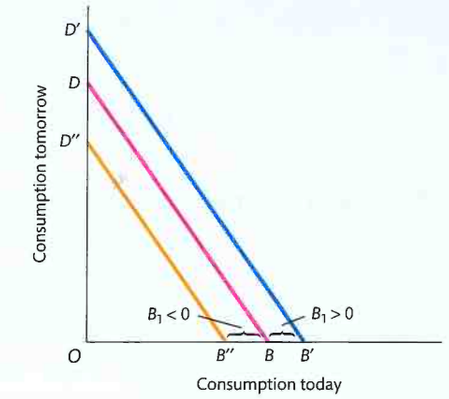

Fig. 6.2 Inheriting Wealth or Indebtedness
When wealth $B_1 > 0$ is inherited, the budget line shifts from BD to $B'D'$. Debt $B_1 < 0$ shifts the budget line to $B''D''$. The lines are parallel because the real interest rate is assumed unchanged.

Now suppose Crusoe had initial tradable wealth B_1 (an initial cache of coconuts). His wealth will increase by this amount and the budget constraint will be modified as follows:[5]

$$C_1+\frac{C_2}{1+r} = Y_1+\frac{Y_2}{1+r}+B_2 = \Omega. \tag{6.3}$$

present value of consumption = present value of income plus initial net assets = total wealth

If $B_1 > 0$, Crusoe can consume more in both periods. But B_1 could be negative, if Crusoe began his existence with debt. In that case, he will have to consume less (in present value terms) in order to repay the debt and interest. In general, total wealth Ω is the sum of inherited wealth or debt B_1 and the present value of income: $\Omega = Y_1 + \frac{Y_2}{1+r} + B_1$. This is shown in Figure 6.2, where the inherited wealth or debt is added to the present value of income. At a given real interest rate, it implies shifting the budget line BD to $B'D'$ (if wealth increases) or $B''D''$ (if it decreases).

[5] This is obtained by noting that today's available endowment is $Y_1 + B_1$ so that (6.2) is changed to $C_2 = Y_2 + (B_1 + Y_1 - C_1)(1+r)$.

6.4 The Firm and the Private Sector's Intertemporal Budget Constraint

6.4.1 Firms and the Investment Decision

Crusoe's income has been exogenous until now. In reality, income mostly comes from planned activities. As we saw in Chapter 3, production requires that resources are diverted from consumption and used to acquire productive capital. Crusoe could plant coconuts today which would grow into trees bearing coconuts tomorrow. Naturally, once planted, a coconut cannot be consumed: it is useful only for its future production. The use of valuable resources to produce more goods later is called **investment** or **fixed capital formation**. Many goods produced in modern economies are designed solely to make future production possible, and have no consumption value at all.

The notion of investment was already explored in Chapter 3 in the discussion of long-term economic growth. The investment decision also has a fundamentally intertemporal aspect. Firms decide to accumulate capital when it is sensible, i.e. profitable to do so, and profitability depends on expected future outcomes. In order to finance their investments, firms can either obtain resources in the capital market (stock exchanges, bond markets, or banks) or use their own funds (retained earnings). In Chapter 3, capital was accumulated as the result of available savings, which was assumed to be an exogenous fraction of national income. In this chapter and those which follow, we will begin to describe investment and savings as conscious choices of firms and households.

6.4.2 The Production Function

The investment decision depends upon the amount of output that can be produced with the available equipment (the number of coconuts to be obtained from a tree). The **production function** $F(K)$ captures this relationship between capital input and output and is depicted in Figure 6.3. It can be thought of as a special case of the production function of Chapter 3, in which labour input is fixed (Robinson's available time).[6] The shape of the curve implies that, as more capital is accumulated, the resulting additional or marginal output declines. That marginal output decreases when input increases is the same principle of **diminishing marginal productivity** that we encountered in Chapters 3 and 4.[7]

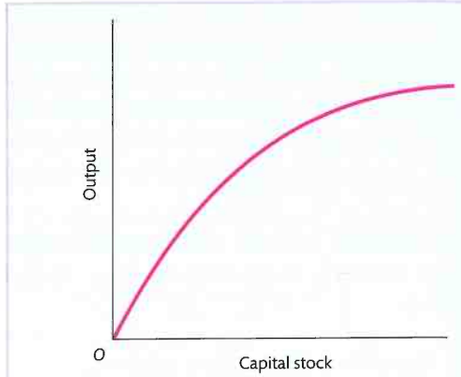

Fig. 6.3 The Production Function
As more input is added, output increases, but at a decreasing rate. This is the principle of declining marginal productivity.

6.4.3 The Cost of Investment

Starting with no capital stock (assuming no coconut trees on the island at the outset), today's investment represents the total stock of capital available for production tomorrow. (Box 6.3 considers the more realistic case when previously accumulated capital already exists.) Crusoe understands that he can either invest K in productive equipment, or save K. In the first case, he will receive output $F(K)$ tomorrow. In the second case, he will receive $(1+r)K$ tomorrow. The real interest rate measures the **opportunity cost** of the resources used in investment. Because of the option of lending at rate r, the investment in this case must yield at least $1+r$ to be worth undertaking.[8]

Figure 6.4 shows the opportunity cost of invested capital K as the ray OR from the origin, which is given by $(1+r)K$. As long as the resulting output exceeds the cost, the technology is sufficiently productive and investment is worthwhile. At point A, investment just covers its cost. There is no economic profit possible. To the right of A, investment uses up more resources than it produces. Positive economic profits occur only to the left of A.

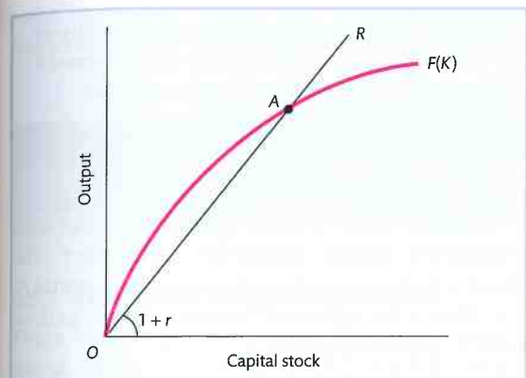

Fig. 6.4 Productive Technology
The cost of borrowing to finance investment is given by OR. As long as output exceeds the cost of borrowing, the technology is productive and the producer makes a profit. Beyond A, she makes losses.

The interest rate r is crucial for the valuation of investments. For example, if the rate of interest were to increase, the OR line would rotate counterclockwise, moving point A to the left and reducing the volume of investment that has any positive value at all. Put differently, a given stock of capital must be more productive to make up for higher borrowing costs. The principle of declining marginal productivity implies that only less capital in use will generate high enough marginal, and therefore average, productivity.

Another approach, that will prove useful later, is to ask what is the net return V from investing K—what Crusoe gets from planting K coconuts as an irrecoverable expense. The value of the investment project, or the value of Crusoe's enterprise, is simply the difference between the present value of output tomorrow and investment today:[9]

$$V = \frac{F(K)}{1+r} - K \,. \tag{6.4}$$

Note again that to compare goods available tomorrow with goods available today, we must price the former in terms of the latter, i.e. we discount the former by applying the intertemporal price $1/(1+r)$.

[6] If we set $L = 1$ and $Y = F(K, L)$ as in Chapter 3, then $Y = F(K, 1)$.

[7] The reason behind this principle is that, given the existing amount of labour (Crusoe's time) used to operate the equipment, adding additional equipment is less and less effective in raising output.

[8] Alternatively, Crusoe could *borrow* coconuts for investment purposes. The interest rate then is literally the cost of this debt-funded investment. This is discussed in the WebAppendix.

[9] We assume that the trees have no resale value; they simply die after the second period. If they didn't, it would be necessary to add back the resale value of the depreciated trees in the second period, which would increase the value of firm. This modification is described in detail in Chapter 8.

