

MACROECONOMICS

Econ 2022



MODULE II

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September, 2019
Arba Minch, Ethiopia

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**ARBA MINCH UNIVERSITY COLLEGE OF BUSINESS AND ECONOMICS
DEPARTMENT OF ECONOMICS**

September, 2020
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Preface

We'll come to the second part of macroeconomics module. In this part you will learn the behavioral foundations of macroeconomics. That is, you deal more on the "Microeconomics behind Macroeconomics," some of the microeconomic models that are useful for analyzing macroeconomic issues. For example, it examines the household's decisions regarding how much to consume and how much money to hold and the firm's decision regarding how much to invest. These individual decisions together form the larger macroeconomic picture. The goal of studying these microeconomic decisions in detail is to refine our understanding of the aggregate economy.

We hope you will find this module worth reading. And finally, we wish you all the best in your study.

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Chapter – One

Consumption

1.1. Introduction

Dear students, welcome to the first chapter of the course MACROECONOMICS. In this chapter we examine the consumption function in greater detail and develop a more thorough explanation of what determines aggregate consumption. The chapter also presents the view of five prominent economists to show the diverse approaches to explaining consumption.

Chapter objectives:

Upon a successful completion of this chapter, students will be able to:

- *understand the Keynesian consumption function and which consumption behavior is well explained by it*
- *Understand the way economists' judge rational and forward looking consumers*
- *Comprehend different consumption functions that solve the consumption puzzle*

Chapter Outline:

- *The concept of consumption*
- *Keynes and the consumption function*
- *Fisher and intertemporal choice*
- *Modigliani and the life-cycle hypothesis*
- *Friedman and the permanent income hypothesis*
- *Robert Hall and the random walk hypothesis*

1.2 The Concept of Consumption

How do households decide how much of their income to consume today and how much to save for the future? This is a microeconomic question because it addresses the behavior of individual decision makers. Yet its answer has macroeconomic consequences. As we have seen in Macroeconomics I, households' consumption decisions affect the way the economy as a whole behaves both in the long run and in the short run.

The consumption decision is crucial for long-run analysis because of its role in economic growth. The consumption decision is crucial for short-run analysis because of its role in determining aggregate demand. Consumption is two-thirds of GDP, so fluctuations in consumption are a key element of booms and recessions. The IS-PC model shows that changes in consumers spending plans can be a source of shocks to the economy, and that the marginal propensity to consume is a determinant of the fiscal policy multipliers.

In previous chapters we explained consumption with a function that relates consumption to disposable income: $C = C_0 + MPC \cdot Y_d$. This approximation allowed us to develop simple models for long-run and short-run analysis, but it is too simple to provide a complete explanation of consumer behavior. In this chapter we examine the consumption function in greater detail and develop a more thorough explanation of what determines aggregate consumption.

Since macroeconomics began as a field of study, many economists have written about the theory of consumer behavior and suggested alternative ways of interpreting the data on consumption and income. This chapter presents the views of some of the prominent economists to show the diverse approaches to explaining consumption.

1.3 Keynes and the Consumption Function

Activity

Dear learners, explain the Keynes' consumption function

We begin our study of consumption with John Maynard Keynes's *General Theory*, which was published in 1936. Keynes made the consumption function central to his theory of economic fluctuations, and it has played a key role in macroeconomic analysis ever since. Let's consider what Keynes thought about the consumption function, and then see what puzzles arose when his ideas were confronted with the data.

Keynes's Conjectures

Today, economists who study consumption rely on sophisticated techniques of data analysis. With the help of computers, they analyze aggregate data on the behavior of the overall economy from the national income accounts and detailed data on the behavior of individual households from surveys. Because Keynes wrote in the 1930s, however, he had neither the advantage of these data nor the computers necessary to analyze such large data sets. Instead of relying on statistical analysis, based on introspection and casual observation. Conjecture is inference based on incomplete evidence.

First, Keynes conjectured that the **marginal propensity to consume**, the amount consumed out of an additional dollar of income, is between zero and one. He wrote that the —fundamental psychological law, upon which we are entitled to depend with great confidence,...is that men are disposed, as a rule and on the average, to increase their consumption as their income increases, but not by as much as the increase in their income. That is, when a person earns an extra dollar, he typically spends some of it and saves some of it. As we saw in *Macroeconomics I* when we

developed the Keynesian cross, the marginal propensity to consume was crucial to Keynes's policy recommendations for how to reduce widespread unemployment. The power of fiscal policy to influence the economy—as expressed by the fiscal-policy multipliers—arises from the feed-back between income and consumption.

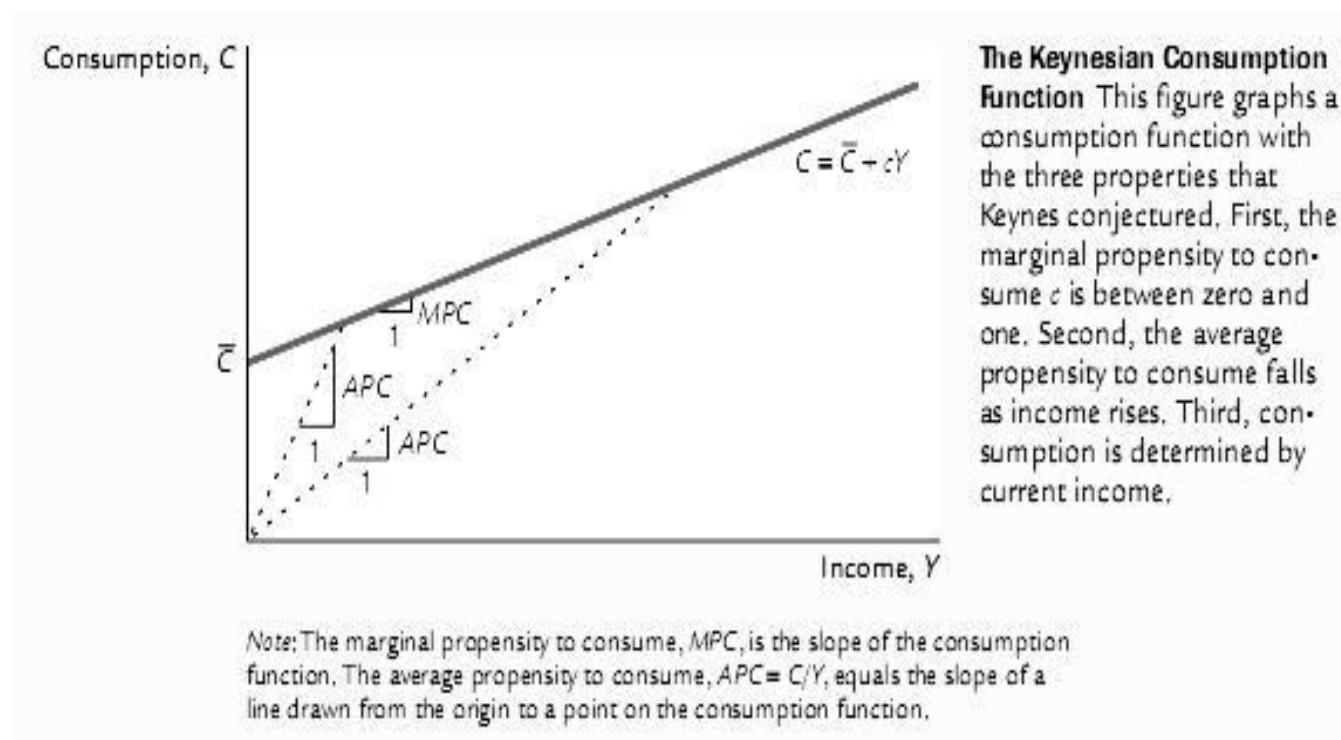
Second, Keynes posited that the ratio of consumption to income, called the average propensity to consume, falls as income rises. He believed that saving was a luxury, so he expected the rich to save a higher proportion of their income than the poor. Although not essential for Keynes's own analysis, the postulate that the average propensity to consume falls as income rises became a central part of early Keynesian economics.

Third, Keynes thought that income is the primary determinant of consumption and that the interest rate does not have an important role. This conjecture stood in stark contrast to the beliefs of the classical economists who preceded him. The classical economists held that a higher interest rate encourages saving and discourages consumption. Keynes admitted that the interest rate could influence consumption as a matter of theory. Yet he wrote that —the main conclusion suggested by experience, I think, is that the short-period influence of the rate of interest on individual spending out of a given income is secondary and relatively unimportant.¶

On the basis of these three conjectures, the Keynesian consumption function is often written as

where C is consumption, Y is disposable income, $\bar{C}$ is constant, marginal propensity to consume. This consumption function, shown in Figure 1-1 (below), is graphed as a straight line.

Figure 1.1



Notice that this consumption function exhibits the three properties that Keynes posited. It satisfies Keynes's first property because the marginal propensity to consume c is between zero and one, so that higher income leads to higher consumption and also to higher saving. This consumption function satisfies Keynes's second property because the average propensity to consume APC is

As Y rises, APC falls, and so the average propensity to consume falls. And finally, this consumption function satisfies Keynes's third property because the interest rate is not included in this equation as a determinant of consumption.

Activity

Dear learners! Elucidate the three conjectures Keynes made about the consumption function

The Early Empirical Successes

Soon after Keynes proposed the consumption function, economists began collecting and examining data to test his conjectures. The earliest studies indicated that the Keynesian consumption function is a good approximation of how consumers behave.

In some of these studies, researchers surveyed households and collected data on consumption and income. They found that households with higher income consumed more, which confirms that the marginal propensity to consume is greater than zero. They also found that households with higher income saved more, which confirms that the marginal propensity to consume is less than one. In addition, these researchers found that higher-income households saved a larger fraction of their income, which confirms that the average propensity to consume falls as income rises. Thus, these data verified Keynes's conjectures about the marginal and average propensities to consume.

