Chapter 20

Consumption

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Preliminary, Comments Welcome

Learning Objectives:

In this chapter, we study

- the neoclassical consumption model, in which individuals choose the time path of their consumption to maximize utility.
- how this standard model leads to a benchmark solution in which consumption is proportional to an individual's total wealth, including current financial wealth and the present value of current and future labor income.
- the heterogeneity in consumer behavior at the micro level; some individuals, often the rich, tend to follow the permanent income hypothesis, while others, often the poor, have consumption that is quite sensitive to current income.
- additional facts about consumption in the aggregate, including the decline in the personal saving rate and the rise in the debt-income ratio in recent decades.

Consumption is the sole end and purpose of all production... — *Adam Smith*

1. Introduction

Consumption accounts for more than two thirds of GDP, more than $10 trillion dollars in the U.S. economy. This spending results from the economic decisions of over 100 million households as they purchase food, clothing, houses, vacations, refrigerators, cars, and health care. What key economic forces shape their decisions?

The models considered in this book until now treat consumption in a very simple way. In the Solow model, individuals save a constant fraction of their income. In the main short-run model, people consume a constant fraction of potential output.

In this chapter, we develop what might be called the **neoclassical consumption model**. Individuals choose consumption at each point in time to maximize a lifetime utility function that depends on current and future consumption. People recognize that income in the future may differ from income today, and such differences influence consumption today.

The neoclassical model we explore in this chapter is a fundamental building block of modern macroeconomics. It is to consumption what the Solow model is to the study of economic growth. This workhorse model allows us to develop a better, more intuitive understanding of the microfoundations of consumption that were summarized earlier in Chapter 10. There, we outlined the insights from the permanent income hypothesis of Milton Friedman and the life cycle model of consumption of Franco Modigliani. Here, we provide careful microfoundations for these frameworks and assess their empirical relevance.

2. The Neoclassical Consumption Model

The first insight of the neoclassical consumption model is that one can make a great deal of progress by thinking of time as involving only two periods: *today* and the *future*. People may earn income today and in the future, they consume today and in the future, and a key decision they have to make is how much to consume today versus in the future. This is the essence of the neoclassical model.

The consumption model then has two main elements: an intertemporal budget constraint and a utility function. We discuss each of these in turn.

2.1. The Intertemporal Budget Constraint

Consider a consumer named Irving — after Irving Fisher, one of the greatest economists of the first half of the twentieth century and one of the originators of the neoclassical consumption model. Suppose that as of this moment, Irving has financial wealth equal to f_{today}. For example, this financial wealth would include Irving's saving account balance and his holdings of stocks and bonds. Irving earns labor income y_{today} today and y_{future} in the future. Letting c denote consumption, Irving faces the following two budget constraints:

$$c_{\text{today}} = y_{\text{today}} - (f_{\text{future}} - f_{\text{today}}) \tag{20.1}$$

$$c_{\text{future}} = y_{\text{future}} + (1+R)f_{\text{future}}. \tag{20.2}$$

Both equations have the form "consumption equals income less saving." The first equation applies to "today," and $f_{\text{future}} - f_{\text{today}}$ represents Irving's saving for the future — the amount he sets aside to increase the balance in his financial accounts. The second equation applies in the future, the second (and last) period of the model. In this case, Irving earns labor income y_{future} but then also earns interest on his financial wealth. Because this is the last period of life, there is nothing to save for and Irving consumes all of his income and wealth at that point.

Combining these two equations yields Irving's **intertemporal budget constraint**:[1]

$$\boxed{\begin{aligned} \underbrace{c_{\text{today}} + \frac{c_{\text{future}}}{1+R}}_{\text{present value of consumption}} &= f_{\text{today}} + y_{\text{today}} + \frac{y_{\text{future}}}{1+R} \\ &= \underbrace{\text{financial wealth} + \text{human wealth}}_{\text{total wealth}} \end{aligned}} \tag{20.3}$$

This equation says that the present discounted value of consumption must equal total wealth. That is, Irving's consumption is constrained by the total resources that will be available to him in the present and in the future. These resources include his existing financial wealth f_{today}. But they also include his **human wealth** — the present discounted value of labor income, $y_{\text{today}} + \frac{y_{\text{future}}}{1+R}$.

This equation shows that Irving's consumption in any given year can be very different from

[1] Rewrite the second equation as $f_{\text{future}} = (y_{\text{future}} - c_{\text{future}})/(1+R)$ and substitute this result into the first equation.

his income. Irving is allowed to save for the future if he so desires, but he can also borrow against his future labor income. What must be true is that the present value of consumption equals the present value of lifetime resources.

2.2. Utility

We assume that Irving chooses his consumption today and in the future in order to maximize utility. For this to make sense, we have to explain how consumption affects utility. The standard assumption in macroeconomics is that consumption delivers utility through a **utility function**. For example, if Irving consumes some amount c in a given period, we assume he receives $u(c)$ units of utility, sometimes called "utils." We assume Irving gets more utility whenever consumption his higher, but that consumption runs into diminishing returns, often called **diminishing marginal utility**. That is, each additional unit of consumption raises utility by a smaller and smaller amount. Diminishing marginal utility is quite intuitive and applies to all kinds of consumption. The first night of the week eating dinner at a fancy restaurant is a special treat; after ten nights in a row, however, another night out seems much less desirable. An example of such a utility function is shown in Figure 20.1, and diminishing marginal utility is reflected in the curvature of utility.

Because Irving consumes in two periods, utility needs to depend on consumption today and on consumption in the future. A natural way to express this is with the following lifetime utility function:

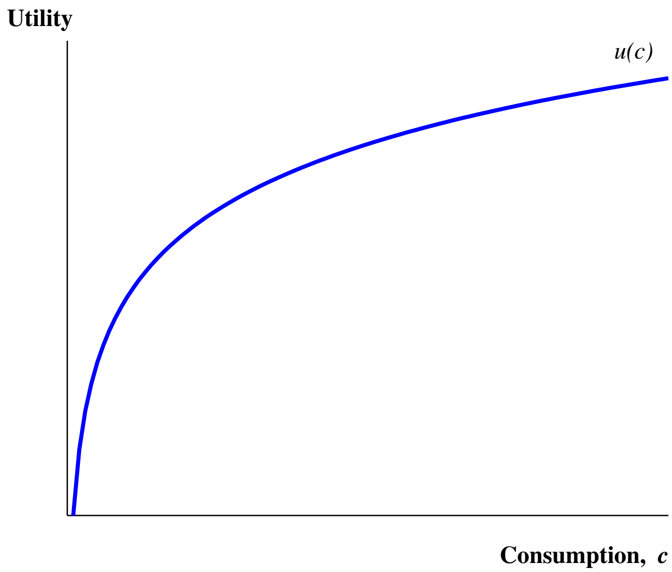
$$U = u(c_{\text{today}}) + \beta u(c_{\text{future}}). \tag{20.4}$$

Irving's lifetime utility depends on how much he consumes today and on how much he consumes in the future. The parameter β is some number — such as 1.0 or 0.9 — that captures the weight that Irving places on the future relative to today. For example, if $\beta = 1$, then Irving treats utility flows today and in the future equally. Alternatively, if $\beta < 1$, a given flow of utility is worth more when it occurs today.