Box 6.3 Gross Investment, Depreciation, and the Capital Stock

When previously accumulated capital already exists in the amount K_1, the situation in the next period is more complicated. The stock of capital may differ in the future from the previously accumulated stock in two ways. First, new capital I_1 may be invested. Second, depreciation—wear, tear, and obsolescence—may remove some of the value of the old capital stock. It is a proportion δ of the capital stock. The new capital stock is:

$$\underset{\text{capital stock tomorrow}}{K_2} = \underset{\text{capital stock today}}{K_1} + \underset{\text{gross investment today}}{I_1} - \underset{\text{depreciation today}}{\delta K_1}.$$

The realized change in the productive capital stock, $\Delta K = K_2 - K_1$, is therefore equal to $I_1 - \delta K_1$, the difference between gross investment and depreciation of previously accumulated capital. For the capital stock to grow, new investment spending must exceed depreciation.

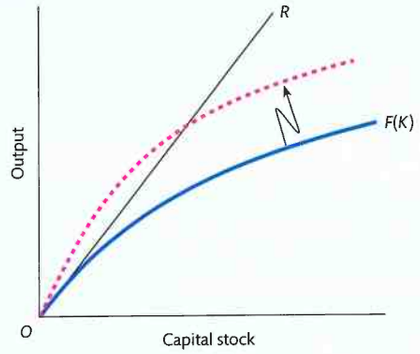

Fig. 6.5 Unproductive Technology
Given the interest rate, no firm will operate with the production function shown in the figure. A technological innovation which shifts the production function upwards can make an unproductive technology productive again.

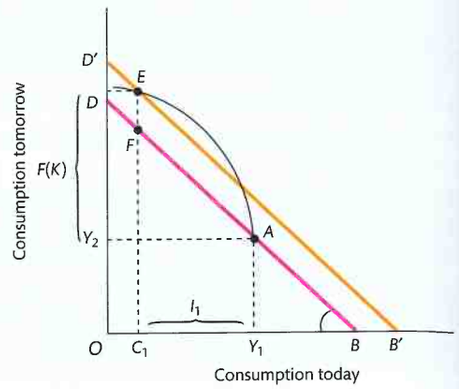

Fig. 6.6 Investment Increases Wealth
Investing I_1 in a productive technology (which becomes K_2 in period 2) allows a household to increase its wealth over and above that corresponding to the initial endowment A. Here wealth increases by BB' as FE additional goods become available in the second period.

An investment project is economically justifiable only if it has a positive present value. In terms of (6.4), that means $V > 0$ or if $F(K) > K(1 + r)$. Figure 6.5 illustrates a case when the technology is not productive enough given the real interest rate. In that case it does not pay to invest anything at all: it is more profitable simply to lend at the rate r. It would require either an improvement in technology (the production function schedule shifts upwards as in Figure 6.5) or a decline in the interest rate (the ray OR rotates downwards) for some investment to be worthwhile.

6.4.4 The Intertemporal Budget Constraint of the Consolidated Private Sector

The budget constraint of Section 6.3 took endowments as given by nature as on Crusoe's island. Once investment and production are taken into account, income tomorrow is no longer simply given by nature. The budget constraint now depends on the amount that is invested and on its profitability. As long as the investment project has positive present value, investment increases wealth. Figure 6.6 shows how this happens. Starting from point A, Crusoe can save either by lending, or by investing an amount I_1 up to a maximum of his endowment Y_1. In the latter case, Crusoe's savings are equal to investment, which is equal to the capital stock for tomorrow's output production (remember: the island is barren upon his arrival, so initial capital $K_1 = 0$). This is the difference between today's endowment Y_1 and consumption C_1:

$$K_2 = I_1 = Y_1 - C_1 \tag{6.5}$$

The more he invests—the more we move to the left in Figure 6.6—the larger will be tomorrow's production. This is why the production function AE is now the mirror image of the one shown in Figure 6.4: as consumption declines and saving rises, we move leftwards from the endowment point A, investment increases and tomorrow's output becomes larger. Tomorrow's income—and consumption as it is the last period—is the sum of the endowment Y_2 (the coconuts lying on the beach) and produced output $F(K_2)$:

$$C_2 = Y_2 + F(K_2) \tag{6.6}$$

The intertemporal budget constraint determines the present value of consumption $C_1 + C_2/(1 + r)$ as equal to total wealth Ω. Recognizing that $C_1 = Y_1 - I_1$ is given by (6.5) and C_2 given by (6.6), the intertemporal budget constraint can be rewritten as:

$$C_1 + \frac{C_2}{1+r} = \Omega = \left[Y_1 + \frac{Y_2}{1+r}\right] + V. \tag{6.7}$$

present value of consumption | total wealth | wealth from endowment | value of the firm

Wealth now consists of two parts.[10] The first part is the present discounted value of the endowment as before in (6.2). The second part is the increase in wealth represented by V, the net value of the investment activity, as in (6.4). In Figure 6.6 the outcome of investment I_1 is shown as point E. Note that E lies above the initial budget line. This is because the production technology is productive at the rate of interest r. The distance OB still represents the present value of the endowment. But now, for a choice of investment I_1 that brings Crusoe to point E, new total wealth is the distance OB'. Since the value of future output is discounted at the same rate r, the new budget line is parallel to BD. The distance BB' represents the net present value of the investment project.[11]

In the parable, Crusoe stands for the private sector as a whole, which consists of individuals and the firms they own. Firms ultimately belong to their shareholders, and the net return from investment raises their wealth. If shareholders anticipate that a firm will become more profitable in the future—because of a technological advance, as represented by the shift in Figure 6.5—then net expected returns rise and they are richer. This wealth gain takes the form of an increase in the value of the firm. In the real world, this would be reflected as an increase in the firm's value in the stock market.[12]

6.5 Public and Private Budget Constraints

6.5.1 The Public Budget Constraint

There was no government on Robinson Crusoe's island. In the real world, there is a public sector, which collects taxes, purchases goods and services, and makes transfers to households. Yet the government is little different from other economic agents. It can borrow, but is expected to repay its debt with interest; if it lends it will expect to be repaid by its debtors. Consider a government, which spends G_1 today and G_2 tomorrow, and raises net taxes T_1 and T_2.[13] The government also has inherited debt D_1 from the past. D_1 already incorporates interest from the past so the government can either pay it off in its entirety, or 'roll it over' into the next period. In latter case, debt incurred must be serviced (interest must be paid) at interest rate r_G, and it is carried forward into the next period. This means that the debt resulting in period 2 from period 1's government activities is:

$$D_2 = (1 + r_G)(D_1 + G_1 - T_1). \tag{6.8}$$

If the government is solvent, all debt at the *end* of period 2 must be paid off in its entirety, i.e. equal to zero, so the government in the second period must

[10] To see this, write wealth as the present discounted value of net income and rearrange using $V = \frac{F(K_2)}{1+r} - I_1$, yielding $\Omega = \left[Y_1 + \frac{Y_2}{1+r}\right] + \left[\frac{F(K_2)}{1+r} - I_1\right] = \left[Y_1 + \frac{Y_2}{1+r}\right] + V$.

[11] A subtle, but important point: This valuation of the firm is independent of whether Crusoe finances the investment himself out of savings (or 'retained earnings' in the language of business) or whether he *borrows* funds to finance it (and discounts the project returns using the same interest rate). In this benchmark case, it doesn't matter. This result is known as the Modigliani-Miller Theorem, and is discussed in the WebAppendix to this chapter.

[12] Because the production function still lies above the new budget line BD', total wealth could be further increased by investing a little bit *less* than I_1. Chapter 8 shows that, when Crusoe strives to do the best he can—behaves optimally—he will invest to push out his new budget line as far as possible, i.e. he maximizes the value of his total wealth.