In other studies, researchers examined aggregate data on consumption and income for the period between the two world wars. These data also supported the Keynesian consumption function. In years when income was unusually low, such as during the depths of the Great Depression, both consumption and saving were low, indicating that the marginal propensity to consume is between zero and one. In addition, during those years of low income, the ratio of consumption to income was high, confirming Keynes's second conjecture. Finally, because the correlation between income and consumption was so strong, no other variable appeared to be important for explaining consumption. Thus, the data also confirmed Keynes's third conjecture that income is the primary determinant of how much people choose to consume.

Secular Stagnation, Simon Kuznets, and the Consumption Puzzle

Although the Keynesian consumption function met with early successes, two anomalies soon arose. Both concern Keynes's conjecture that the average propensity to consume falls as income rises.

The first anomaly became apparent after some economists made a dire-and, it turned out, erroneous-prediction during World War II. On the basis of the Keynesian consumption function, these economists reasoned that as incomes in the economy grew over time, households would consume a smaller and smaller fraction of their incomes. They feared that there might not be enough profitable investment projects to absorb all this saving. If so, the low consumption would lead to an inadequate demand for goods and services, resulting in a depression once the wartime demand from the government ceased. In other words, on the basis of the Keynesian consumption function, these economists predicted that the economy would experience what they called secular stagnation-a long depression of indefinite duration-unless fiscal policy was used to expand aggregate demand.

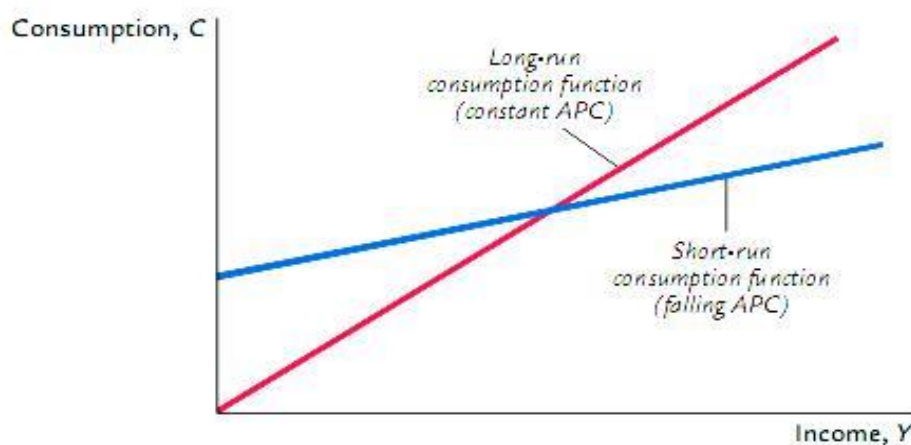
Fortunately for the economy, but unfortunately for the Keynesian consumption function, the end of World War II did not throw the country into another depression. Although incomes were much higher after the war than before, these higher incomes did not lead to large increases in the rate of saving. Keynes's conjecture that the average propensity to consume would fall as income rose appeared not to hold.

The second anomaly arose when economist Simon Kuznets constructed new aggregate data on consumption and income dating back to 1869. Kuznets assembled these data in the 1940s and would later receive the Nobel Prize for this work. He discovered that the ratio of consumption to income was remarkably stable from decade to decade, despite large increases in income over the period he studied. Again, Keynes's conjecture that the average propensity to consume would fall as income rose appeared not to hold.

The failure of the secular-stagnation hypothesis and the findings of Kuznets both indicated that the average propensity to consume is fairly constant over long periods of time. This fact presented a puzzle that motivated much of the subsequent work on consumption. Economists wanted to know why some studies confirmed Keynes's conjectures and others refuted them. That is, why did Keynes's conjectures hold up well in the studies of household data and in the studies of short time-series, but fail when long time-series were examined?

Figure 1-2 illustrates the puzzle. The evidence suggested that there were two consumption functions. For the household data or for the short time-series, the Keynesian consumption function appeared to work well. Yet for the long time-series, the consumption function appeared to have a constant average propensity to consume. In Figure 1-2, these two relationships between consumption and income are called the short-run and long-run consumption functions. Economists needed to explain how these two consumption functions could be consistent with each other.

Figure 1.2



The Consumption Puzzle

Studies of household data and short time-series found a relationship between consumption and income similar to the one Keynes conjectured. In the figure, this relationship is called the short-run consumption function. But studies of long time-series found that the average propensity to consume did not vary systematically with income. This relationship is called the long-run consumption function. Notice that the short-run consumption function has a falling average propensity to consume, whereas the long-run consumption function has a constant average propensity to consume.

1.4 Fisher and Intertemporal Choice

The consumption function introduced by Keynes relates current consumption to current income. This relationship, however, is incomplete at best. When people decide how much to consume and how much to save, they consider both the present and the future. The more consumption they enjoy today, the less they will be able to enjoy tomorrow. In making this tradeoff, households must look ahead to the income they expect to receive in the future and to the consumption of goods and services they hope to be able to afford.

The economist Irving Fisher developed the model with which economists analyze how rational, forward-looking consumers make intertemporal choices—that is, choices involving different periods of time. Fisher’s model illuminates the constraints consumers face, the preferences they have, and how these constraints and preferences together determine their choices about consumption and saving.

The Intertemporal Budget Constraint

Most people would prefer to increase the quantity or quality of the goods and services they consume—to wear nicer clothes, eat at better restaurants, or see more movies. The reason people consume less than they desire is that their consumption is constrained by their income. In other words, consumers face a limit on how much they can spend, called a budget constraint. When they are deciding how much to consume today versus how much to save for the future, they face an *intertemporal budget constraint*, which measures the total resources available for consumption today and in the future. Our first step in developing Fisher’s model is to examine this constraint in some detail.

To keep things simple, we examine the decision facing a consumer who lives for two periods. Period one represents the consumer’s youth and period two represents the consumer’s old age. The consumer earns income Y_1 and consumes C_1 in period one, and earns income Y_2 and consumes C_2 in period two. (All variables are real—that is, adjusted for inflation.) Because the consumer has the opportunity to borrow and save, consumption in any single period can be either greater or less than income in that period.

Consider how the consumer’s income in the two periods constrains consumption in the two periods. In the first period, saving equals income minus consumption. That is,

$$S = Y_1 - C_1,$$

where S is saving. In the second period, consumption equals the accumulated saving, including the interest earned on that saving, plus second-period income. That is,

$$C_2 = (1 + r)S + Y_2,$$

where r is the real interest rate. For example, if the interest rate is 5 percent, then for every \$1 of saving in period one, the consumer enjoys an extra \$1.05 of consumption in period two. Because there is no third period, the consumer does not save in the second period.

Note that the variable S can represent either saving or borrowing and that these equations hold in both cases. If first-period consumption is less than first-period income, the consumer is saving, and S is greater than zero. If first-period consumption exceeds first-period income, the consumer is borrowing, and S is less than zero. For simplicity, we assume that the interest rate for borrowing is the same as the interest rate for saving.

To derive the consumer's budget constraint, combine the two preceding equations. Substitute the first equation for S into the second equation to obtain

$$C_2 = (1 + r)(Y_1 - C_1) + Y_2.$$

To make the equation easier to interpret, we must rearrange terms. To place all the consumption terms together, bring $(1 + r)C_1$ from the right-hand side to the left-hand side of the equation to obtain

$$(1 + r)C_1 + C_2 = (1 + r)Y_1 + Y_2.$$

Now divide both sides by $1 + r$ to obtain

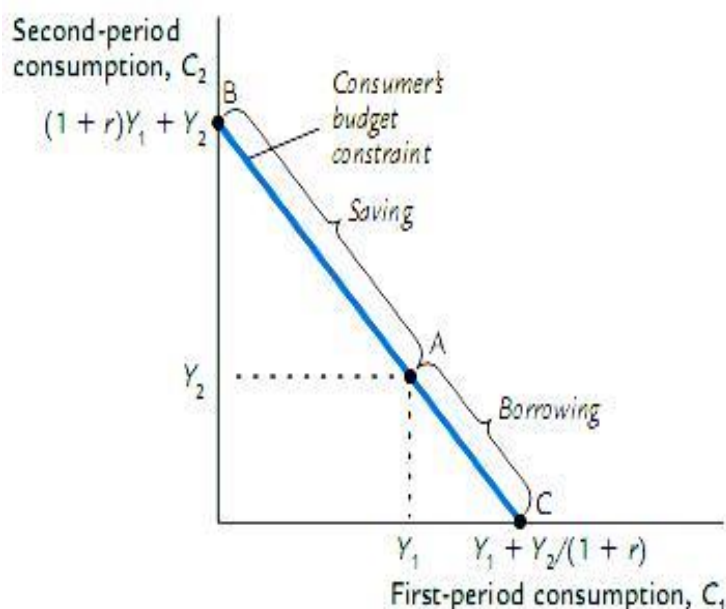
$$C_1 + \frac{C_2}{1 + r} = Y_1 + \frac{Y_2}{1 + r}.$$

This equation relates consumption in the two periods to income in the two periods. It is the standard way of expressing the consumer's intertemporal budget constraint.

Figure 1-3 graphs the consumer's budget constraint. Three points are marked on this figure. At point A, the consumer consumes exactly his income in each period ($C_1 = Y_1$ and $C_2 = Y_2$), so there is neither saving nor borrowing between the two periods. At point B, the consumer consumes nothing in the first period ($C_1=0$) and saves all income, so second-period consumption C_2 is $(1 + r)Y_1 + Y_2$. At point C, the consumer plans to consume nothing in the second period ($C_2=0$) and borrows as much as possible against second-period income, so first-period consumption C_1 is $Y_1 + Y_2 / (1 + r)$. Of course, these are only three of the many combinations of

first- and second-period consumption that the consumer can afford: all the points on the line from B to C are available to the consumer.

Figure 1.3



The Consumer's Budget Constraint This figure shows the combinations of first-period and second-period consumption the consumer can choose. If he chooses points between A and B, he consumes less than his income in the first period and saves the rest for the second period. If he chooses points between A and C, he consumes more than his income in the first period and borrows to make up the difference.