2.3. Choosing Consumption to Maximize Utility

We've now completed the setup of the neoclassical consumption model. Irving gets utility from consuming in each period, as in equation (20.4), and he must choose his consumption to satisfy the intertemporal budget constraint in equation (20.3). The model is closed by assuming that

Figure 20.1: Flow utility $u(c)$



Note: A consumption level of c delivers a flow of utility to the consumer of $u(c)$. Utility rises when c increases, but the amount of the increase gets smaller and smaller, reflecting diminishing marginal utility.

Irving choose his consumption so as to maximize utility subject to his budget constraint:

$$\max_{c_{\text{today}},c_{\text{future}}} U = u(c_{\text{today}}) + \beta u(c_{\text{future}}), \text{ subject to}$$
$$c_{\text{today}} + \frac{c_{\text{future}}}{1+R} = \bar{W} \tag{20.5}$$

where we've defined $\bar{W} \equiv f_{\text{today}} + y_{\text{today}} + \frac{y_{\text{future}}}{1+R}$. That is, $\bar{W}$ denotes total wealth, the sum of financial wealth and human wealth.

Solving this problem requires calculus, and the solution is derived step-by-step in the footnote below. However, the solution turns out to be quite intuitive. In fact, walking through the intuition will allow you to get the solution yourself without going through the details.[2]

First, look at the utility function. If Irving consumes a little more today, the extra utility he

[2]To solve the consumer's problem using calculus, begin by solving for c_{future} using the intertemporal budget constraint: $c_{\text{future}} = (1+R)(\bar{W} - c_{\text{today}})$. Substituting this expression into the utility function, we can write the maximization problem in terms of c_{today} only:

$$\max_{c_{\text{today}}} u(c_{\text{today}}) + \beta u\left((1+R)(\bar{W} - c_{\text{today}})\right).$$

We solve by setting the derivative of utility with respect to c_{today} equal to zero:

$$u'(c_{\text{today}}) + \beta u'(c_{\text{future}})(1+R)(-1) = 0.$$

Rearranging this equation gives the solution in the main text.

gets is the marginal utility of consumption today, which we can write as $u'(c_{\text{today}})$. Alternatively, Irving can consume a little more tomorrow, in which case he gets the marginal utility of consumption tomorrow, adjusted by the discount parameter: $\beta u'(c_{\text{future}})$.

Now recall the logic of the intertemporal budget constraint. The essence of this constraint is that Irving can consume one unit today, or can save that unit and consume $1+R$ units in the future. If he's maximized utility, Irving must be indifferent between consuming today or in the future. This key condition can be stated as

$$\boxed{u'(c_{\text{today}}) = \beta(1+R)u'(c_{\text{future}}).} \tag{20.6}$$

This expression is called the **Euler equation** for consumption. It is one of the most famous equations in macroeconomics, lying at the heart of advanced macroeconomic models, and it has a beautiful intuition.

The Euler equation essentially says that Irving must be indifferent between consuming one more unit today on the one hand and saving that unit and consuming in the future on the other. If Irving consumes today, he gets the marginal utility of consumption today — the left-hand side of the equation, $u'(c_{\text{today}})$. If Irving saves that unit instead, he gets to consume $1+R$ units in the future, each giving him $u'(c_{\text{future}})$ extra units of utility. Because this utility comes in the future, it must be discounted by the weight β. That's the right side of the Euler equation. The fact that these two sides must be equal is what guarantees that Irving is indifferent to consuming today versus in the future.

2.4. Solving the Euler Equation: Log Utility

In order to get an explicit solution for consumption, we need to specify a functional form for the utility function $u(c)$. A common choice is the logarithmic function: $u(c) = \log c$. In fact, the specific curve drawn in Figure 20.1 is exactly this case. The reason this case is so common is that it has a very nice property:

If $u(c) = \log c$, then the marginal utility of consumption is $u'(c) = \frac{1}{c}$.

If you are familiar with calculus, then you will understand why this statement is true. If you are not familiar with calculus, do not be concerned — just take the statement as a fact that you can use.

Using the fact that $u'(c) = 1/c$, the Euler equation in (20.6) can be written as

$$\frac{1}{c_{\text{today}}} = \beta(1+R)\frac{1}{c_{\text{future}}}. \tag{20.7}$$

Rearranging this equation slightly leads to another very intuitive result:

$$\boxed{\frac{c_{\text{future}}}{c_{\text{today}}} = \beta(1+R).} \tag{20.8}$$

Notice that the left-hand side of this equation is just the growth rate of consumption (plus one). Equation (20.8) therefore says that Irving chooses his consumption so that the growth rate of consumption is the product of the discount parameter and the interest rate he can earn on his saving. The less weight Irving places on future utility (a lower β), the lower is consumption growth. On the other hand, the higher is the interest rate, the faster is consumption growth.

In fact, writing the Euler equation in terms of consumption growth reveals another deep insight into macroeconomics: why interest rates and growth rates are often similar numbers, like 2 percent. In the partial equilibrium consumption problem that Irving is solving, Irving takes the value of the real interest rate R as given and chooses any consumption growth rate he wishes. The economy as a whole consists of a bunch of people like Irving, we might suppose, and in *general equilibrium*, the real interest rate and the growth rate of the economy are both endogenous variables – as we saw in the growth models in Chapters 4 through 6. The Euler equation then explains how these two variables are related. In fact, the general equilibrium interpretation of the Euler equation switches the logic around in a way. In general equilibrium, a Solow/Romer type model pins down the growth rate of the economy. The Euler equation then determines the interest rate that Irving faces!