[13] G denotes government purchases of goods and services. It is not the same as total government spending or outlays, which include transfer payments. In our notation, transfer payments are deducted from taxes, resulting in net taxes T. Although interest payments are treated like transfers in the national income and product accounts, they are such a central component of the intertemporal budget constraint that we will always distinguish them from other transfers throughout this book.

obey $(1 + r_G)(D_2 + G_2 - T_2) = 0$. Combining this with equation (6.8), we find that:

$$D_1 = T_1 - G_1 + \frac{T_2 - G_2}{1 + r_G}. \quad (6.9)$$

A solvent government is one in which initial debt ($D1$) is financed by present value of current and future **primary budget surpluses**, denoted by $T_1 - G_1$ and $T_2 - G_2$. The primary surplus is defined as the government budget balance (the difference between receipts and expenditures) from which interest receipts or payments have been removed. A government which is borrowing has a deficit, or a negative surplus. Thus, the total borrowing requirement of a government ('headline deficit') is the sum of (1) the **primary deficit**, the amount by which non-interest-related expenditures exceed revenues, and (2) interest payments and debt repayment. The distinction between primary and 'headline' deficits is used frequently when reporting the budget of highly indebted governments. For example, the IMF reports that in 2015, Italy had an overall budget surplus of –€43 bn euros (a deficit) or about 2.6% of GDP, but at the same time showed a primary *surplus* of €22.7 bn, or about 1.4% of GDP.[14]

The lesson of the two-period government of Robinson Crusoe is a central one: in the second and last period, the government must repay its obligations in full. Equation (6.9) means that tomorrow's primary surplus ($T_2 - G_2$) must be sufficient to repay today's deficit ($G_1 - T_1$) plus initial debt burden D_1, plus the interest service on the borrowing:

$$T_2 - G_2 = (1 + r_G)(D_1 + G_1 - T_1).$$

A government with obligations tomorrow in some combination of indebtedness today ($D_1 > 0$) or deficits today ($G_2 > T_2$) will have to run surpluses tomorrow to repay them. This is the government's budget constraint, which can be rearranged as:

$$D_1 = \left[T_1 + \frac{T_2}{1 + r_G}\right] - \left[G_1 + \frac{G_2}{1 + r_G}\right]. \quad (6.10)$$

[14] *Source:* World Economic Outlook database. As a further example, consider Robinson Crusoe's government in the first period. The stock of debt to begin with is D_1, the primary surplus is $T_1 - G_1$ while interest 'income' is $-r_G(D_1 + G_1 - T_1)$. The headline *deficit* in the first period is therefore the surplus multiplied by –1, or $G_1 - T_1 + r_G(D_1 + G_1 - T_1)$.

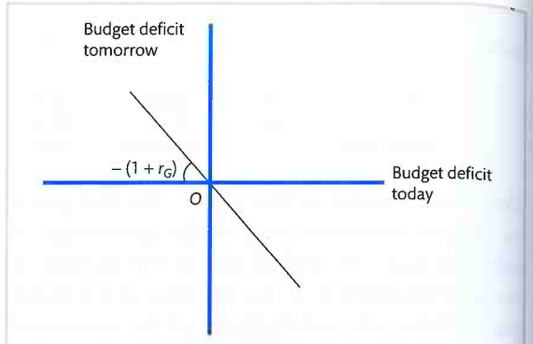

Fig. 6.7 The Government Budget Line
A deficit today must be matched by a budget surplus tomorrow, or vice versa, if the government is to obey its intertemporal budget constraint.

For the government to obey its intertemporal budget constraint, the sum of the present value of primary budget surpluses is equal to initial outstanding debt. This also means that the present value of government income must be sufficient to cover the present value of purchases plus the initial debt. The government budget constraint is illustrated in Figure 6.7 for the case of no initial debt or assets ($D_1 = 0$). The budget line has slope $-(1 + r_G)$ and passes through the origin.

The two-period parable contains a strong message: governments with debt and deficits *today* must run primary surpluses *tomorrow*; similarly, governments with a comfortable fiscal position today can relax (a little) in the future. Yet do governments really obey their budget constraints? The European debt crisis—Box 6.4 discusses its origins—may give some reason to doubt it. In fact, governments throughout history have been faced with budget problems, sometimes resulting in spectacular defaults, or repudiation of past debts. Yet an error commonly made by politicians and the general public is to look only at the current year's deficit as a measure of the government's solvency. Especially when the economy is growing robustly, tax revenues can be expected to grow over time as well, thus easing some of the burden.[15] For that

[15] The implications of economic growth for government budget constraints and stabilization policy will be explored in detail in Chapter 17.

reason, it is always a good idea to measure expenditures and tax revenues relative to GDP. Still, in order to avoid defaults, today's primary deficits require primary surpluses later, and conversely. Given spending plans, lower taxes today are followed by higher taxes tomorrow. Alternatively, for a given path of taxes, more spending today requires spending cuts tomorrow. How long does 'today' last before a government is hit 'tomorrow' by the budget constraint?

Figure 6.8 shows that governments do generally obey their budget constraints. It shows the evolution of primary budget balances for four countries over time, relative to the size of the economy measured by the GDP. Some countries (the UK) show a succession of primary deficits and surpluses. In other cases (Ireland, Italy, the USA) deficits have been sustained over many years, yet eventually the primary budgets were corrected, sometimes moving into spectacular surpluses. The financial crisis of 2007–2008 has led to sudden relapses in Ireland, the UK, and the US. The case of Ireland is unusual (note that the scale is not the same for all four countries). In 2010, the government had to scramble to save its collapsing banks. With a deficit of some 30% of GDP, the Irish government itself went into crisis and had to be bailed out by the other Eurozone countries with assistance from the International Monetary Fund. Italy, on the other hand, managed to keep its budget roughly balanced. Yet it went into near-crisis when markets took a dim view of several decades of large deficit

Box 6.4 The European Debt Crisis

Many people were surprised by the sudden panic in the market for Greek government debt in the spring of 2010, especially as it seemed to spread to other Eurozone countries. Several years later, a number of countries are still running deficits. Even though these deficits are generally smaller, there are lingering doubts that some countries will be economically or politically able to meet their budget constraints. It is often considered that a sovereign default is inconceivable, yet history is littered with government defaults, frequently accompanied by sharp political upheavals; examples include the turbulent years of the French Revolution, the October 1917 revolution in Russia, the end of the Weimar Republic in 1933, and Castro's revolution in Cuba.[16] In most cases, however, defaults are just the end of a long period of debt accumulation, reflecting a long string of budget deficits which don't seem to demonstrate any budget constraint at all. This was true of much of Latin America in the 1980s, Russia in 1998, Argentina in 2001, and Iceland in 2008.

The history of government finance shows that default is a subjective concept.[17] Technically, it occurs when the borrower country has failed to service its debt, meaning that it has missed a payment due—even by a day! Yet financial markets, which finance most of the deficits, can be enormously patient or excessively optimistic. It is always possible to arrange a short-term 'bridge' loan, even on short notice, for a few years' time, if there is a high chance that the loan will be repaid. This is precisely what happened with Greece in July 2015.

In the end, it is not really possible to know with certainty whether a government is meeting its budget constraint at any point in time. In reality, the intertemporal borrowing constraint features public spending and tax revenue streams that extend into the infinite future. If there are lenders out there with strong nerves and enough patience, current deficits associated with a temporary decline in tax revenues in a recession can be overlooked. This is why the current situation—which will be examined in more detail throughout the rest of the book—is so disturbing.

[16] The public debt should be distinguished from the external debt, although in some instances the public debt is held by foreigners and represents the bulk of the external debt. This chapter assumes that the public debt is held by domestic residents.

[17] We will have much more to say about this in Chapter 17, which looks more carefully at government deficits, debt, and the role of the central bank.