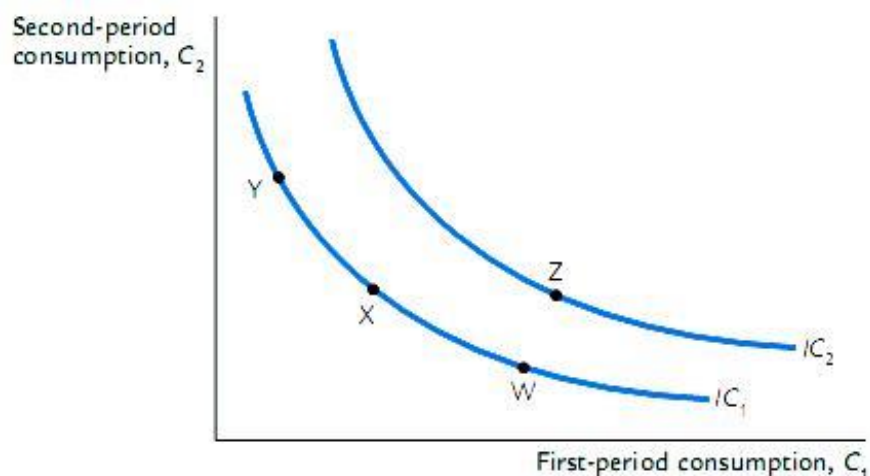
Consumer Preferences

The consumer's preferences regarding consumption in the two periods can be represented by indifference curves. An indifference curve shows the combinations of first-period and second-period consumption that make the consumer equally happy.

Figure 1-4 shows two of the consumer's many indifference curves. The consumer is indifferent among combinations W, X, and Y, because they are all on the same curve. Not surprisingly, if the consumer's first-period consumption is reduced, say from point W to point X, second-period consumption must increase to keep him equally happy. If first-period consumption is reduced again, from point X to point Y, the amount of extra second-period consumption he requires for compensation is greater.

The slope at any point on the indifference curve shows how much second-period consumption the consumer requires in order to be compensated for a one-unit reduction in first-period consumption. This slope is the *marginal rate of substitution* between first-period consumption and second-period consumption. It tells us the rate at which the consumer is willing to substitute second-period consumption for first-period consumption.

Figure 1.4



The Consumer's Preferences
Indifference curves represent the consumer's preferences over first-period and second-period consumption. An indifference curve gives the combinations of consumption in the two periods that make the consumer equally happy. This figure shows two of many indifference curves. Higher indifference curves such as IC_2 are preferred to lower curves such as IC_1 . The consumer is equally happy at points W, X, and Y, but prefers point Z to points W, X, or Y.

The consumer is equally happy at all points on a given indifference curve, but he prefers some indifference curves to others. Because he prefers more consumption to less, he prefers higher indifference curves to lower ones. In Figure 1-4, the consumer prefers the points on curve IC_2 to the points on curve IC_1 .

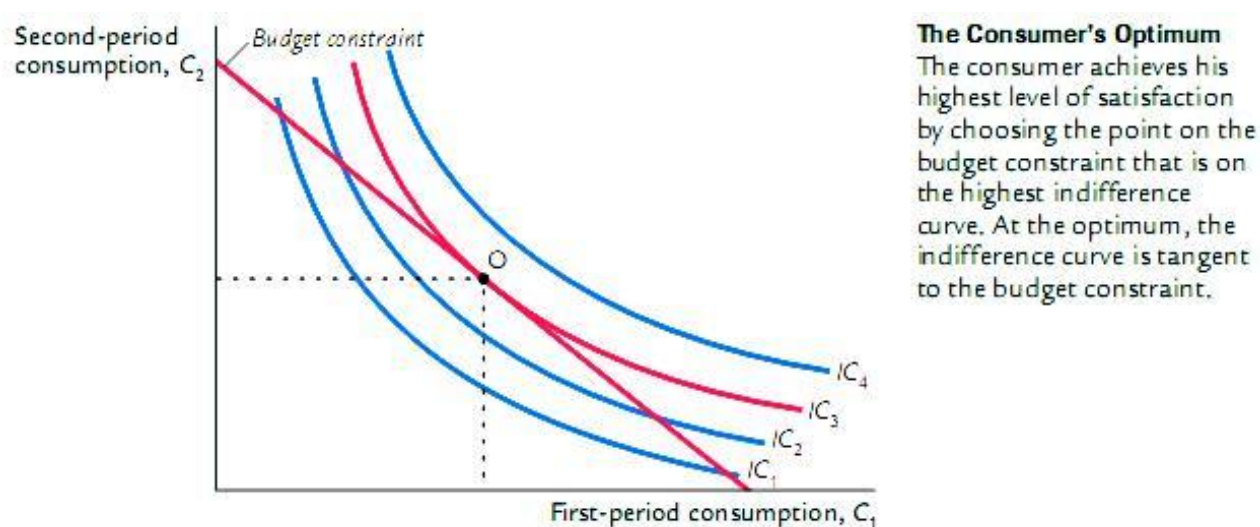
The set of indifference curves gives a complete ranking of the consumer's preferences. It tells us that the consumer prefers point Z to point W, but that may be obvious because point Z has more consumption in both periods. Yet compare point Z and point Y: point Z has more consumption in period one and less in period two. Which is preferred, Z or Y? Because Z is on a higher indifference curve than Y, we know that the consumer prefers point Z to point Y. Hence, we can use the set of indifference curves to rank any combinations of first-period and second-period consumption.

Optimization

Having discussed the consumer's budget constraint and preferences, we can consider the decision about how much to consume. The consumer would like to end up with the best possible combination of consumption in the two periods- that is, on the highest possible indifference curve. But the budget constraint requires that the consumer also end up on or below the budget line, because the budget line measures the total resources available to him.

Figure 1-5 shows that many indifference curves cross the budget line. The highest indifference curve that the consumer can obtain without violating the budget constraint is the indifference curve that just barely touches the budget line, which is curve IC_3 in the figure. The point at which the curve and line touch-point O for —optimum!—is the best combination of consumption in the two periods that the consumer can afford.

Figure 1.5



Notice that, at the optimum, the slope of the indifference curve equals the slope of the budget line. The indifference curve is tangent to the budget line. The slope of the indifference curve is the marginal rate of substitution MRS , and the slope of the budget line is one plus the real interest rate. We conclude that at point O,

$$MRS = 1 + r.$$

The consumer chooses consumption in the two periods so that the marginal rate of substitution equals one plus the real interest rate.

How Changes in Income Affect Consumption

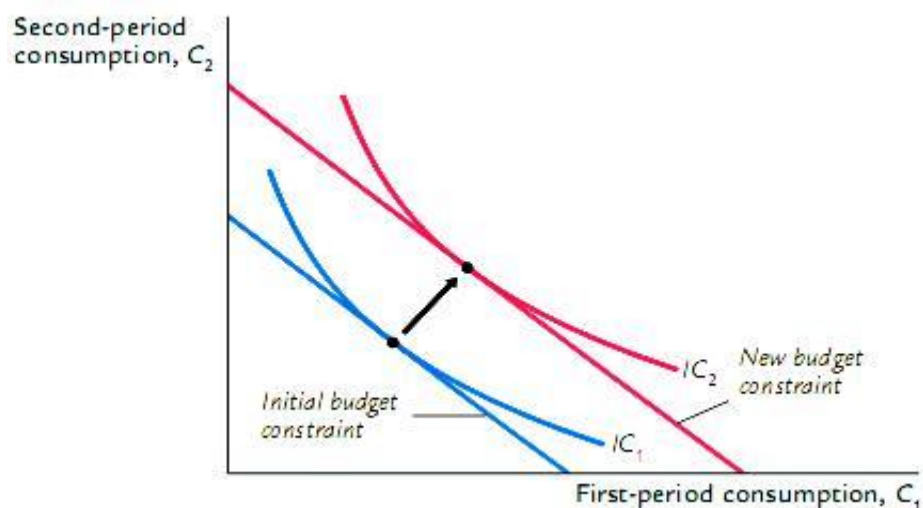
Now that we have seen how the consumer makes the consumption decision, let's examine how consumption responds to an increase in income. An increase in either Y_1 or Y_2 shifts the budget constraint outward, as in Figure 1-6. The higher budget constraint allows the consumer to choose a better combination of first-and second-period consumption-that is, the consumer can now reach a higher indifference curve.

In Figure 1-6, the consumer responds to the shift in his budget constraint by choosing more consumption in both periods. Although it is not implied by the logic of the model alone, this situation is the most usual. If a consumer wants more of a good when his or her income rises, economists call it a normal good. The indifference curves in Figure 1-6 are drawn under the assumption that consumption in period one and consumption in period two are both *normal goods*.

The key conclusion from Figure 1-6 is that regardless of whether the increase in income occurs in the first period or the second period, the consumer spreads it over consumption in both periods. This behavior is sometimes called consumption smoothing. Because the consumer can borrow and lend between periods, the timing of the income is irrelevant to how much is consumed today (except, of course, that future income is discounted by the interest rate). The lesson of this analysis is that consumption depends on the present value of current and future income-that is, on

$$\text{Present Value of Income} = Y_1 + \frac{Y_2}{1+r}$$

Notice that this conclusion is quite different from that reached by Keynes. *Keynes posited that a person's current consumption depends largely on his current income. Fisher's model says, instead, that consumption is based on the resources the consumer expects over his lifetime.*

Figure 1.6

An Increase in Income An increase in either first-period income or second-period income shifts the budget constraint outward. If consumption in period one and consumption in period two are both normal goods, this increase in income raises consumption in both periods.

How Changes in the Real Interest Rate Affect Consumption

Let's now use Fisher's model to consider how a change in the real interest rate alters the consumer's choices. There are two cases to consider: the case in which the consumer is initially saving and the case in which he is initially borrowing. Here we discuss the saving case; Problem one at the end of the chapter asks you to analyze the borrowing case.