An example may help illustrate how this works. Suppose the growth rate of the economy — and therefore of consumption — is 2 percent per year, which we think of as coming from some long-run growth model. Suppose to start that $\beta = 1$. In this case, the Euler equation implies that the real interest rate will also be 2 percent, exactly equal to the growth rate. To the extent that consumers prefer to get their utility today instead of in the future, β may be less than one and therefore the real interest rate will be a little higher than 2 percent. What's key here is that *the Euler equation explains how interest rates and growth rates are closely related.*

2.5. Solving for c_{today} and c_{future}: Log Utility and $\beta = 1$

The Euler equation in equation (20.8) is one equation but features two unknowns, c_{today} and c_{future}. Therefore, to solve for consumption today and in the future, we need one more equation. What is it? The answer, of course, is the original intertemporal budget constraint in equation (20.5).

Because it is helpful in solving further to see these two equations together, we repeat them here:

$$\frac{c_{\text{future}}}{c_{\text{today}}} = \beta(1+R). \qquad \text{(Euler equation)}$$

$$c_{\text{today}} + \frac{c_{\text{future}}}{1+R} = \bar{W} \qquad \text{(IBC)}$$

Now consider the case where $\beta = 1$. In this case, these two equations can be solved easily just by looking at them closely. In particular, the Euler equation implies that $\frac{c_{\text{future}}}{1+R} = c_{\text{today}}$, so consumptions are equal (in present value). Plugging this result into the intertemporal budget constraint immediately implies

$$c_{\text{today}} = \frac{1}{2} \cdot \bar{W} \qquad (20.9)$$

and

$$c_{\text{future}} = \frac{1}{2} \cdot (1+R)\bar{W}. \qquad (20.10)$$

For log utility and $\beta = 1$, then, Irving consumes one half of his wealth today and saves the other half. In the future, he can then consume the remainder of his wealth together with the interest it has earned.

2.6. The Effect of a Rise in R on Consumption

How does does consumption respond to a rise in the interest rate? As a starting point for answering this question, consider the solution in equation (20.9) that we just derived in the special case of log utility. On first glance, it may appear that a change in the interest rate will leave consumption unaffected. But that is not quite right. In particular, recall that total wealth $\bar{W}$ depends on the interest rate because it includes the present discounted value of labor income. A higher interest rate will reduce this present value in general and therefore will reduce consumption in the case of log utility. This force is called the *wealth effect* of a higher interest rate, because it works through the total wealth term.

You may also recall from your study of microeconomics that changes in interest rates often involve both a *substitution effect* and an *income effect*. In the case of log utility, these effects offset each other, which is why the interest rate does not appear explicitly in equation (20.9). When utility takes a different form, however, these effects enter. The substitution effect of a higher interest rate is that current consumption is now more expensive (because saving will lead to even more consumption in the future), so consumers will tend to reduce their consumption today. The income effect says that consumers are now richer — because their current saving leads to more income in the future — which makes them want to consume more today. In general, a higher interest rate can either raise or lower current consumption because these effects work in opposite directions.

3. Lessons from the Neoclassical Model

The neoclassical consumption model allows us to more deeply understand several of the issues related to consumption that were originally raised in Chapter 10. It also produces some additional new lessons. These are discussed below.

3.1. The Permanent Income Hypothesis

In discussing the microfoundations for consumption in Chapter 10, we introduced Milton Friedman's **permanent income hypothesis**. According to this view, consumption depends on some average value of income rather than on current income. In strong versions of the hypothesis, we said, consumption might depend on the present discounted value of income.

The neoclassical consumption model provides a way of making this statement precise. In particular, we see from equation (20.9) that consumption is proportional to a consumer's overall wealth, $\bar{W} = f_{\text{today}} + y_{\text{today}} + \frac{y_{\text{future}}}{1+R}$. However, this total wealth depends on the present discounted value of income. The permanent income hypothesis, then, is one implication of the neoclassical consumption model.

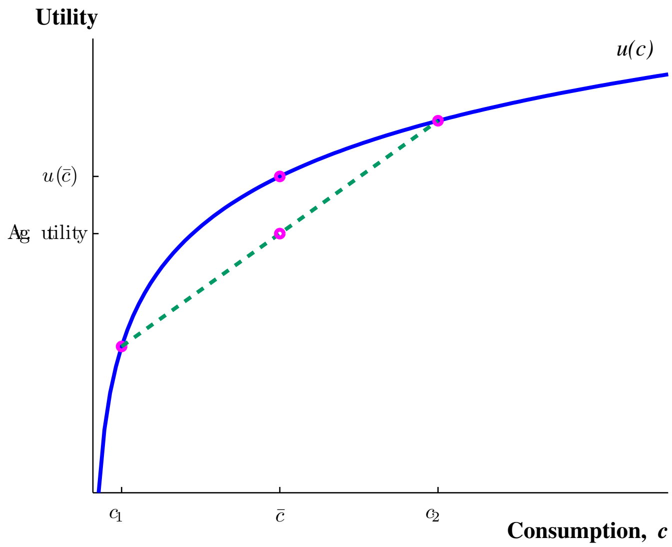
The intuition behind the permanent income result is that consumers wish to smooth their consumption over time. This desire is embedded in the utility function $u(c)$. To begin, suppose $\beta = 1$ and $R = 0$ and consider Figure 20.2. Suppose Irving could consume c_1 today and c_2 in the future, or could consume the average of these two values in both periods. Because of diminishing marginal utility, Irving prefers to smooth consumption and take the average in both periods. Now consider what happens if $R > 0$. From the Euler equation, we know that this change leads consumption to grow over time. Because of Irving's basic desire to smooth consumption, he must be paid a positive interest rate not to keep consumption constant.

How does Irving respond to a temporary increase in income? Suppose y_{today} rises by $100. Equation (20.9) implies that Irving's consumption will rise by only 1/2 as much as the increase in income, or $50. Instead, Irving saves the remainder and consumes it in the future, smoothing out the burst of income.

In this simple example, the value of 1/2 is called the **marginal propensity to consume**: if income goes up by one dollar, consumption rises by 1/2 that amount. Similarly, the marginal propensity to consume out of today's wealth is also 1/2.

In richer models the marginal propensity to consume out of income differs from 1/2. For

Figure 20.2: The Desire to Smooth Consumption



Note: Suppose Irving could consume c_1 today and c_2 in the future, or could consume the average of these two values in both periods. Because of diminishing marginal utility, Irving prefers to smooth consumption and take the average in both periods. (This assumes $\beta = 1$ and $R = 0$ so these results can be shown easily in a simple graph.)

example, if we increase the number of periods in Irving's life — for example to three periods or perhaps to 80 periods, where each period represents a year of life — then the marginal propensity to consume is approximately equal to one divided by the number of periods; this approximation is exact when $R = 0$ and $\beta = 1$. In other words, if Irving expects to live for another 50 years, the marginal propensity to consume out of another dollar of income will be something like 1/50. The general lesson from models in which the permanent income hypothesis holds is that the marginal propensity to consume out of income or wealth is relatively small.