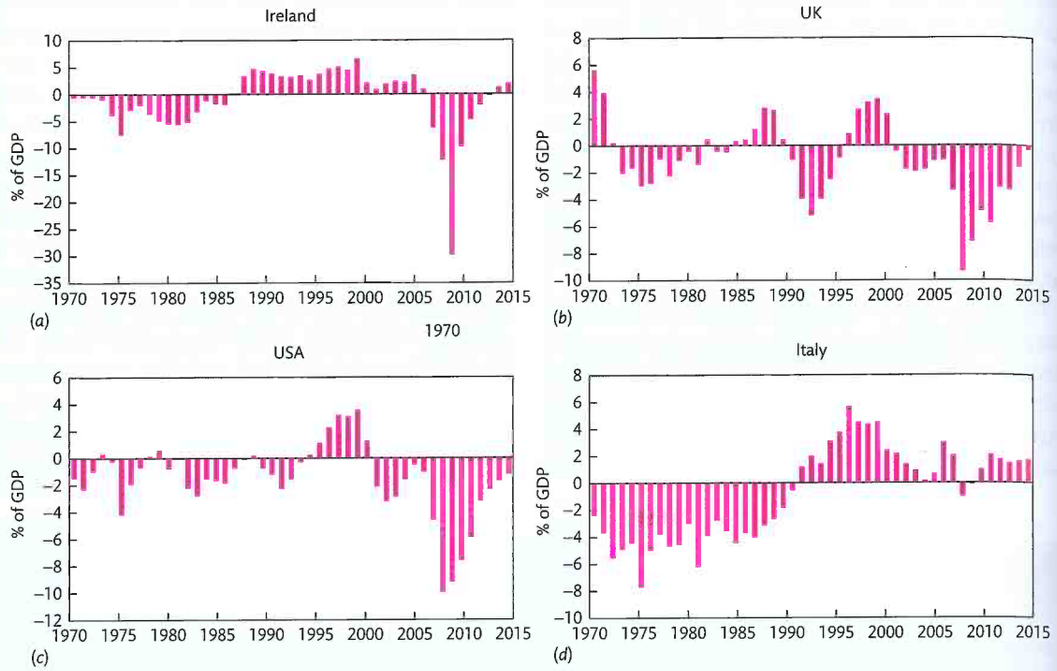

Fig. 6.8 Primary Consolidated Government Budget Surpluses, Four Countries, 1970–2015

Over time, primary budget balances must add up, in present-value terms, to initial public debt. Some governments, like the UK, have maintained primary budget balances on average over many years. Those that have allowed deficits to cumulate into large indebtedness will eventually have to run surpluses, as has been the case in Ireland, Italy, and the USA.

Source: Economic Outlook, OECD.

and smaller surpluses that left a legacy of a public debt of some 110% of GDP. These examples show how sudden unexpected spending needs or long strings of insufficient surpluses can stretch the intertemporal budget constraint to its limits.

6.5.2 The Consolidated Public and Private Budget Constraint

Both households and firms—which are owned by households—ultimately have to pay the taxes. They cannot ignore the public sector budget constraint. Much as they must include the budget constraints of the firms that they own, households must also see through the public sector financing veil. In this section we follow this logic and integrate the private and public budget constraints to face intriguing and important consequences.

For simplicity, we ignore the existence of firms and set initial government debt to zero. The private and public intertemporal constraints are side-by-side as follows:

$$\text{(6.11)} \qquad C_1 + \frac{C_2}{1+r} = Y_1 - T_1 + \frac{Y_2 - T_2}{1+r}$$

$$\text{(6.12)} \qquad G_1 + \frac{G_2}{1+r_G} = T_1 + \frac{T_2}{1+r_G}.$$

In the first budget constraint, the private citizens pay the taxes, which reduces disposable income as defined in Chapter 2, while in the second, the government receives them. Note that we do not assume that the government and the private sector face the same interest rates when they borrow and lend. Traditionally, the private sector is considered as less safe than the public sector (but a crisis may be changing this presumption). The government sector borrows and lends at rate r_G, while the private sector borrows and lends at rate $r > r_G$. Combining the private and public budget constraints yields the consolidated budget constraint.[18]

$$\text{(6.13)} \qquad \underbrace{C_1 + \frac{C_2}{1+r}}_{\text{present value of consumption}} = \underbrace{(Y_1 - G_1) + \frac{Y_2 - G_2}{1+r}}_{\text{present value of private resources net of government spending}} + \underbrace{\left[\frac{r - r_G}{1+r}\right](G_1 - T_1)}_{\text{present value of the government's financing advantage}} = \Omega$$

A comparison of the consolidated budget constraint (6.13) with the private constraint (6.11) shows that both link private consumption to private wealth—remember that to simplify, we ignored inherited debts or assets. Before consolidation, private wealth is the present value of disposable incomes (net of taxes) over both periods. Equation (6.12) shows that after consolidation, private wealth includes two parts. First, the present value of incomes net of public spending, not taxes. This means that households can only consume the output that the government has not taken for itself. As long as the government respects its budget constraint, its spending will be paid for by taxes, now or in the future, and it does not seem to matter when!

Yet it does matter. The second part of private wealth reflects the difference between the interest rates at which the government and the private sector can borrow. If, as is normally the case, the government can borrow more cheaply than the private sector, $r > r_G$, this part is positive: the more the government borrows, the better off the private sector is. In order to understand this surprising result, consider the case when the government reduces taxes today and raises them tomorrow to meet its budget constraint. This means that it will have to borrow today at rate r_G and pay back tomorrow. The private sector will pay less taxes today but more tomorrow; it makes sense for the private sector to save the corresponding amount, at interest rate r. The private sector benefits from this operation because it earns r on its saving and will have to pay more taxes to cover the public borrowing at the lower interest rate r_G. In effect, the government borrows on behalf of the private sector, allowing the private sector to save at a higher rate than it borrows indirectly. Of course, it is also true that if the government borrows on *worse* terms than its citizens, that is when $r < r_G$, it can *reduce* net wealth of its citizens.

6.5.3 The Ricardian Equivalence Proposition

The story gets even more interesting. Suppose for the moment, that the interest rates of the private sector and the government are exactly equal, so $r = r_G$. In that case, the consolidated budget constraint (6.13) collapses to:

$$\text{(6.14)} \qquad C_1 + \frac{C_2}{1+r} = (Y_1 - G_1) + \frac{Y_2 - G_2}{1+r}.$$

This looks very much like the private sector budget constraint (6.11), except that now taxes do not appear, so that it does not matter at all when taxes are levied as long as the government abides by its budget constraint. Once the government has 'helped itself' to G_1 and G_2 of output, the private sector will take the rest whenever it wishes in the form of C_1 and C_2, borrowing or lending as needed. In fact, the private sector has fully internalized the public sector's budget constraint. The hypothesis that the private sector fully internalizes the public sector's budget constraint is known as the **Ricardian equivalence proposition**.[19] In Figure 6.9, point A represents Crusoe's endowment measured before taxes. Once public spending is taken into account as in (6.13), the private endowment is represented by point A'. The government reduces Crusoe's private wealth by an amount represented by the dis-

[18] To derive this result, multiply both sides of (6.12) by $(1+r_G)/(1+r)$, and rewrite as

$$G_1 + \frac{G_2}{1+r} + \frac{r_G - r}{1+r}G_1 = T_1 + \frac{T_2}{1+r} + \frac{r_G - r}{1+r}T_1, \text{ or}$$

$$T_1 + \frac{T_2}{1+r} = G_1 + \frac{G_2}{1+r} + \frac{r_G - r}{1+r}(G_1 - T_1)$$ Substitution of this last expression into (6.11) yields (6.13).

[19] Named after English economist David Ricardo (1772–1823), who first formulated this idea, only to dismiss it as unlikely. The idea has been revived and championed by Harvard economist Robert Barro.