Figure 1-7 shows that an increase in the real interest rate rotates the consumer's budget line around the point (Y_1, Y_2) and, thereby, alters the amount of consumption he chooses in both periods. Here, the consumer moves from point A to point B. You can see that for the indifference curves drawn in this figure first-period consumption falls and second-period consumption rises.

Economists decompose the impact of an increase in the real interest rate on consumption into two effects: an income effect and a substitution effect. Textbooks in microeconomics discuss these effects in detail. We summarize them briefly here.

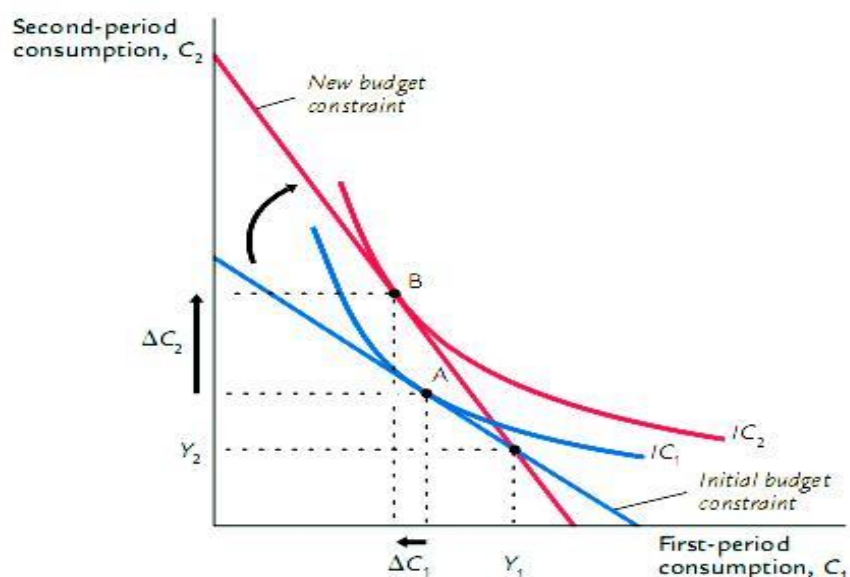
The income effect is the change in consumption that results from the movement to a higher indifference curve. Because the consumer is a saver rather than a borrower (as indicated by the fact that first-period consumption is less than first-period income), the increase in the interest

rate makes him better off (as reflected by the movement to a higher indifference curve). If consumption in period one and consumption in period two are both normal goods, the consumer will want to spread this improvement in his welfare over both periods. This income effect tends to make the consumer want more consumption in both periods.

The substitution effect is the change in consumption that results from the change in the relative price of consumption in the two periods. In particular, consumption in period two becomes less expensive relative to consumption in period one when the interest rate rises. That is, because the real interest rate earned on saving is higher, the consumer must now give up less first-period consumption to obtain an extra unit of second-period consumption. This substitution effect tends to make the consumer choose more consumption in period two and less consumption in period one.

The consumer's choice depends on both the income effect and the substitution effect. Both effects act to increase the amount of second-period consumption; hence, we can confidently conclude that an increase in the real interest rate raises second-period consumption. But the two effects have opposite impacts on first-period consumption, so the increase in the interest rate could either raise or lower it. Hence, depending on the relative size of the income and substitution effects, an increase in the interest rate could either stimulate or depress saving.

Figure 1.7



An Increase in the Interest Rate
An increase in the interest rate rotates the budget constraint around the point (Y_1, Y_2) . In this figure, the higher interest rate reduces first-period consumption by ΔC_1 and raises second-period consumption by ΔC_2 .

Constraints on Borrowing

Fisher's model assumes that the consumer can borrow as well as save. The ability to borrow allows current consumption to exceed current income. In essence, when the consumer borrows, he consumes some of his future income today. Yet for many people such borrowing is impossible. For example, a student wishing to enjoy spring break in Langano would probably be unable to finance this vacation with a bank loan. Let's examine how Fisher's analysis changes if the consumer cannot borrow.

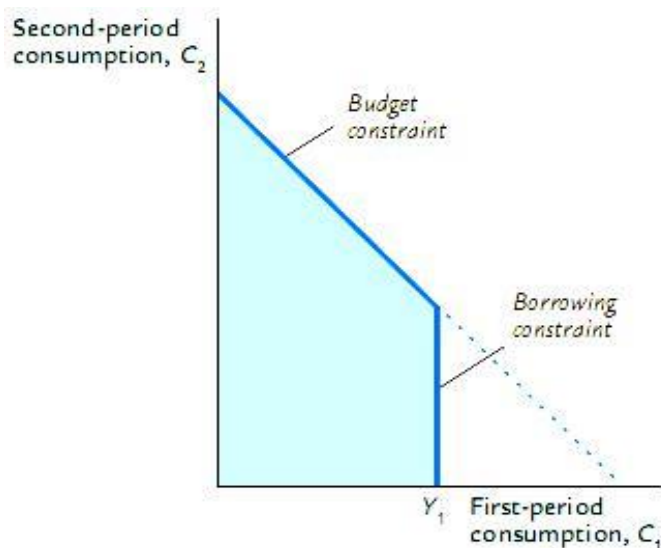
The inability to borrow prevents current consumption from exceeding current income. A constraint on borrowing can therefore be expressed as

$$C_1 \leq Y_1.$$

This inequality states that consumption in period one must be less than or equal to income in period one. This additional constraint on the consumer is called a *borrowing constraint* or, sometimes, a *liquidity constraint*.

The consumer's choice must satisfy both the intertemporal budget constraint and the borrowing constraint. The shaded area in the Figure 1-8 represents the combinations of first-period consumption and second-period consumption that satisfy both constraints.

Figure 1.8



A Borrowing Constraint If the consumer cannot borrow, he faces the additional constraint that first-period consumption cannot exceed first-period income. The shaded area represents the combination of first-period and second-period consumption the consumer can choose.

Figure 1-9 shows how this borrowing constraint affects the consumption decision. There are two possibilities. In panel (a), the consumer wishes to consume less in period one than he earns. The borrowing constraint is not binding and, therefore, does not affect consumption. In panel (b), the consumer would like to choose point D, where he consumes more in period one than he earns, but the borrowing constraint prevents this outcome. The best the consumer can do is to consume his first-period income, represented by point E.

The analysis of borrowing constraints leads us to conclude that there are two consumption functions. For some consumers, the borrowing constraint is not binding, and consumption in both periods depends on the present value of lifetime income,

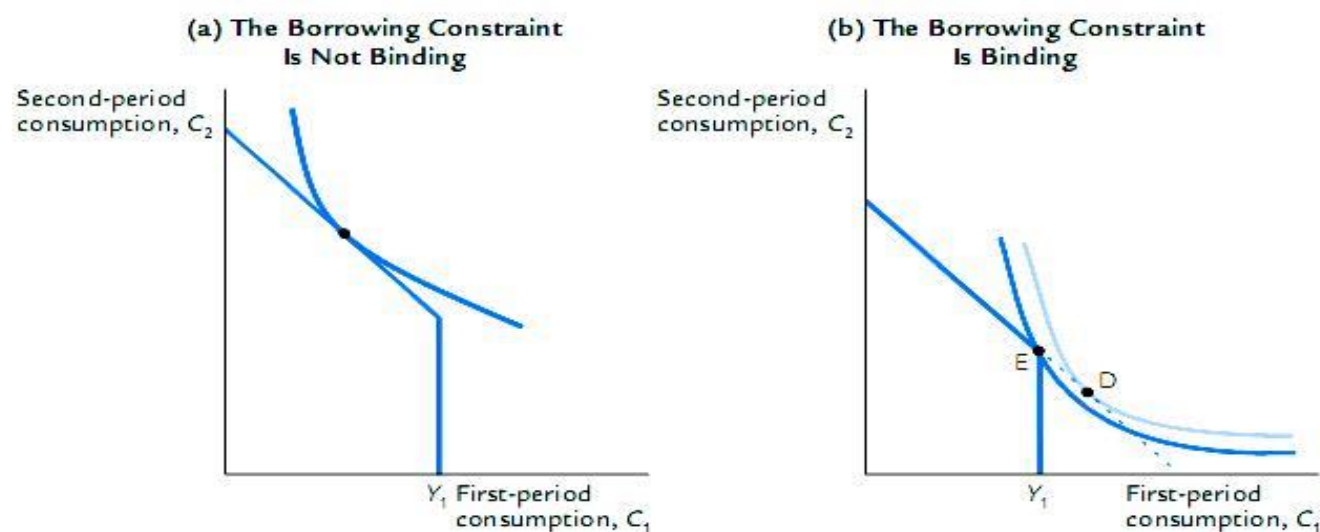
$$Y_1 + [Y_2/(1 + r)].$$

For other consumers, the borrowing constraint binds, and the consumption function is

$$C_1 = Y_1 \text{ and } C_2 = Y_2.$$

Hence, for those consumers who would like to borrow but cannot, consumption depends only on current income.

Figure 1.9



The Consumer's Optimum With a Borrowing Constraint When the consumer faces a borrowing constraint, there are two possible situations. In panel (a), the consumer chooses first-period consumption to be less than first-period income, so the borrowing constraint is not binding and does not affect consumption in either period. In panel (b), the borrowing constraint is binding. The consumer would like to borrow and choose point D. But because borrowing is not allowed, the best available choice is point E. When the borrowing constraint is binding, first-period consumption equals first-period income.

1.5 Franco Modigliani and the Life-Cycle Hypothesis

In a series of papers written in the 1950s, *Franco Modigliani* and his collaborators *Albert Ando* and *Richard Brumberg* used Fisher's model of consumer behavior to study the consumption function. One of their goals was to solve the consumption puzzle—that is, to explain the apparently conflicting pieces of evidence that came to light when Keynes's consumption function was brought to the data. According to Fisher's model, consumption depends on a person's lifetime income. Modigliani emphasized that income varies systematically over people's lives and that saving allows consumers to move income from those times in life when income is high to those times when it is low. This interpretation of consumer behavior formed the basis for his *life-cycle hypothesis*.