3.2. Ricardian Equivalence

The concept of Ricardian equivalence, also first discussed in Chapter 10, can also be better understood in the explicit neoclassical model. In particular, looking back at the derivation of the intertemporal budget constraint, one can see that y should be interpreted as resources *after taxes*. That is, taxes — both today and in the future — must be substracted from the right-hand side of the intertemporal budget constraint. Lifetime wealth $\bar{W}$ is the present discounted value of resources net of taxes.

The Ricardian equivalence claim is that a change in the timing of taxes does not affect consumption. A tax cut today, financed by an increase in taxes in the future, will not affect consumption if the Ricardian claim is true. This claim is almost trivial to see in our neoclassical model. Clearly a change in the *timing* of taxes will leave $\bar{W}$ unchanged. Therefore the consumer's maximization problem as specified in equation (20.5) will be unchanged and there is no reason for consumption to change.

The essence of the Ricardian approach to the government is that consumption depends on the present discounted value of taxes and is invariant to the timing of taxes.

How well does Ricardian equivalence describe what happens empiricially when the government changes the timing of taxes? The answer depends. For example, we will see below that to the extent that consumers are constrained by borrowing constraints, Ricardian equivalence need not hold. It can also break down when the tax cuts are given to people who differ from the people paying the higher taxes. This might occur because of a progressive tax system or because current generations are receiving a tax cut that will be paid for by higher taxes on future generations. These issues will be discussed in more detail in Chapter (Govt).

3.3. Borrowing Constraints

A key assumption of the neoclassical model is that Irving can freely save or borrow at the market interest rate R. This may be a good description of the opportunities available to many consumers, but there may also be some consumers who, for whatever reason, have no financial wealth and are unable to borrow in credit markets. Financial conditions could be bad in the economy as a whole, or perhaps the individual's credit history is not good and no one will provide a loan.

In this case, the intertemporal budget constraint is no longer the correct constraint. Instead, the constraint on consumption for individuals with no financial wealth and no access to credit is much simpler:

$$c_{\text{today}} \leq y_{\text{today}}. \tag{20.11}$$

That is, Irving's consumption is constrained by the lack of borrowing opportunities to be no greater than his income in each period.

If Irving was already consuming less than his income, then this constraint may not be binding: Irving is already saving, so not allowing him to borrow does not change anything. Alternatively, if Irving's current income is sufficiently low, he may wish to borrow. In this case, the borrowing constraint binds and his consumption is constrained to equal his income: $c_{\text{today}} = y_{\text{today}}$.

Interestingly, the marginal propensity to consume from an extra dollar of income changes significantly when borrowing constraints are present. We saw earlier that the marginal propensity to consume when the permanent income hypothesis holds is typically a small number, such as one divided by the number of periods of life remaining. In contrast, when borrowing constraints bind, consumption is exactly equal to income. If income rises by one dollar, consumption rises by one dollar as well, and the marginal propensity to consume is unity, much larger than before.

3.4. Consumption as a Random Walk

What happens if Irving's income is uncertain? No one knows what the future holds, and tomorrow Irving may receive a long-sought promotion that raises his income. Alternatively, his job may be outsourced and he may become unemployed. There are two important insights that emerge from thinking carefully about consumption when income is uncertain. We discuss one now and one in the next subsection.

In the presence of uncertainty, the neoclasical model implies that consumption today depends on *all information* the consumer has about the present value of lifetime resources. Clearly there is no way for the consumer to know if she will win the lottery 25 years from now. However, she may know that she is currently under consideration for a big promotion and will likely be earning substantially more income in the future than she is today. This information — and all other available information — should be reflected in her current consumption.

In 1978, Robert Hall of Stanford University developed this implication, commonly known as the **random walk** view of consumption.[3] Because all known information should be incorporated into current consumption, changes in consumption should be unpredictable. Apart from the general trend in consumption associated with the interest rate in the Euler equation, consumption should be equally like to move up or down over time, at least if the permanent income hypothesis is correct. When an expected promotion arrives, the effect on consumption should be relatively small — after all, the promotion was expected and so the extra future income should already be reflected in current consumption. On the other hand, an unexpected job loss may have a much larger effect on current consumption, particularly if the unemployment spell is expected to be long.

— Case Study: Consumption versus Expenditure —

A key prediction of the basic neoclassical consumption model is that consumption should

[3] Robert E. Hall, "Stochastic Implications of the Life Cycle-Permanent Income Hypothesis: Theory and Evidence" *Journal of Political Economy*, vol. 86 (December 1978), pp. 971–987.

not change when a long-anticipated event comes to pass. For example, retirement typically does not come as a surprise and is instead of the most anticipated events in an individual's lifetime. According to the neoclassical consumption model, then, one would expect consumption to remain relatively unchanged when people retire. In fact, expenditures on consumption change quite markedly around this event — falling by around 17 percent according to a study we discuss momentarily. Such a large decline in consumption expenditures was for many years a long-standing puzzle for the neoclassical model.

This puzzle was recently solved by Erik Hurst of the University of Chicago and Mark Aguiar of the University of Rochester.[4] Aguiar and Hurst study a novel data set of food diaries for a large number of households. They show that while *expenditures* on consumption do indeed decline sharply upon retirement, consumption itself shows no such decline. Instead, households spend much more time shopping for food and preparing it themselves. The quantity and the quality of food actually consumed is maintained when individuals retire, even though the amount of money spent on food declines. So what initially appears to be a puzzle for the neoclassical consumption model turns out to be quite supportive once consumption itself is studied, as opposed to money spent on consumption.

——— End of Case Study ———

3.5. Precautionary Saving

The second key implication that arises when income is uncertain is that consumers may save to hedge against the possibility of a large drop in income, perhaps associated with unemployment or disability. This type of saving is called **precautionary saving**. Interestingly, such a consumer might save even when income and wealth are temporarily low, when the basic permanent income hypothesis would suggest borrowing. Why? As long as the possibility remains that income could fall even further, consumers may engage in precautionary saving to insure themselves against that outcome. In fact, the recent financial crisis provides an excellent example of precautionary saving. As we will document carefully at the end of this chapter, saving rates rose sharply during the financial crisis, and precautionary motives are a logical part of the explanation.[5]

The precautionary saving motive can therefore lead consumers to behave as if they face bor-

[4] Mark Aguiar and Erik Hurst, "Consumption vs. Expenditure" *Journal of Political Economy* vol. 113 (October 2005), pp. 919–948.