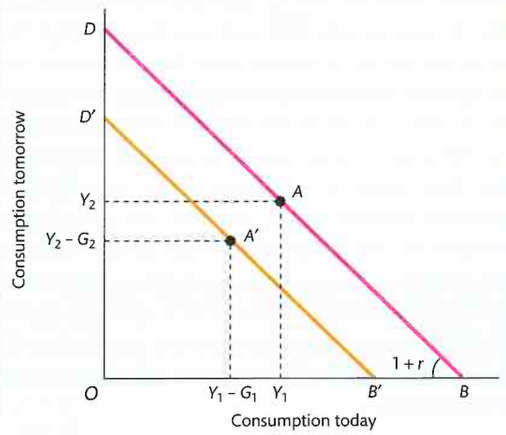

Fig. 6.9 Ricardian Equivalence

The government's spending and taxing activities reduce private wealth. Given government purchases, the precise scheduling of taxes does not matter.

tance BB', which is either the present value of taxes or the present value of public spending—the two are equal because of the government budget constraint. As long as the public and private sectors borrow and lend at the same rate ($r = r_G$), these intertemporal shifts are equivalent and the public borrowing can be matched one for one by private saving along the same private budget line.

The Ricardian equivalence proposition can be stated in a number of different ways. The first is that total national spending—the sum of private and public spending on goods and services—cannot exceed the country's wealth. The country can borrow or lend abroad, but it must respect its (national) budget constraint.[20] The second is that private sector wealth—which can be spent on private consumption—is the difference between the present value of production or income on the one hand and public purchases of goods and services on the other. The implication is that the pattern of taxation over time has no effect on private wealth. What matters in the end is public spending, which represents resources taken away from the private sector. Finally, Ricardian equivalence means that its citizens do not treat government debt as net wealth. Government's indebtedness does not appear as part of private wealth on the right-hand side of (6.14). The private sector sees through the veil of government. It recognizes that the government's promises to pay the principal and interest on public debt are matched by taxes levied to service the debt, today or tomorrow. Public bonds are an asset to households, which is exactly offset by the present value of their future tax liabilities.

6.5.4 When Ricardian Equivalence Fails

For obvious reasons, the Ricardian equivalence result is highly controversial. It means that the path of taxes is irrelevant for the behaviour of the private sector. It implies that public borrowing and the resulting stock of government debt do not, on net, contribute to the wealth position of households. Holding constant the path of government purchases of goods and services, budget deficits do not matter! This controversial Ricardian equivalence result requires a number of assumptions, and this section reviews them critically. In the end, the result of this discussion is that budget deficits probably do matter, and that at least some fraction of public debt is regarded by the private sector as wealth.[21]

Different interest rates

A central assumption behind the Ricardian equivalence result is that the government and the private sector face the same interest rate. Is that realistic? It has long been taken for granted that, in any country, governments borrow at the lowest interest rate. The reasoning is that the government is considered a less risky borrower than most private businesses or individuals because governments can always tax to pay back their debts while private agents may find themselves unable to reimburse some loans. In the developed countries, the difference between the rates at which a government

[20] This can be readily shown by rewriting (6.13) as

$$(C_1 + G_1) + \frac{C_2 + G_2}{1+r} = Y_1 + \frac{Y_2}{1+r}$$

[21] Other potential failures of the Ricardian equivalence proposition are related to the behaviour of agents under uncertainty, and go beyond the scope of this book.

Table 6.1 Interest Rates for Government and Corporate Bonds, 29 February 2016 (% per annum)

	10-Year Government Bond	10-Year Corporate Bonds	
		A-rated	BBB-rated
United Kingdom	1.32	3.46	4.25
United States	1.74	3.57	4.74
Euro Area	1.05	1.67	2.66

Source: Macrobond.

borrows and those that apply to firms in good standing has traditionally been some 1–2% more for businesses, and much more for households. Table 6.1 shows that this still holds for the UK, US, and the Eurozone as a whole, but it is definitely not the case for individual countries.

This was a nearly universal observation before the crisis hit the Eurozone. Figure 6.10 shows that when the crisis started to unfold in 2009, the Italian government borrowing privilege gradually began to erode. By late 2010, Italian firms with solid credit ratings were paying interest rates on debt that were considerably lower than those paid by the government. While government and private interest rates are taken as given for the purposes of the analysis, they are in fact endogenous and depend on a number of factors. Box 6.4 already hinted that the reason for increases in government interest rates could be a perceived increased risk of default. Chapters 7 and 17 will make this case more clearly. In any case, when $r_G > r$ the government should be wary of running deficits, since according to the logic of the budget constraint, they are hurting, not helping their citizens; in this case deficits reduce, rather than increase, their net wealth!

Mortal or new citizens

Another objection is that Ricardian equivalence must fail because citizens are not all alike when they face the taxman: some pay a lot more taxes than others. So the burden of public debt service is

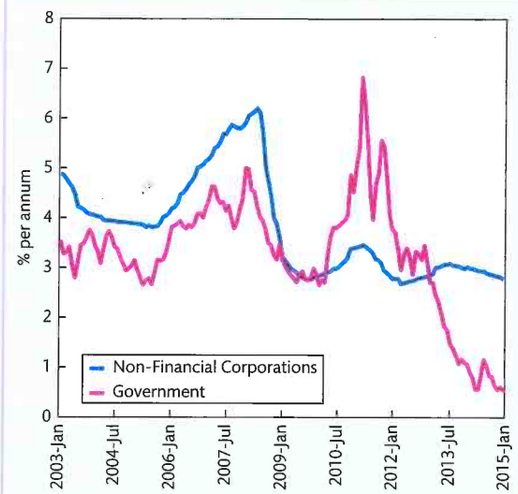

Fig. 6.10 Public and Private Borrowing Rates in Italy, 2003:1–2016:1

The interest rates refer to 5-year maturity loans to non-financial corporations and to the government in Italy. Normally, the private sector borrows at a higher rate than the sovereign. The reversal, which lasted from September 2010 to November 2013, was a potent signal that Italy was in the midst of a public debt crisis.

Source: ECB.

not equally borne by all citizens. Similarly, some hold government debt, and some don't. Yet, this does not imply that the aggregate household sector can escape the implications of equations (6.12) and (6.14). In the *aggregate* some pay more than average, others pay less and, as a first approximation, it does not matter.[22]

On the other hand, citizens are certainly mortal. If they are not alive in period 2, they have little reason to care about the implication of the intertemporal budget constraint of the government. Of course, no one knows whether they will be alive next period but there is always a possibility, unfortunately, that the answer will be negative. Collectively, the private sector currently alive may

[22] It is true that poor people do not save and spend all of their income, while rich people only spend a fraction of what they earn. Taking from the rich to give to the poor does raise spending. Yet, the effect is typically very small, hence the 'first approximation' conclusion.

factor in only a fraction of *all* future tax liabilities. In that case, government debt represents private wealth as we realize that we will not be alive next period and therefore we will not pay taxes to cover the public debt. To those who will not be alive, holding the current debt represents wealth. In a similar vein, new agents—immigrants, perhaps—who enter at some future date will pay taxes to reimburse the public debt issued before they arrived. This too breaks the link between the budget constraint of the presently living generations and future government revenues.