The Hypothesis

One important reason that income varies over a person's life is retirement. Most people plan to stop working at about age 65, and they expect their incomes to fall when they retire. Yet they do not want a large drop in their standard of living, as measured by their consumption. To maintain consumption after retirement, people must save during their working years. Let's see what this motive for saving implies for the consumption function.

Consider a consumer who expects to live another T years, has wealth of W , and expects to earn income Y until she retires R years from now. What level of consumption will the consumer choose if she wishes to maintain a smooth level of consumption over her life?

The consumer's lifetime resources are composed of initial wealth W and life-time earnings of $R \cdot Y$. (For simplicity, we are assuming an interest rate of zero; if the interest rate were greater than zero, we would need to take account of interest earned on savings as well.) The consumer can divide up her lifetime resources among her T remaining years of life. We assume that she wishes to achieve the smoothest possible path of consumption over her lifetime. Therefore, she divides this total of $W + RY$ equally among the T years and each year consumes

$$C = (W + RY)/T.$$

We can write this person's consumption function as

$$C = (1/T)W + (R/T)Y.$$

If every individual in the economy plans consumption like this, then the aggregate consumption function is much the same as the individual one. In particular, aggregate consumption depends on both wealth and income. That is, the economy's consumption function is

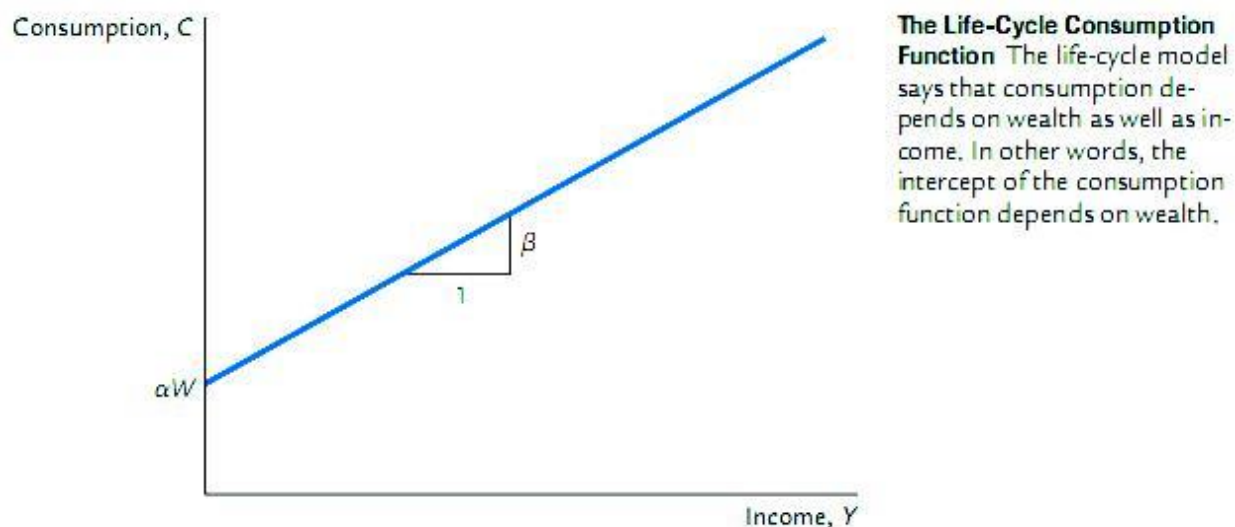
$$C = \alpha W + \beta Y,$$

where the parameter α is the marginal propensity to consume out of wealth, and the parameter β is the marginal propensity to consume out of income.

Implications

Figure 1-10 graphs the relationship between consumption and income predicted by the life-cycle model. For any given level of wealth W , the model yields a conventional consumption function similar to the one shown in Figure 1-1.

Figure 1.10



Notice, however, that the intercept of the consumption function, which shows what would happen to consumption if income ever fell to zero, is not a fixed value, as it is in Figure 1-1. Instead, the intercept here is W and, thus, depends on the level of wealth.

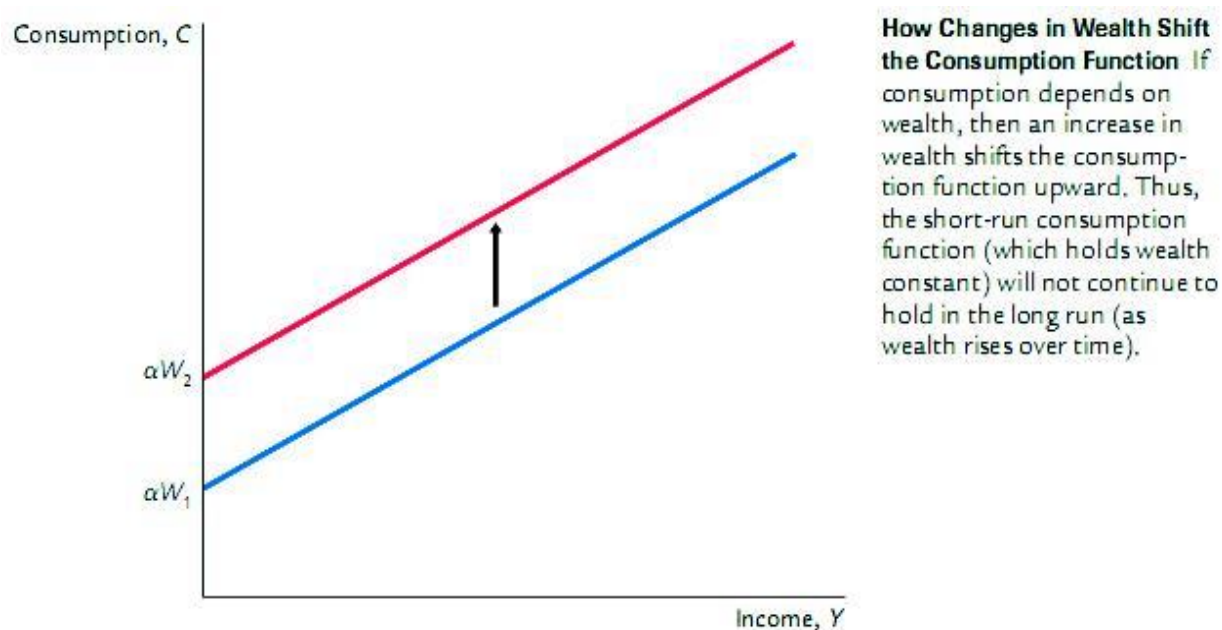
This life-cycle model of consumer behavior can solve the consumption puzzle. According to the life-cycle consumption function, the average propensity to consume is

$$C/Y = \alpha(W/Y) + \beta.$$

Because wealth does not vary proportionately with income from person to person or from year to year, we should find that high income corresponds to a low average propensity to consume when looking at data across individuals or over short periods of time. But, over long periods of time, wealth and income grow together, resulting in a constant ratio W/Y and thus a constant average propensity to consume.

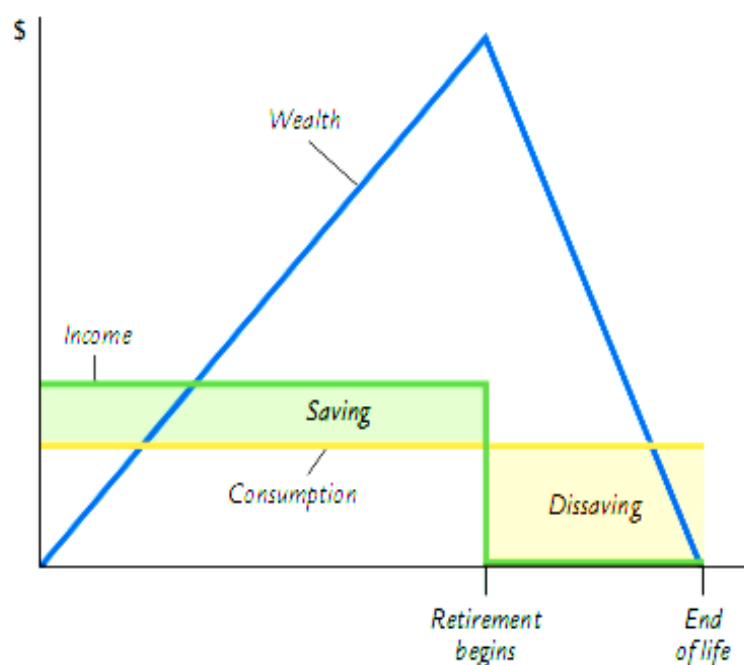
To make the same point somewhat differently, consider how the consumption function changes over time. As Figure 1-10 shows, for any given level of wealth, the life-cycle consumption function looks like the one Keynes suggested. But this function holds only in the short run when wealth is constant. In the long run, as wealth increases, the consumption function shifts upward, as in Figure 1-11. This upward shift prevents the average propensity to consume from falling as income increases. In this way, Modigliani resolved the consumption puzzle posed by Simon Kuznets's data.

Figure 1.11



The life-cycle model makes many other predictions as well. Most important, it predicts that saving varies over a person's lifetime. If a person begins adulthood with no wealth, she will accumulate wealth during her working years and then run down her wealth during her retirement years. Figure 1-12 illustrates the consumer's income, consumption, and wealth over her adult life. According to the life-cycle hypothesis, because people want to smooth consumption over their lives, the young who are working save, while the old who are retired dissave.

Figure 1.12



Consumption, Income, and Wealth Over the Life Cycle If the consumer smooths consumption over her life (as indicated by the horizontal consumption line), she will save and accumulate wealth during her working years and then dissave and run down her wealth during retirement.

Activity

Dear students, how does the life-cycle hypothesis solve the consumption puzzle?