[5] A nice introduction to precautionary saving can be found in Christopher Carroll, "A Theory of the Consumption Function, With and Without Liquidity Constraints," *Journal of Economic Perspectives*, vol. 15 (Summer 2001), pp. 23–45.

rowing constraints even when they do not. That is, consumers with low income who look like they ought to be borrowing may save instead. Moreover, their consumption may be especially sensitive to their current income, just as in the case of a borrowing constraint. Precautionary saving and borrowing constraints, then, are two explanations for why the marginal propensity to consume out of income can be higher than the permanent income hypothesis would dictate.

4. Empirical Evidence on Consumption

As we have seen, the neoclassical consumption model is quite rich and can lead to a range of outcomes. For individuals with sufficient wealth, consumption may obey the permanent income hypothesis and follow a random walk, with only news of changes in income leading to changes in consumption. On the other hand, individuals with low wealth or who cannot borrow in credit markets may display much greater sensitivity to current income.

What does the evidence say? This section reviews a range of evidence on consumer behavior, including microeconomic evidence from individual households and aggregate evidence about the macro properties of consumption.

4.1. Evidence from Individual Households

One of the most studied areas of macroeconomics in recent decades has been the determinants of consumption at the household level. This literature is too large to review in detail, but we summarize its three centrals findings here.[6]

First, the Euler equation and the permanent income hypothesis provide a useful first-order description of the consumption behavior of many households, particularly those with above average wealth. The marginal propensity to consume out of a temporary income shock is low, and consumption smoothing is effective for these households.

Second, there are also many households, especially those with low income and wealth, that behave as if they are borrowing constrained or engaging in precautionary saving. For these households, consumption tracks income quite well, and the marginal propensity to consume from a temporary boost in income is high.

At this point it is worth pausing to note something that plays a central role in modern economics: households are heterogeneous. That is, there is not a single type of household with

[6] In addition to the economists mentioned elsewhere in this chapter, others who have made important contributions include Mark Aguiar, Orazio Attanasio, Chris Carroll, Karen Dynan, Pierre-Olivier Gourinchas, Chang-Tai Hsieh, Erik Hurst, Miles Kimball, Dirk Krueger, David Laibson, Sydney Ludvigson, Annamaria Lusardi, Jonathan Parker, Fabrizio Perri, Luigi Pistaferri, Andrew Samwick, Nick Souleles, and Stephen Zeldes.

a single marginal propensity to consume. The micro side of consumption is much messier. Consumption is very sensitive to income for some households, while others are much more successful at smoothing consumption. This gives rise to aggregation issues: the effect on aggregate consumption of a 1 percent increase in GDP depends on a range of microeconomic responses and on the distribution of heterogeneous households. Neither the permanent income hypothesis nor a simple equation in which consumption responds one-for-one to changes in income provides a good description of aggregate consumption for modern economies. The real world is somewhere in between. For example, it has been suggested that the average marginal propensity to consume in rich countries may be about 25 to 30 percent.[7]

The third and final lesson from the extensive research on household consumption is that there are many anomalies and departures from the permanent income model — and from the simple model of households as rational economic agents for that matter. One of the most active areas of economic research in the last decade goes by the name of **behavioral economics**. This research blends insights from psychology, neuroscience, and economics in an effort to create a better understanding of how individuals make economic decisions. We discuss it in more detail in the accompanying case study.

— Case Study: Behavioral Economics and Consumption —

A common assumption in economics is that the agents in our models are perfectly rational, forward-looking individuals who are extremely good at solving complicated economic problems. They are the kind of people who would get an "A+" in all of their economics classes (although they might not do as well in comparative literature). It will not surprise you that most people in the world fall short of this high standard. So the question at the heart of behavioral economics is this: What happens if we build our models around more realistic behavioral assumptions? For example, what if people are not that good at solving math problems, are susceptible to emotional advertising, and are willing to spend a lot to avoid losses?

Behavioral approaches have been applied throughout economics. But one of the applications that has met with the greatest success is the theory of consumption and saving. David Laibson of Harvard University has proposed a simple modification of the behavior of our standard rational economic agents. In particular, based on a number of psychological experiments, Laibson considers the possibility that people may be particularly impatient when faced with decisions involving today versus the future. Laibson shows that under this assumption, consumption would be more sensitive to movements in income than the permanent income hy-

[7] This estimate comes from the paper by Chris Carroll cited earlier.

pothesis predicts. Such departures have been observed empirically. For example, some people seem to borrow excessively using credit cards that have very high interest rates. Others may have trouble exerting the self-control required to save in response to large, temporary boosts in income.

Some of the most compelling evidence on the importance of behavioral considerations comes from 401(k) retirement plans. These employer-sponsored plans encourage employees to save a portion of their salaries for retirement by providing favorable tax treatment. Individuals can choose what fraction of their salary to save, up to a maximum, and can pick from a range of financial instruments, including money market and mutual funds. The default design of these plans turns out to have a tremendous impact on how individuals participate: default options are "sticky." For example, research shows that when employees are enrolled by default in 401(k) plans, almost no one opts out and participation is therefore almost 100 percent. In contrast, when new employees are not enrolled automatically, fewer than half participate during their first year employed. Another (in)famous example comes from the energy-trading company Enron. In 2000, current and past employees of the Enron Corporation held $2.1 billion in the firm's 401(k) retirement plan. An astounding 62% of these funds were held in Enron's own stock, despite the fact that employees were allowed (and generally encouraged by financial advisors) to diversify their holdings. In just a few weeks at the end of 2001, Enron collapsed in bankruptcy due to accounting fraud. Shares that had traded at $83 each earlier in the year became worthless, and thousands of employees and retirees saw much of their retirement saving wiped out.[8]

Economists are working hard to create better models of economic behavior, and the insights from behavioral economics are likely to play an important role in this endeavor.[9]