Restrictions on borrowing

Many households cannot borrow as much as future expected income would justify; sometimes they cannot borrow at all. They may be unable to convince lenders—typically banks—of their creditworthiness. For their part, lenders only possess incomplete information on the creditworthiness of borrowers when they apply for credit. In addition, future incomes are never really certain, so lending to households is risky. Borrowing rates exceed lending rates to compensate for this risk.[23] In the worst case, no lending is extended and individuals are said to be credit rationed. The case of credit rationing is represented in Figure 6.11. With a net private endowment represented by point A, the agent can only move along her budget line on the segment AD. The segment AB is not attainable through private borrowing. This means that the consolidated budget constraint—and Ricardian equivalence—is irrelevant for that agent. For instance, consider the case where the government runs a deficit today, so that $T_1 < G_1$, borrowing at rate r_G which we assume equal to r for simplicity. The agent may now reach point A' and could consume $Y_1 - T_1$, which is larger than $Y_1 - G_1$. She benefits when the government does the borrowing that she cannot do.

Most often, individuals face higher and rising costs of borrowing. Lending institutions frequently demand higher interest rates from individuals to compensate for additional risk. The situation is similar to the case studied in the previous section and is also illustrated in Figure 6.11. When lending, the constrained agent can move along AD, but for borrowing she moves along AB'. The budget line is now kinked at the endowment point. In this case, public debt contributes to citizens' wealth, and the time profile of taxes affects the private sector budget constraint. At point A' the constrained citizen is better off than at any point along AB'. Once again, when the government borrows on behalf of its citizens, it increases the wealth of those who cannot borrow on those terms.

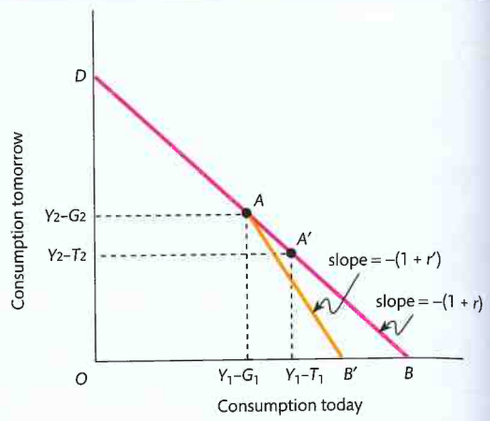

Fig. 6.11 Borrowing Constraints

When the household cannot borrow at all, its budget line is restricted to the segment AD, because it cannot consume today more than what is left of the endowment after public spending ($Y_1 - G_1$). If the government reduces taxes and borrows instead (here, from abroad), the household's borrowing line extends to the segment $A'D$. When borrowing constraints take the form of a higher private bor-rowing rate r', the budget line is the kinked line $B'AD$. A budget deficit at A' at a lower interest rate $r = r_G$ relaxes the private household's budget constraint.

Distortionary taxation and unemployed resources

There are many other reasons why the Ricardian equivalence can fail. An important one is that taxes are distortionary in the sense that they alter people's behaviour. For example, taxation on labour income reduces take-home pay, which may lead some to work less, as explained in Chapter 4. This will reduce output. This is not the case in the parable of Crusoe, because the supply of coconuts is exogenous but, in the real world, output is endogenous and affected by taxes. Another important argument against the Ricardian equivalence is the presence of unemployment. Changes in taxes or public spending may affect the level of economic activity in ways that are explained in Chapter 8 and later chapters.

Evidence

Given the long list of qualifications, it would seem quite unlikely that Ricardian equivalence could ever hold in practice. Yet, it receives some empirical backing, especially when the public budget moves by large amounts that are clearly perceptible to the private sector, possibly signalling important policy shifts. One piece of evidence that partly supports the Ricardian equivalence is presented in Figure 6.12, which considers the case of the United Kingdom. The figure shows that changes in the UK's government primary budget balance are partly mirrored by household savings: when the government borrows more, that is when it runs a bigger deficit or smaller surplus, households save more as if they were putting at least some money aside to face future tax liabilities. More formal studies, using advanced statistical techniques, indeed suggest that households save about half of tax cuts. Ricardian equivalence is thus '50% true'—this is an oversimplification, of course, but worth keeping in mind.

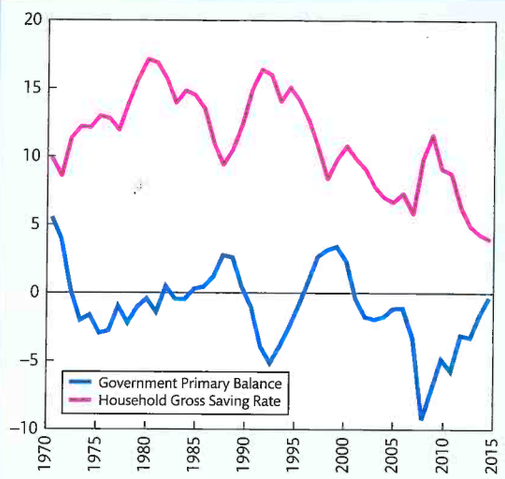

Fig. 6.12 Ricardian Equivalence in the UK, 1970–2016

The figure plots the primary budget balance of the British government (in per cent of GDP) and the household saving rate, the proportion (in per cent) of disposable income that is saved. Remarkably, the two curves tend to move systematically in opposite directions, although not always and not exactly. This suggests that at least some part of the spending of British households behaves in a Ricardian fashion.
Source: *Economic Outlook*, OECD.

6.6 The Current Account and the Budget Constraint of the Nation

6.6.1 The Primary Current Account

The consolidated budget constraint of the private and public sectors can be thought of as the intertemporal budget constraint of the nation as a whole. In Chapter 2 we saw that national net saving vis-à-vis the rest of the world occurs through the current account. Like the public sector budget surplus, the current account can be decomposed into the **primary current account** and net investment income, which is the part of income account that represents the net investment income (interest service) on foreign assets and liabilities:

$$\text{(6.15)}\quad \underset{\text{surplus } (CA)}{\text{current account}} = \underset{(PCA)}{\text{primary current account surplus}} + \text{net investment income (rF)},$$

where F stands for the country's net asset position (sometimes called net investment position) vis-à-vis the rest of the world, and r, as before, is the real interest rate paid on F. Net investment income is positive when the country holds more assets than liabilities ($F > 0$), or negative in the case of an indebted country ($F < 0$).[24] Translated into the two-period framework, the budget constraint of the nation requires that the present value of a country's

[23] More details on the rates of return paid on risky assets are provided in Chapter 7.

[24] In Chapter 2, it was noted that when writing (2.8) as income less absorption ($Y - A = CA$) then the proper measure of income is GNDI. If we ignore the difference between rF and the international income account balance, equation (6.15) shows that if Y is GDP, we have $Y - A = PCA$.

Box 6.5 Global Imbalances

Figure 6.13 show estimates of net foreign asset positions—what we have called F_1—for selected countries, expressed as the percentage of each country's GDP. At one end of the spectrum, countries like Switzerland, Japan, or the Netherlands could in theory run current account deficits for years and still not violate their budget constraints; in fact, these countries are still running surpluses and further accumulating net foreign assets. At the other end of the spectrum, countries like Greece, Portugal, Ireland, and Spain must eventually start paying back their debts, and yet they are still running current account deficits.