1.6 Milton Friedman and the Permanent-Income Hypothesis

In a book published in 1957, Milton Friedman proposed the permanent-income hypothesis to explain consumer behavior. Friedman's permanent-income hypothesis complements Modigliani's life-cycle hypothesis: both use Irving Fisher's theory of the consumer to argue that consumption should not depend on current income alone. But unlike the life-cycle hypothesis, which emphasizes that income follows a regular pattern over a person's lifetime, the permanent-income hypothesis emphasizes that people experience random and temporary changes in their incomes from year to year.

The Hypothesis

Friedman suggested that we view current income Y as the sum of two components, permanent income Y^P and transitory income Y^T . That is,

$$Y = Y^P + Y^T$$

Permanent income is the part of income that people expect to persist into the future. Transitory income is the part of income that people do not expect to persist. Put differently, permanent income is average income, and transitory income is the random deviation from that average.

Different forms of income have different degrees of persistence. A good education provides a permanently higher income, whereas good weather provides only transitorily higher income. Although one can imagine intermediate cases, it is useful to keep things simple by supposing that there are only two kinds of income: permanent and transitory.

Friedman reasoned that consumption should depend primarily on permanent income, because consumers use saving and borrowing to smooth consumption in response to transitory changes in income. For example, if a person received a permanent raise of \$10,000 per year, his consumption would rise by about as much. Yet if a person won \$10,000 in a lottery, he would not consume it all in one year. Instead, he would spread the extra consumption over the rest of his life. Assuming an interest rate of zero and a remaining life span of 50 years, consumption would rise by only \$200 per year in response to the \$10,000 prize. Thus, consumers spend their permanent income, but they save rather than spend most of their transitory income.

Friedman concluded that we should view the consumption function as approximately

$$C = \alpha Y^P.$$

Where α is a constant that measures the fraction of permanent income consumed. The permanent-income hypothesis, as expressed by this equation, states that consumption is proportional to permanent income.

Implications

The permanent-income hypothesis solves the consumption puzzle by suggesting that the standard Keynesian consumption function uses the *wrong variable*. According to the permanent-income hypothesis, consumption depends on permanent income; yet many studies of the consumption function try to relate consumption to current income. Friedman argued that this errors-in-variables problem explains the seemingly contradictory findings.

Let's see what Friedman's hypothesis implies for the average propensity to consume. Divide both sides of his consumption function by Y to obtain

$$APC = C/Y = \alpha Y^P/Y.$$

According to the permanent-income hypothesis, the average propensity to consume depends on the ratio of permanent income to current income. When current income temporarily rises above permanent income, the average propensity to consume temporarily falls; when current income temporarily falls below permanent income, the average propensity to consume temporarily rises.

Now consider the studies of household data. Friedman reasoned that these data reflect a combination of permanent and transitory income. Households with high permanent income have proportionately higher consumption. If all variation in current income came from the permanent component, the average propensity to consume would be the same in all households. But some of the variation in income comes from the transitory component, and households with high transitory income do not have higher consumption. Therefore, researchers find that high-income households have, on average, lower average propensities to consume.

Similarly, consider the studies of time-series data. Friedman reasoned that year-to-year fluctuations in income are dominated by transitory income. Therefore, years of high income should be years of low average propensities to consume. But over long periods of time—say, from

decade to decade-the variation in income comes from the permanent component. Hence, in long time-series, one should observe a constant average propensity to consume, as is fact Kuznets found.

Activity

Dear students, how does the permanent income hypothesis solve the consumption puzzle?

1.7. Robert Hall and the Random-Walk Hypothesis

The permanent-income hypothesis is based on Fisher's model of inter-temporal choice. It builds on the idea that forward-looking consumers base their consumption decisions not only on their current income but also on the income they expect to receive in the future. Thus, the permanent-income hypothesis highlights that consumption depends on people's expectations. Recent research on consumption has combined this view of the consumer with the assumption of rational expectations. The rational-expectations assumption states that people use all available information to make optimal forecasts about the future. This assumption can have profound implications for the study of consumer behavior.

The Hypothesis

The economist Robert Hall was the first to derive the implications of rational expectations for consumption. He showed that if the permanent-income hypothesis is correct and if consumers have rational expectations, then changes in consumption over time should be unpredictable. When changes in a variable are unpredictable, the variable is said to follow a **random walk**. According to Hall, the combination of the permanent-income hypothesis and rational expectations implies that consumption follows a random walk. Hall reasoned as follows.

According to the permanent-income hypothesis, consumers face fluctuating income and try their best to smooth their consumption over time. At any moment, consumers choose consumption based on their current expectations of their lifetime incomes. Over time, they change their consumption because they receive news that causes them to revise their expectations. For example, a person getting an unexpected promotion increases consumption, whereas a person getting an unexpected demotion decreases consumption. In other words, changes in consumption reflect —surprises‖ about lifetime income. If consumers are optimally using all available information, then they should be surprised only by events that were entirely unpredictable. Therefore, changes in their consumption should be unpredictable as well.

Implications

The rational-expectations approach to consumption has implications not only for forecasting but also for the analysis of economic policies. *If consumers obey the permanent-income hypothesis and have rational expectations, then only unexpected policy changes influence consumption. These policy changes take effect when they change expectations.* For example, suppose that today the government passes a tax increase to be effective next year. In this case, consumers receive the news about their lifetime incomes when the government passes the law (or even earlier if the law's passage was predictable). The arrival of this news causes consumers to revise their expectations and reduce their consumption. The following year, when the tax hike goes into effect, consumption is unchanged because no news has arrived.

Hence, if consumers have rational expectations, policymakers influence the economy not only through their actions but also through the public's expectation of their actions. Expectations, however, cannot be observed directly. Therefore, it is often hard to know how and when changes in fiscal policy alter aggregate demand

Summary

- ✓ Keynes conjectured that the marginal propensity to consume is between zero and one, that the average propensity to consume falls as income rises, and that current income is the primary determinant of consumption. Studies of household data and short time-series confirmed Keynes's conjectures. Yet studies of long time-series found no tendency for the average propensity to consume to fall as income rises over time.
- ✓ Recent work on consumption builds on Irving Fisher's model of the consumer. In this model, the consumer faces an intertemporal budget constraint and chooses consumption for the present and the future to achieve the highest level of lifetime satisfaction. As long as the consumer can save and borrow, consumption depends on the consumer's lifetime resources.
- ✓ Modigliani's life-cycle hypothesis emphasizes that income varies somewhat predictably over a person's life and that consumers use saving and borrowing to smooth their consumption over their lifetimes. According to this hypothesis, consumption depends on both income and wealth.
- ✓ Friedman's permanent-income hypothesis emphasizes that individuals experience both permanent and transitory fluctuations in their income. Because consumers can save and borrow, and because they want to smooth their consumption, consumption does not respond much to transitory income. Consumption depends primarily on permanent income.
- ✓ Hall's random-walk hypothesis combines the permanent-income hypothesis with the assumption that consumers have rational expectations about future income. It implies that changes in consumption are unpredictable, because consumers change their consumption only when they receive news about their lifetime resources

Review Questions

1. Assume that a consumer has already lived 30 years and expects to live for more 40 years of which he intends to work 20 years. According to the life-cycle hypothesis, the consumption function of the consumer is?

A)	C)
B)	D) None
2. Which one of the following is **not** one of the Keynes's conjectures about consumption function

A) MPC is between 0 and 1	B) Both income and interest rate are the primary determinants of consumption
C) APC falls as income increases	D) None
3. Identify the wrong match

A) Life-Cycle Hypothesis: Franco Modigliani	B) Permanent Income Hypothesis: Milton Friedman
C) Random Walk Hypothesis: Robert Hall	D) Inter temporal Choice: John Maynard Keynes
4. According to Hall's random walk hypothesis,

A) Predictable changes in income doesn't lead to predictable changes in consumption	B) Only unexpected policy changes influence consumption
C) Consumption follows a random walk	D) All
5. According to Fisher's two period intertemporal choice when borrowing constraint is binding,

A) First-period consumption equals to first-period income	B) Consumption depends on only current income
C) Second-period consumption equals second-period income	D) All
6. All of the following are transitory incomes, **except**

A) income due to promotion	B) income due to winning a lottery
C) income due to unusual good weather condition	D) income due to a one year bonus

7. Which one of the following is true about permanent income hypothesis
- A) Consumption depends on current income alone
 - B) Income follows a regular pattern over a person's lifetime
 - C) Consumption depend primarily on permanent income
 - D) All
8. Secular-stagnation
- A) It is the Great Depression
 - B) It is a boom of indefinite duration
 - C) It is coined by Keynes
 - D) It is a depression of indefinite duration
9. At the optimum of the intertemporal choice of a consumer?
- A) The indifference curve is tangent to the budget line
 - B) The slope of the indifference curve is equal to the slope of the budget line
 - C)
 - D) All
10. Abebe obeys the two-period Fisher's model consumption. He earns nothing in the first period, and earns 11,000 birr in the second period. He can borrow or save money at the interest rate r . We observe that Abebe consuming 5000 birr in the first period and 5000 in the second period. What is the interest rate
- A) 20%
 - B) 10%
 - C) 5%
 - D) 1%

Chapter Two

Investment

2.1. Introduction

Dear learners! In the previous chapter we have discussed about spending on consumption goods which provide utility to the household today. In this chapter, we study spending on investment goods which provide a higher standard of living later in life.

Chapter Objectives:

Dear students, after reading this chapter thoroughly, you are expected to know:

- *Investment is the most volatile sector of aggregate demand*
- *The different types of investment*
- *The factors that shift the investment function*
- *Investment reflects the adjustment of the existing capital stock to the current demand for capital*
- *Investment spending is the primary link from monetary policy to aggregate demand*

Chapter Outline:

- *The concept of investment*
- *Business fixed investment*
- *Investment and the capital stock*
- *Effects of tax laws*
- *Residential investment*
- *Inventory investment*
- *The impact of government policy on investment*

2.2 The Concept of Investment

Before developing any theories about investment choices by people it is important to define what is meant by investment.