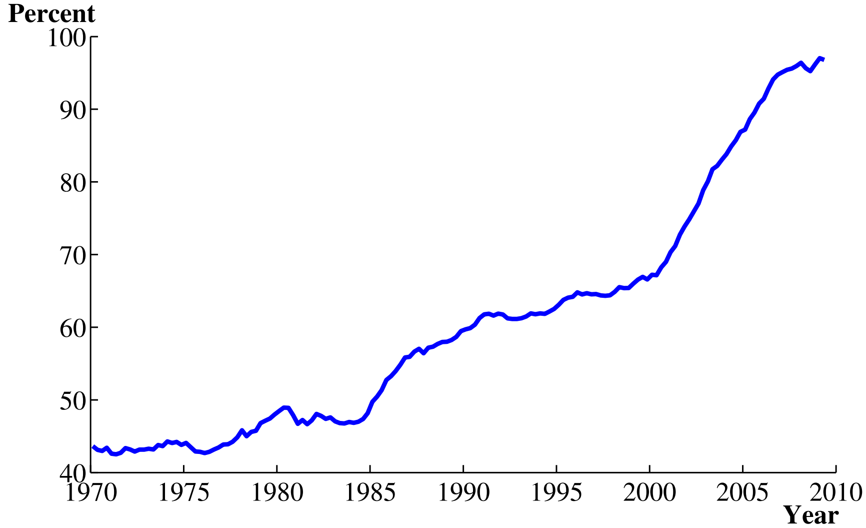
[ZZZ Cut related case study from Chapter 10, p. 252 1st edition]

——— End of Case Study ———

[8]The examples in this paragraph are from two papers: James J. Choi, David Laibson, Brigitte C. Madrian and Andrew Metrick, "Optimal Defaults," *American Economic Review Papers and Proceedings*, vol. 93 (May 2003), pp. 180–185. James Choi, David Laibson, and Brigitte Madrian, "Are Empowerment and Education Enough? Underdiversification in 401(k) Plans" *Brookings Papers on Economic Activity* vol. 2 (2005), pp. 151-198.

[9]For more on the application of behavioral economics to consumption, see George-Marios Angeletos, David Laibson, et al., "The Hyperbolic Consumption Model: Calibration, Simulation, and Empirical Evaluation," *Journal of Economic Perspectives*, vol. 15 (Summer 2001), pp. 47–68. Broader overviews of behavioral economics can be found in two papers: Matthew Rabin, "Psychology and Economics" *Journal of Economic Literature* (March 1998), pp. 11–46; and Colin Camerer, George Lowenstein, and Drazen Prelec, "Neuroeconomics: How Neuroscience Can Inform Economics" *Journal of Economic Literature* (March 2005), pp. 9–64.

Figure 20.3: Household Debt as a Percent of GDP



Note: The ratio of debt accumulated by the household sector to GDP has doubled since 1970, rising very sharply between 2000 and 2008. Source: *Flow of Funds of the United States* via the FRED database.

4.2. Aggregate Evidence

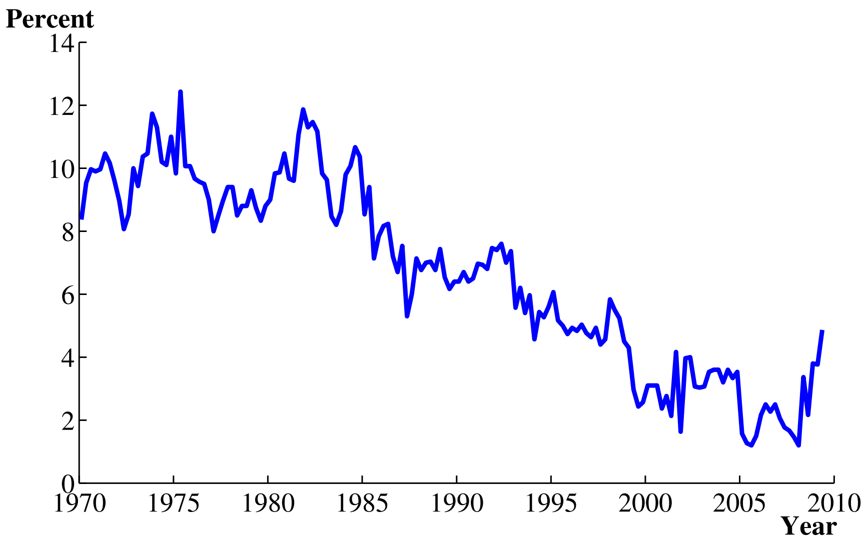
We noted in Chapter 2 that aggregate consumption as a share of GDP had risen from about 63 percent in 1970 to 70 percent in 2005. This section provides more insight into how the consumption share of GDP increased so substantially.

Figure 20.3 documents that households have increased their borrowing substantially in recent decades. In the 1970s and early 1980s, household debt was typically less than 50 percent of GDP. Beginning in the mid 1980s, however, this ratio began to rise, reaching about 67 percent of GDP in 2000 and then rising sharply to nearly 100 percent of GDP by 2009. Back in Chapter 13, we noted that the recent financial crisis was a balance sheet crisis. Here, we see the large increase in household debt that is one element of that story.

The remarkable rise in household debt is paralleled by a large, steady decline in the personal saving rate, as shown in Figure 20.4. The **personal saving rate** is the ratio of personal saving to disposable income (i.e., income net of taxes). This saving rate declines from more than 10 percent in much of the 1970s and early 1980s to less than 2 percent by 2007. One effect of the financial turmoil in recent years has been to increase the personal saving rate; during the first part of 2009, the rate has averaged more than 4 percent.

These two figures illustrate that U.S. households have increased their borrowing and re-

Figure 20.4: The Personal Saving Rate



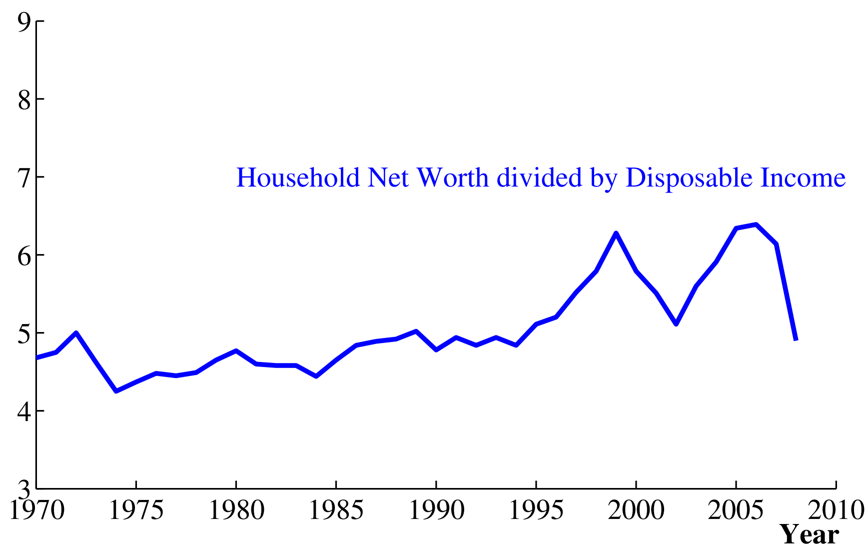
Note: Between 1980 and 2008, the personal saving rate fell from about 10 percent to below 2 percent before rising in 2009. Source: The FRED database.