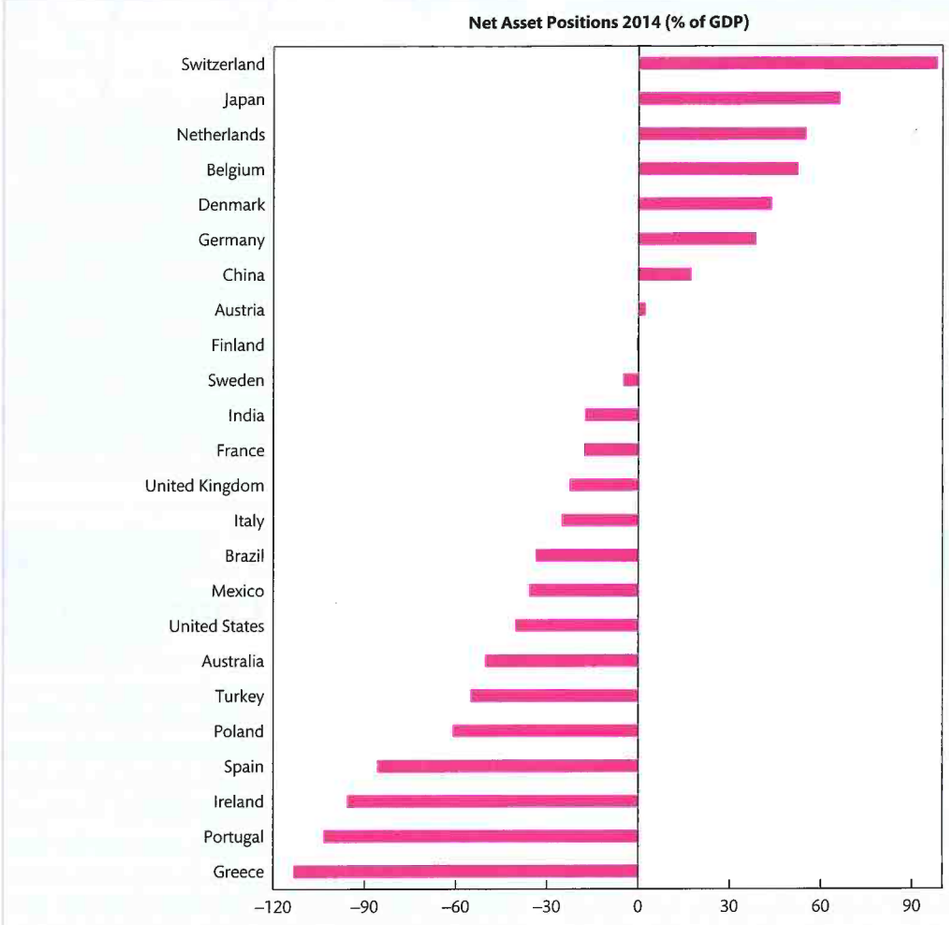

Fig. 6.13 Net Asset Positions, 2014 (% of GDP)

The figure displays the difference between what residents (households, firms, and government) own abroad and what they owe to the rest of the world. This includes not only loans to foreign countries less borrowing from abroad, but also ownership of financial assets, foreign exchange reserves, com-panies, production facilities, and buildings. The net position is measured in relation to each country's GDP.

Source: *World Economic Outlook*, IMF.

Box 6.6 Pyramids: Is it Possible to Beat the Budget Constraint?

Failure to understand the budget constraint can be costly for ordinary citizens and governments alike. The view that debts must be repaid is frequently lost on investors in 'pyramids'. Pyramids are dubious investments which promise depositors outsized returns, but pay those returns to the earliest investors by using newly invested money from others. Word of mouth spreads the news of the wonderful opportunity and more and more gullible people line up to invest, especially when the first depositors are repaid and sceptics are silenced by the 'evidence'. So the scheme grows and grows, as it must if only to pay back maturing deposits. But it cannot grow indefinitely, simply because there is not an infinity of people in a country, or even in the world. Pyramids eventually collapse and the people who set up such schemes know it. So they wait until they have enough investors, and then suddenly disappear with the money, and thousands discover that they have just lost their lifetime savings.

Pyramids are often called Ponzi schemes, after Charles Ponzi, an Italian immigrant to the USA who operated a large-scale scheme in the early twentieth century. Poor Ponzi did not run away fast enough; he went to jail, was later released, deported, and died a pauper in a Rio de Janeiro hospital.[25] Most countries ban pyramid schemes, but they flourished in the early years of transition in several former communist countries (with huge ones in Bulgaria, Romania, and Russia). Apparently, most ordinary citizens didn't grasp the mathematics of intertemporal trade and budget constraints, or were convinced by smooth-talking salesmen that they could pass the potato off to others in time. The collapse of an Albanian Ponzi scheme in late 1996 wiped out the savings of tens of thousands of already poor people, many of whom had sold their cattle and houses in response to promises of 300% return and more. Massive street demonstrations and social unrest subsequently brought down the government, which had failed to close down the pyramids after they had collected an estimated €1.1 billion in a country with a GDP at the time of €2.3 billion.

Modern pyramid schemes are not the exclusive preserve of Eastern European countries. For more than a decade, New York financier Bernie Madoff ran what was probably the biggest pyramid ever. He was able to attract the money of savvy professional investors and rich grandmothers from around the world. He now sits in a US federal prison after defrauding his clients of an estimated $65 billion. The recent 'sub-prime' crisis in the USA, in which mortgages (long-term housing loans), were traded between banks and investors, has many aspects of a Ponzi scheme. Fundamentally, loans of poor quality were made, then pooled together, repackaged, and sold off to other investors, who rationalized the investments with expectations of ever-increasing house prices. As long as there is greed and overestimation of one's own chances, there will be attempts to beat the intertemporal budget constraint. They are successful only for the few brilliant and greedy criminals who originated the scheme in the first place. Assuming they get away with it.

primary current account surpluses be no less than the value of international assets in the first period:

$$PCA_1 + \frac{PCA_2}{1+r} \geq -F_1 . \tag{6.16}$$

present value of current and future primary current accounts $\geq$ current net external debt

If a country has net wealth at the beginning of period 1 ($F_1 > 0$), it can draw on it to run future current account deficits. If there is external debt ($F_1 < 0$), the present value of current accounts must be positive, by an amount sufficient to repay the external debt plus interest. Box 6.5 presents the net external position of a few countries.

This pattern has been called **global imbalances**, a topic that is a recurrent theme of countless international summits and finance minister meetings. This situation cannot go on indefinitely, because budget constraints cannot be violated. The fear is that the constraint will reassert itself through a crisis, pretty much as evolving violations of the government budget constraint eventually led to the Eurozone crisis.

The implication for the country as a whole is the same as for the private and public sectors. A primary current account deficit in the first period ($PCA_1 < 0$) must be repaid by primary current surpluses (in

[25] For more details on Charles Ponzi's life see <http://en.wikipedia.org/wiki/Charles_Ponzi>.

present value) in the second unless the previously accumulated assets ($F_1 > 0$) are sufficiently large. Symmetrically, surpluses in the first period enable a nation to spend more than it produces in the future. It would seem wasteful for a country not to do this; otherwise it is literally giving away resources in return for claims on the rest of the world that it will never use. For that reason, it seems likely that countries with large surpluses today will eventually get wise and start using these surpluses to improve the standards of living of its citizens.

6.6.2 Enforcement of International Credit Contracts and Sovereign Borrowing

If a country persistently fails to satisfy its budget constraint, it will face a host of problems. Many of the crises of the 1990s can be traced back to growing fears that some countries were not going to meet their budget constraints. But ultimately international borrowers have more or less honoured their obligations. Research shows that despite spectacular exceptions, international borrowers more often than not actually repay their debt in present value terms.

Governments, just like private households and firms, face an intertemporal budget constraint that limits their ability to borrow at any point in time to the present value of lifetime resources. 'Lifetime' has a clear definition for individuals; for firms and governments less so, since the existence of firms and governments is neither guaranteed nor necessarily limited. Nevertheless, within a legal jurisdiction, private borrowers and lenders will generally be able to rely on special institutions to enforce the budget constraint. Firms or individuals who simply walk away from debts face bankruptcy—exclusion from future borrowing—and possibly jail. Of course, there are always exceptions, but they generally involve fraud, either via outright default ('take the money and run') or more complicated schemes such as financial pyramid schemes described in Box 6.6. These tricks are either illegal or declared to be soon after they are detected. In principle, these rules should also apply to governments, regardless of whether they borrow at home or abroad. As soon as they appear to be violating their budget constraint, the source of credit should dry up rapidly. International institutions with the purpose of monitoring international borrowing exist—the International Monetary Fund, the Paris Club, or the London Club are examples—but function imperfectly. Arguably, the European sovereign debt crisis starting in 2010 arose because such an institution was absent within the European Monetary Union.