Activity

Dear student, what do you understand when people say investment? Please, write your answer on the space provided below.

Good! In macroeconomics, investment doesn't include purchases that merely reallocate existing assets among different individuals. Investment creates new capital.

Definition of Investment: It is the formation of real capital, tangible or intangible, that will produce a stream of goods and services in the future.

Investment is the most volatile component of GDP. When expenditure on goods and services falls during a recession, much of the decline is usually due to a drop in investment spending. Investment makes up 25% of GDP, and although obviously not as large as consumption it is at least of equal importance for two reasons.

First, because investment adds to the capital stock which is a key input used to produce output and thus in determining economic output. The relationship between investment and the capital stock can be expressed in the following way:

Where

- ✓ K_t = stock of capital at time t .
- ✓ I_t = gross investment at time t .
- ✓ δ = the depreciation rate.

Note that the notation used above assumes that investment undertaken today does not really become productive until the future. This is usually the assumption we use in modern macroeconomics.

Second, because most of the fluctuations in output seem to occur due to fluctuations in investment. Thus, if we want understand business cycles we have to understand investment.

For example, a well-established fact of modern economies is that investment fluctuates a lot more than Y or C (we can also see that I fluctuates more than Y , probably because of the large fluctuations in investment which helps to make up Y).

Furthermore, inventory investment, which makes up only a small percentage of I , is extremely volatile and in a recession more than half the fall in spending for a typical industrialized country comes from a decline in inventory investment as firms run down their inventories.

Moreover, private investment makes up roughly 85% of total investment and so this is where we need to focus our attention. This is not to say that government investment is not important, as basic infrastructure is crucial for a whole range of activities, including for firms producing output. But, private investment clearly is of much greater importance.

Finally, understanding investment decisions allows us to consider the economic effects will of many types of government policies, even those that we would not think at a first glance would impact on investment.

Categories of Investment

There are three basic types of investment undertaken in an economy:

1. *Investment in Physical Capital* — business fixed investment (e.g. plant and machinery, office buildings); residential construction investment (e.g. houses, and significant additions to houses, that require building permits); changes in firm's inventories (e.g. as they provide revenue in the

future, not today); purchases of durable goods by households (e.g. cars, fridges); government purchases of investment goods and buildings (e.g. roads, hospitals, harbors);

2. *Investment in Human Capital* — schooling, university study, apprenticeships etc.

3. *Investment in Knowledge Capital* — things we know about scientific and other areas.

The national income accounts only measure parts of 1.

2.3 Business Fixed Investment

Many people are intensely interested in business fixed investment and it not difficult to understand why; it constitutes the basic equipment used by firms to produce output whether it be computers, factories, machine tools, or offices. The term —business‖ means that these investment goods are bought by firms for use in future production. The term —fixed‖ means that this spending is for capital that will stay put for a while. We will learn about the most common theory developed to explain this form of investment, *the neoclassical theory of investment*, which is the one currently used by economists.

Underlying Theory

The neoclassical theory of investment looks at investment decisions as being affected by output, but on the basis of a cost-benefit decision. That is, firms may have a desired output level they wish to produce, given the price the output can be sold at, but the bundle of inputs they use will depend on their relative costs and benefits so as to maximize the profits of firms.

The Formal Model

We will now write the basic idea described above as a formal model. To begin with define the following variables:

the quantity of output produced by the firm.

the quantity of capital used by the firm.

the quantity of labour used by the firm.

the production function which relates how the inputs capital and labour are used to produce outputs.

Next, we need to specify the key assumption used by the model:

Firms act to maximize their profits where profits equal revenue less costs. If firms maximize profits by hiring labor and capital, then the amount they choose to hire will satisfy the condition

for each factor, or in this case their _____ equals their cost. Let,

= the marginal nominal wage cost paid to employees.

= the marginal nominal —rentall cost that firms incur in using capital.

= the price the firms receive for their output.

= the aggregate price level.

Where it is important to note that the implicit or explicit cost of using capital is not simply the actual price of the capital, since the capital can be resold. The cost of using the capital is the implicit (or explicit if rented from another firm) cost of renting the capital over the period it is used (we will discuss this in more detail soon) which we are calling R (e.g. if we build a dam and use it to produce electricity then the capital cost per unit of electricity is not the total cost of the dam, but some fraction of it relating to what portion of it was used to produce the unit of electricity). Given our assumption, we know that the logical implication is that capital and labor are employed up to the point where.

And

And we will now explore more about the _____ and the _____ of using capital.

Marginal Benefit of Using Capital

The real benefit of using capital is given by the _____ that the production firm earns from the output it produces using the capital. It is also worth noting that the _____ of the factors, and hence the _____, depends in general on the actual quantities of the factors used. That is,

Where it is clear that the level of output depends on both and . In many cases economists assume diminishing returns to the factors of production, or that as we increase the amount of a factor used output increases but at a diminishing rate. We will use this assumption here.

From following the logical implications of our assumptions we have deduced that there are three things that will influence the marginal benefit of using capital:

1. *Stock of Capital* — e.g. the higher the stock of capital, the lower the MPK . This is just the assumption of diminishing returns to the factors of production.
2. *Quantity of Labor Used* — e.g. the higher the quantity of labor used, the higher the MPK .
3. *State of the Production Technology* — e.g. the better the technology, the higher the MPK .

Remark: Labor may be a substitute for capital, but it also complements it as well.

If there was no labor then it is doubtful capital would be able to produce output!

Marginal Cost of Using Capital

The cost of owning capital is more complex. For each period of time that it rents out a unit of capital, the rental firm bears three costs:

1. When a rental firm borrows to buy a unit of capital, it must pay interest on the loan. If P_K is the purchase price of a unit of capital and i is the nominal interest rate, then iP_K is the interest cost. Notice that this interest cost would be the same even if the rental firm did not have to borrow: if the rental firm buys a unit of capital using cash on hand, it loses out on the interest it could have earned by depositing this cash in the bank. In either case, the interest cost equals iP_K .
2. While the rental firm is renting out the capital, the price of capital can change. If the price of capital falls, the firm loses, because the firm's asset has fallen in value. If the price of capital rises, the firm gains, because the firm's asset has risen in value. The cost of this loss or gain is ΔP_K .
3. While the capital is rented out, it suffers wear and tear, called **depreciation**. If δ is the rate of depreciation—the fraction of capital's value lost per period because of wear and tear—then the dollar cost of depreciation is δP_K .

The total cost of renting out a unit of capital for one period is therefore

Nominal cost of capital

=

And to summarize, the nominal cost of capital depends on:

- The price of capital.
- The interest rate.
- The rate at which capital prices are changing
- The depreciation rate

Example: Assume that XYZ is a car-rental company. The company buys cars for 500,000 birr each and rents them out to other businesses. The company faces an annual interest rate of 10 %. In the market, car prices are raising at 5% per annum for each car the company owns, and each car depreciates at 20% per year. Find the company's cost of capital.

Solution:

- ✓ Interest cost
- ✓ Capital gain
- ✓ Depreciation

Therefore, total cost of capital . It means that the cost to the car-rental company of keeping a car in its capital stock is 175,000 birr.

What we have worked out is perfectly correct, but we will involve one more assumption to simplify the expression for the cost of capital. For simplicity, assume that the price of capital goods increases at the same rate as the inflation rate. This can be characterized mathematically as,

, where π = the inflation rate.

We also know that (i.e. the real interest rate is approximately equal to the nominal interest rate less the inflation rate)

Hence, we can write the cost of capital as

Cost of capital =

The above equation states that the cost of capital depends on the price of capital, the real interest rate, and depreciation rate.

Finally, we want to express the cost of capital relative to other goods in the economy. The real $\frac{P_K}{P}$ (the cost of buying and renting out a unit of capital measured in units of the economy's output) is

Real Cost of Capital

This equation states that the real cost of a capital depends on:

- i) $\frac{P_K}{P}$ The relative price of the capital good, /
- ii) r The real interest rate,
- iii) δ The depreciation rate,

Profit Rate of Capital

Now we know what determines both the MB and the MC of using and thus owning capital. We are now in a position to answer the basic question of how much capital should firms in total use and own. The answer to this is that it all depends on the profit rate of capital, which equals,

$$= \frac{P_K}{P} - r - \delta$$

There are three cases to consider:

1. $\frac{P_K}{P} - r - \delta > 0$: It means there are potential profits a firm could earn by increasing its capital stock. $\frac{P_K}{P} - r - \delta > 0$ and the amount of net investment is positive.
2. $\frac{P_K}{P} - r - \delta < 0$: It means the firm is making losses on the last units of capital it is using and it could increase profits by reducing its capital stock. $\frac{P_K}{P} - r - \delta < 0$ and the amount of net investment is negative.
3. $\frac{P_K}{P} - r - \delta = 0$: It means the firm is maximizing the amount of profits it can earn from using capital and does not want to change its capital stock.

And so a firm's decision about whether to add to its capital stock, or reduce it through depreciation depends upon the profit rate or the difference between the $\frac{P_K}{P}$ and the cost of capital. Note that unlike the accelerator theory, the neoclassical theory shows us what determines the optimal or desired capital stock, it is the amount of capital where $\frac{P_K}{P} - r - \delta = 0$, or no more profits can be made from changing the firm's amount of capital.

The Determinants of Investment

Now consider a rental firm's decision about whether to increase or decrease its capital stock. For each unit of capital, the firm earns real revenue and bears the real cost. The real profit per unit of capital is

$$\text{Profit Rate} = \text{Revenue} - \text{Cost}$$

$$=$$

Since the real rental price in equilibrium equals the r , we can write the profit rate as

$$\text{Profit Rate} =$$

The rental firm makes a profit if the r is greater than the cost of capital. It incurs a loss if the r is less than the cost of capital.