duced their saving for much of the last two decades, choosing to consume more instead. Why have these changes occurred? Economists have put forward a number of explanations. One of the most widely held explanations is that large capital gains in the stock market and housing market during the last several decades have reduced the need for additional saving. The balance in your 401k plan can increase because you add more saving each month, or it can increase because the value of the assets being held has risen. The large gains in the stock market in the 1980s and 1990s and the large gains in real estate before the financial crisis may have made households feel sufficiently wealthy that they felt they could reduce their personal saving and even borrow more to raise their consumption.

Evidence for this claim is documented in Figure 20.5. Household wealth — even as a ratio to income — rose during the 1980s and 1990s, despite the rise in debt and the decline in saving. Similarly, the recent rise in the saving rate in light of the financial crisis is consistent with this explanation: as the value of their financial assets has declined, households have increased their saving rate. Economists will be watching the behavior of the personal saving rate in coming years with must interest.[10]

[10] For a discussion of these explanations, see "Remarks by Vice Chairman Roger W. Ferguson, Jr. to the National Bankers Association," Nashville, Tennessee, October 6, 2004. The extent to which stock market returns affect saving and consumption is discussed by James Poterba, "Stock Market Wealth and Consumption," *Journal of Economic Perspectives*, vol. 14 (Spring 2000), pp. 99–118.

Figure 20.5: Household Wealth (as a ratio to Income)



Note: Despite the rise in debt and the decline in saving, household wealth rose during the 1980s and 1990s. During the last decade, wealth declined following the dot-com stock market crash, recovered with the housing market boom, and then declined again back to its 1990 level following the collapse in financial markets. Source: *Flow of Funds of the United States.*

The permanent income model provides another possible explanation for the rise in borrowing and decline in saving. If households believe they will be much richer in the future (moreso in the United States than in other countries), then they may borrow against their high future income. A story like this one would seem to make more sense for a country like China or India than for the United States. However, China's saving rate has been rising rather than falling. This story by itself, then, seems to get the facts backward. We will come back to this puzzle in Chapter (IntlTrade) when we discuss international trade.

5. Summary

1. The neoclassical consumption model is based on rational individuals who choose the time path of their consumption to maximize a utility function subject to their intertemporal budget constraint.

2. This problem is relatively easy to study when we consider only two periods, such as *today* and the *future*.

3. The solution to this basic problem is a version of the permanent income hypothesis: consumption in each period is a fraction of total wealth, where total wealth includes financial resources, current income, and the present discounted value of future income.

4. This solution can also be expressed in terms of the Euler equation for consumption. This equation says that individuals are indifferent between consuming a little more today, on the one hand, or saving a little more and consuming the proceeds in the future.

5. A key implication of this result is that individuals will seek to smooth out any shocks to current and future income, suggesting that the marginal propensity to consume out of a temporary increase in current income is likely to be small.

6. There are two forces that may counterbalance this low marginal propensity to consume, however. Individuals who are constrained from borrowing in credit markets — perhaps because they have zero or low wealth and uncertain income — may set their consumption proportional to their income. Even if they are unencumbered by borrowing constraints, however, such individuals may engage in precautionary saving to insure themselves against the possibility of unemployment or disability and may therefore also have a high marginal propensity to consume.

7. Empirical evidence, consistent with this theory, suggests that while the permanent income model is a good benchmark for describing the consumption of well-off individuals, there are also many poorer consumers with a high marginal propensity to consume.

8. Behavioral economics provides a more nuanced approach to the study of individual behavior, incorporating insights from psychology and neuroscience. Thusfar, this literature has served primarily to highlight many ways in which individuals depart from neoclassical behavior.

9. Aggregate evidence on consumption during the 1980s and 1990s shows a rise in debt as a ratio to income and a decline in the personal saving rate. Despite these changes, household wealth as a ratio to income also rises during this period before falling back to its 1990 level in response to the recent financial turmoil.

6. Key Concepts

behavioral economics, borrowing constraints, diminishing marginal utility, Euler equation, financial wealth, human wealth, intertemporal budget constraint, marginal propensity to consume, permanent income hypothesis, personal saving rate, precautionary saving, random walk view of consumption, Ricardian equivalence, utility function

7. Review Questions

1. What are the key building blocks of the neoclassical consumption model?

2. What is an intertemporal budget constraint, and where does it come from? What is the economic interpretation of the intertemporal budget constraint?

3. What is a lifetime utility function, and it what sense does it exhibit diminishing returns?

4. Summarize the main implications of the neoclassical consumption model for consumption and saving.

5. What is the Euler equation for consumption and what is its economic interpretation?

6. How are interest rates and growth rates related according to the neoclassical consumption model and why?

7. What is the marginal propensity to consume? How is it affected by borrowing constraints or precautionary saving issues?

8. Summarize the key facts about the behavior of the personal saving rate during recent decades and place these facts in their macroeconomic context.

8. Exercises

worked exercise

1. **The neoclassical consumption model, a student's perspective:** Consider the special case solved in the text where $\beta = 1$ and utility takes the log form. Suppose the real interest rate is 5 percent. Let's give this consumer a financial profile that might look like that of a typical economics student: suppose initial assets are $f_{\text{today}} = \$5,000$, and the path for labor income is $y_{\text{today}} = \$10,000$ and $y_{\text{future}} = \$100,000$.

   (a) What is the individual's human wealth? Total wealth?

   (b) How much does a neoclassical consumer consume today and in the future?

   (c) By how much does consumption today rise if current labor income increases by $10,000?

   (d) By how much does consumption today rise if future labor income rises by $10,000? Why does your answer here differ from that in part (c)?

   (e) If the interest rate rises to 10 percent, what happens to total wealth and consumption today?

   (f) What happens to consumption if the student is constrained for some reason and cannot borrow when young?