All the same, it is important to distinguish between international borrowing by private entities and **sovereign borrowing**, or borrowing by national governments from foreigners. A country cannot be bankrupted or jailed. Unlike private lending within a country, enforcement of sovereign loan contracts is legally difficult. What happens when a country's government is unable to service its debt? The first reaction is that foreign lending immediately stops, and this often affects would-be private borrowers. The country must at least balance its current account, since it cannot borrow, which forces painful adjustments in private and public budgets. Thereafter, negotiations start with the creditors to try to arrange a rescheduling of debt service. Rescheduling means that the terms of repayment are changed from the original loan agreement, but without changing the present value of those repayments. Debt forgiveness, in contrast, involves a reduction in the present value of the loan burden to the borrowing country, and a loss to the creditor.

Summary

1 Because households may borrow or lend, their budget constraint is fundamentally intertemporal. It incorporates all current and future spending on the one hand, and all current and future income on the other. Future spending and incomes are discounted using the interest rate at which households can borrow or lend.

2 Wealth is the sum of the present value of current and future income and inherited assets less debts. The intertemporal budget constraint requires that the present value of spending be less than, or equal to, wealth. It applies to all economic agents, households, firms, the public sector, and the nation as a whole.

3 When firms invest, they forego—on behalf of their shareholders—current consumption for future output. The profitability of investment depends both on the technology and on the rate of interest. The rate of interest is the opportunity cost of capital that investors apply to investment projects because it is available on other assets.

4 Budget constraints can be added together, or consolidated. Consolidating the households' and the firms' budget constraints gives the budget constraint of the private sector. To a first approximation, firms are a veil: they provide their owners or shareholders with a means of increasing their wealth.

5 The public sector intertemporal budget constraint implies that, for a given time profile of government purchases, tax reductions today imply tax increases later on, and conversely. Alternatively, given a tax profile, more government spending today implies less spending later on, and conversely.

6 The Ricardian equivalence proposition asserts that the private sector internalizes the public sector budget constraint. Public debt does not represent private wealth, and the path of taxes over time does not affect the private sector budget constraint. If the private sector can freely borrow at the same rate as the government, additional public dissaving is matched one for one by private saving.

7 Ricardian equivalence is unlikely to hold for several reasons. Interest rates are different and usually lower for governments than private agents. Individuals may rightly expect that some current public debt will be repaid after they die. Many households face borrowing constraints. Yet there is some evidence that the private sector internalizes part of government debt.

8 The national budget constraint is the consolidation of the private and public sector budget constraints. It states that the present value of primary current account deficits cannot exceed the nation's net external wealth. It also implies that, all things being equal, higher primary current account deficits today will require primary current account surpluses in the future.

9 Although it must also obey an intertemporal budget constraint, sovereign borrowing by a nation may differ from private international borrowing by its individual residents. One difference is that governments and countries cannot be bankrupted, and the assets of defaulting governments are hard to seize.

Key Concepts

- intertemporal budget constraint
- rational expectations hypothesis
- endowment
- autarky
- intertemporal trade
- real interest rate
- intertemporal price
- discounting
- consol
- budget line
- present discounted value
- investment

- fixed capital formation
- production function
- diminishing marginal productivity
- opportunity cost
- primary budget surpluses
- primary deficit
- Ricardian equivalence proposition
- primary current account
- global imbalances
- sovereign borrowing

Exercises

1 Draw a budget line for Crusoe in a two-period world, assuming an interest rate r of 5% and an income of 100 in the first period (Y_1) and 200 in the second (Y_2). What is the value of total wealth Ω? Why are your answers different when instead $Y_1 = 200$ and $Y_2 = 100$?

2 Use the example given to consider the case of a higher interest rate $r = 10\%$. In terms of wealth, which version of Crusoe has more to lose from an increase in the interest rate? Compare your answer to an individual with $Y_1 = 300$ and $Y_2 = 0$. Explain.

3 Suppose that Crusoe cannot trade intertemporally with his native neighbours, but coconuts no longer spoil completely, so he can store them for consumption tomorrow. Consider the case $Y_1 = 200$ and $Y_2 = 100$, and suppose that 10% of the stored coconuts are lost because of spoilage. Represent this budget constraint graphically. Why does opening the market for loans always make him better off?

4 In the text, Robinson Crusoe does not want to leave any wealth beyond tomorrow because he will be rescued. The situation would be different if he wanted to leave his friend Friday a gift of a fixed amount B_3 in the second period (B_3 might also be thought of as a bequest). Write down Crusoe's budget constraint and represent it graphically.

5 The real interest rate is 5%. What is the value of a new firm which invests €200,000 initially and expects to have profits (sales minus costs) of €100,000 next year, €70,000 the year after, €40,000 the third year, and then to close down with equipment valued at zero? How does your answer change if the equipment bought initially is instead sold for €50,000? How does your answer change if the interest rate rises to 10%?

6 Sometimes when a firm announces a plan to take over another firm using its cash and not to distribute dividends to its shareholders, its share price decreases; and when the plans are cancelled, the share price rises again. At other times, the opposite pattern is observed. Can you explain why? Under what conditions would you expect such an action to have no effect at all?

7 Suppose the production function has the Cobb-Douglas form: $Y = AK^{\alpha}L^{1-\alpha}$, and assume labour input is fixed at $L = 1$. Let $\alpha = 0.5$ and $A = 1$. At an interest rate of 5% and no depreciation, what is the level of the capital stock K for which the project is just profitable? How does your answer change when the interest rate is 10%? When the depreciation rate is 5% per annum? When $A = 2$?

8 Write down the value of the firm when the production function is $Y_2 = F(K_2, L)$ with $L = 1$, and the capital stock in the second period is given by $K_2 = I_1 + (1 - \delta)K_1$. How does the initial and given stock of capital in the first period affect the firm's value? The depreciation rate? The rate of investment?

9 Consider a government in a two-period world starting with €1,000 in debt. $G_1 = G_2 = 500$ and $T_1 = 400$. If the interest rate $r_G = 0.05$, what do taxes in the second period need to be to guarantee the solvency of this government? How does your answer change when $r_G = 0.10$?

10 Starting from your answer to the previous problem, show how a tax cut in period 1 can increase wealth if $r_G = 0.05$ and $r = 0.10$? What happens if $r_G = 0.15$? If $r_G = 0.10$?

11 Compare the two measures of the Italian budget shown in Figure 6.8 with that of Table 17.3 (in Chapter 17). Explain the difference.

Essay Questions

1 Why do you think the interest rate is positive? What would be the consequence of a negative (real) interest rate?

2 For the government to honour its budget constraint, it is sufficient but not necessary that its budget be balanced every year. Why? Why might a balanced budget law not be a good idea? What conclusions do you draw?

3 Some contend that the 'pay as you go' system of social security in many European countries, in which the pension contributions of the currently employed are used to pay the pension benefits of older workers already in retirement, is a pyramid scheme. Do you agree or disagree? Explain.

4 When a country defaults on its external debt, a frequent controversy concerns whether the country is unable or unwilling to honour its debt. Discuss this distinction and why it is difficult to resolve the controversy.

5 Argentina defaulted in 2002 in the midst of an economic and political crisis. Initially, the government refused to negotiate with its creditors. Eventually, in 2005 it reached an agreement with most creditors, which included a debt reduction of 70%, and started to pay back the remaining. Yet, a minority of creditors insisted on being paid back in full. After years of legal battles in the US, these creditors won in 2014. Many of them, sometimes called 'vulture funds', had bought the debt from previous creditors at much discounted prices and stand to make huge profits. This story raises many issues such the sanctity of debts, the responsibilities of lenders, equal treatment of creditors, or the role of vulture funds. What is your own view?