2. **The neoclassical consumption model, a retirement perspective:** Consider the special case solved in the text where $\beta = 1$ and utility takes the log form. Suppose the real interest rate is 5 percent. Let's give this consumer a financial profile that might look like that of a middle-aged college professor contemplating retirement: suppose initial assets are $f_{\text{today}} = \$50,000$, and the path for labor income is $y_{\text{today}} = \$100,000$ and $y_{\text{future}} = \$10,000$.

   (a) What is the individual's human wealth? Total wealth?

   (b) According to the neoclassical model, how much does the college professor consume today and in the future? How much does the college professor save today?

   (c) If current labor income rises by $20,000, by how much will saving change?

(d) By how much does consumption today rise if future labor income rises by $10,000?

(e) If the interest rate rises to 10 percent, by how much do total wealth and today's consumption change? By how much does saving change? Why are these effects so much smaller than in Exercise 1?

3. **Financial wealth and consumption:** Consider the neoclassical consumption model with log utility and $\beta = 1$. Suppose an individual begins with $10,000 in stocks and $30,000 of equity in her house, so that financial assets are $f_{\text{today}} = \$40,000$. Suppose her labor income stream is $50,000, both today and in the future, and suppose the real interest rate is zero.

   (a) What is c_{today} and c_{future}? How much does the consumer save today?

   (b) Suppose the stock market booms, doubling in value. By how much do consumption and saving change today?

   (c) Alternatively, suppose housing prices rise so that the individual's equity in her house rises to $50,000. Now what happens to consumption and saving today?

   (d) Discuss briefly how this exercise is related to the state of the U.S. economy around 2007.

4. **Interest rates and growth rates:** Consider the Euler equation for consumption for log utility, equation (20.8) and answer the following questions.

   (a) If the real interest rate is 5 percent and $\beta = 1$, what growth rate for consumption will households choose?

   (b) What if $\beta = .95$?

   (c) Alternatively, suppose the long-run growth model means GDP per person will grow at a constant rate of 2 percent per year. Suppose $\beta = .95$. In order for the Euler equation to hold in this case, what value must the real interest rate take?

5. **The neoclassical consumption model: log utility and $\beta \neq 1$:** With log utility, the solution to the neoclassical consumption model is given implicitly by the two equations on page zzz, the Euler equation and the intertemporal budget constraint:

$$\frac{c_{\text{future}}}{c_{\text{today}}} = \beta(1+R).$$

$$c_{\text{today}} + \frac{c_{\text{future}}}{1+R} = \bar{W}$$

There, we solved these two equations for c_{today} and c_{future} in the special case where $\beta = 1$. This exercise considers the case where β differs from one.

(a) Solve these two equations for c_{today} and c_{future} when $\beta \neq 1$.

(b) Verify that the solution matches what we obtained in the text when $\beta = 1$.

(c) When $\beta < 1$, is c_{today} higher or lower than when $\beta = 1$? Why?

6. **Ricardian equivalence?** Suppose that the government fears the economy might be heading into a recession and decides to cut income taxes today in an effort to prevent the recession.

   (a) How does the Ricardian equivalence argument apply in this case? How will consumption respond according to this argument?

   (b) How will your answer change if some individuals are borrowing constrained?

7. **Inequality and the neoclassical consumption model:** As discussed extensively in Chapter 7, income inequality has risen in recent decades in the United States. This question considers the implications for consumption inequality.

   (a) Suppose a substantial part of the rise in inequality is due to the rising returns to education, so that more highly educated workers are permanently richer than less educated workers. According to the neoclassical consumption model, what would happen to consumption inequality?

   (b) Alternatively, suppose that most of the rise in inequality is due to an increase in the frequency and magnitude of temporary shocks (like unemployment or temporary booms and busts in particular industries). What would happen to consumption inequality in this case?

8. **Household debt and saving in the U.S. economy:** Figures 20.3 and 20.4 showed household debt as a percentage of GDP and the personal saving rate. According to these graphs, the ratio of household debt to GDP in 2007, before the financial crisis took hold, was just under 100 percent. In the same year, the personal saving rate was 1.7 percent.

   (a) Using the FRED database hosted by the Federal Reserve Bank of St. Louis, obtain the latest values for these two statistics. How has the ratio of household debt to GDP changed since 2007? What about the personal saving rate?

   (b) Discuss some possible explanations for these changes.

9. Worked Exercises

1. The neoclassical consumption model, a student's perspective:

(a) Human wealth is the presented discounted value of labor income:

$$y_{\text{today}} + \frac{y_{\text{future}}}{1+R} = \$10,000 + \frac{\$100,000}{1.05} = \$105,238.$$

Total wealth is the sum of financial wealth and human wealth, so we just add $5,000 to our previous answer to get $110,238.

(b) According to the solution to the neoclassical consumption model in this case,

$$c_{\text{today}} = \frac{1}{2} \cdot \bar{W} = 0.5 \times \$110,238 = \$55,119$$

and

$$c_{\text{future}} = \frac{1}{2} \cdot (1+R)\bar{W} = 0.5 \times 1.05 \times \$110,238 = \$57,875.$$

Notice how remarkable this is: even though the student's income is only $10,000 today, her consumption is more than $55,000! Something to think further about: how is the student able to consume more than her income? Do you think students behave like this in reality? Why or why not?

(c) An increase in current labor income by $10,000 raises total wealth by this same amount. The marginal propensity to consume out of total wealth is 1/2 (since the solution for consumption is $c_{\text{today}} = \frac{1}{2} \cdot \bar{W}$). So consumption today rises by $5,000.

(d) Alternatively, if the rise occurs in the future, then total wealth increases by only the present value of $10,000 which is $10,000/1.05=$9,524. Consumption rises by half this amount, or $4,762. The amount is smaller because future income is worth less than current income (because of the positive interest than can be earned).

(e) An increase in the interest rate will reduce consumption today because of the *wealth effect*: it lowers the present discounted value of labor income. With an interest rate of 10 percent, a calculation like that in part (a) indicates that human wealth is only $100,909 so total wealth is only $105,909. Consumption today is therefore only $52,955.

(f) In this problem, the student's income is very low initially, so according to the neoclassical consumption model, she should borrow a large amount so that her current consumption lines up better with her high future income. If she is borrowing constrained, however, this will not be possible. Instead, she will wish to consume as much as she can today, which will mean she consumes all her current resources: current labor income plus current financial assets, or $15,000. Notice two things. First, borrowing constraints can markedly change consumption. Second, they make consumption depend much more on current labor income.