We can now see the economic incentives that lie behind the rental firm's investment decision. The firm's decision regarding its capital stock - that is, whether to add to it or to let it depreciate - depends on whether owning and renting out capital is profitable. The change in the capital stock, called ΔK , depends on the difference between the r and cost of capital.

We can also now see that the separation of economic activity between production and rental firms-although useful to clarify our thinking - is not necessary for our conclusion regarding how firms choose investment.

For a firm that both uses and owns capital, the benefit of an extra unit of capital is the r , and the cost is the cost of capital. Like a firm that owns and rents out capital, this firm adds to its capital stock if the r exceeds the cost of capital. Thus, we can write

Where $I(r)$ is the function showing how much net investment responds to the incentive to invest.

We can now derive the investment function. Total spending on business fixed investment is the sum of net investment and the replacement of depreciated capital. The investment function is

$$I = I(r, \delta, K)$$

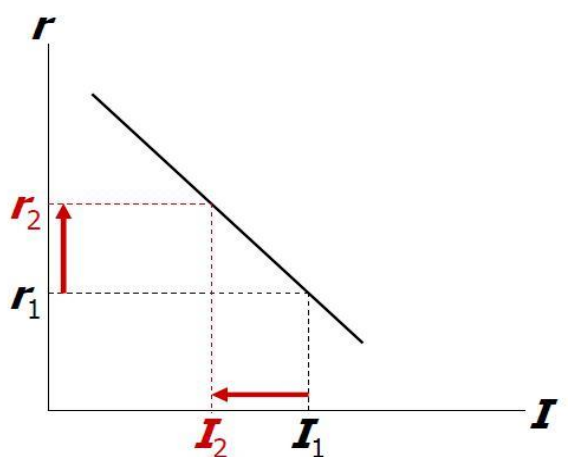
Business fixed investment depends on the interest rate, the cost of capital, and the amount of depreciation. This model shows why investment depends on the interest rate. An increase in the real interest rate raises the cost of capital and leads firms to reduce their investment. Similarly, a decrease in the real interest rate lowers the cost of capital. It therefore raises the amount of profit from owning capital and increases the incentive to accumulate more capital. For this reason, the investment schedule relating investment to the interest rate slopes downward, as in panel (a) of Figure 2.1. The model also shows what causes the investment schedule to shift. Any event that raises the marginal product of capital increases the profitability of investment and causes the investment schedule to shift outward, as in panel (b) of Figure 2.1.

For example, a technological innovation that increases the production function parameter A raises the marginal product of capital and, for any given interest rate, increases the amount of capital goods that rental firms wish to buy.

Figure 2.1

An increase in r

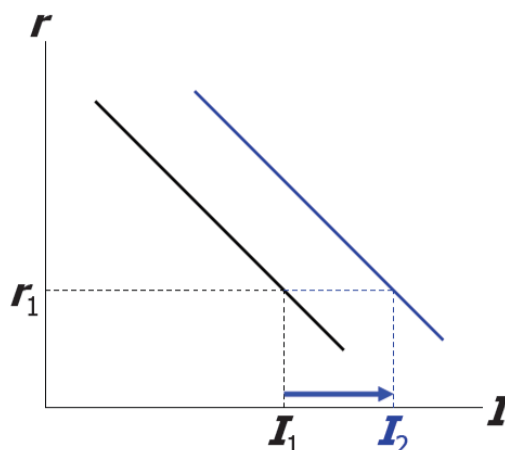
- raises the cost of capital
- reduces the profit rate
- and reduces investment:



Panel a) shows that business fixed investment increases when the interest rate falls. This is because a lower interest rate reduces the cost of capital and therefore makes owning capital more profitable

An increase in MPK or decrease in P_K/P

- increases the profit rate
- increases investment at any given interest rate
- shifts I curve to the right.



Panel b) shows an outward shift in the investment function, which might be due to an increase in the marginal product of capital or a decrease in the relative price of capital.

Finally, consider what happens as this adjustment of the capital stock continues over time. If the capital stock begins above the cost of capital, the capital stock will rise and the real interest rate will fall. If the capital stock begins below the cost of capital, the capital stock will fall and the real interest rate will rise. Eventually, as the capital stock adjusts, the real interest rate approaches the cost of capital. When the capital stock reaches a steady-state level, we can write

Thus, in the long run, the real interest rate equals the real cost of capital.

2.4. Investment and the Capital Stock

A logical conclusion from the neoclassical theory of investment is that both net and gross investment of firms are a negative function of real interest rate because the cost of capital is positively affected by changes in real interest rate, which negatively affects the profit rate of capital. We can show this relationship graphically as: and a change in any other variable that affects the MB or MC of using and owning capital by firms in an economy other than the real interest rate can be shown by a shift of the investment function (e.g. an increase in the MPK, say from a technological innovation, causes a rightward shift in the investment schedule).

The amount of investment that is undertaken depends on whether or not firms are using and owning the optimal amount of capital, that is, whether or not the profit rate is zero or non-zero. In the long-run equilibrium, with the profit rate equaling zero, we would expect that the amount of net investment is zero with gross investment being positive and just offsetting the amount of depreciated capital each period. Once a firm is in its long-run state, only a change in real interest rate, or MPK, or some other variable, will affect the demand for capital and thus the amount of investment demanded. This will cause net investment to stop being zero and the capital stock will adjust to get back to a new long-run equilibrium situation.

2.5 Effects of Tax Laws

We have focused on a few key variables which affect the amount of investment undertaken, but in reality anything which affects the cost or benefit of using capital will affect the amount of investment undertaken by firms. One key set of variables are tax rates set by the government. We can amend the profit rate relationship we derived above to include the effects of government taxes. Let τ be the tax rate on firm revenues. Then the after-tax profit rate of capital equals,

$$\text{Profit rate} =$$

So that we can see that the tax reduces the profits earned from capital by reducing the MB of using and owning capital.

Taxes on Income Earned from Owning Capital

This is simply the company tax. This tax isn't directly levied on capital income but on a company's profits, which include income and costs from all factors, but some proportion of its incidence is on income earned from capital and we can think of it in this way. An increase in the company tax will effectively increase and hence decrease investment. This sort of policy will discourage the accumulation of .

Investment Tax Credits

This is a policy where firms' tax liabilities are reduced by how much they spend on new capital during a year. This effectively lowers, reducing the cost of capital and causing an increase in investment. This sort of policy will encourage the accumulation of .

Tax Treatment of Depreciation

Corporate profits are taxed and profits are just revenue minus costs. Part of the costs of production of firms is depreciation on capital so that firms are allowed to include depreciation of their capital as a cost when calculating the amount of profit to be taxed.

But depreciation is calculated using historical cost, not replacement cost which tends to understate the true cost of depreciation in periods of high inflation, which overstates the profits being made. This means a tax is levied even if the economic profit is zero, which effectively increases, reducing investment, and discouraging the accumulation of capital.

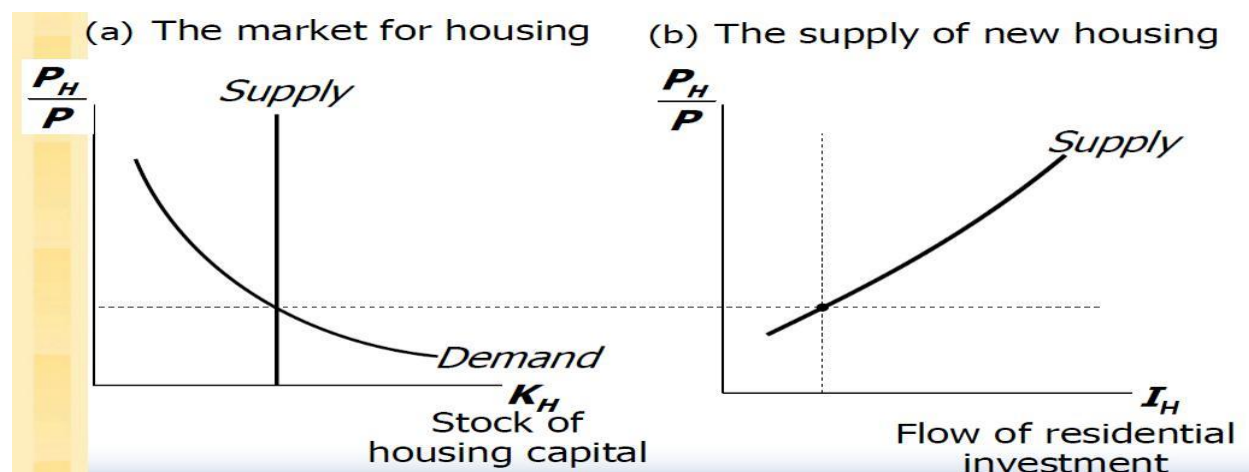
2.6. Residential Investment

In this section we consider the determinants of residential investment. We begin by presenting a simple model of the housing market. Residential investment includes the purchase of new housing both by people who plan to live in it themselves and by landlords who plan to rent it to others. To keep things simple, however, it is useful to imagine that all housing is owner-occupied.

The Stock Equilibrium and the Flow Supply

There are two parts to the model. First, the market for the existing stock of houses determines the equilibrium housing price. Second, the housing price determines the flow of residential investment. Panel (a) of Figure 2.2 shows how the relative price of housing is determined by the supply and demand for the existing stock of houses. At any point in time, the supply of houses is fixed. We represent this stock with a vertical supply curve. The demand curve for houses slopes downward, because high prices cause people to live in smaller houses, to share residences, or sometimes even to become homeless. The price of housing adjusts to equilibrate supply and demand. Panel (b) of Figure 2.2 shows how the relative price of housing determines the supply of new houses. Construction firms buy materials and hire labor to build houses and then sell the houses at the market price.

Figure 2.2



The Determination of Residential Investment: The relative price of housing adjusts to equilibrate supply and demand for the existing stock of housing capital. The relative price then determines residential investment, the flow of new housing that construction firms build.

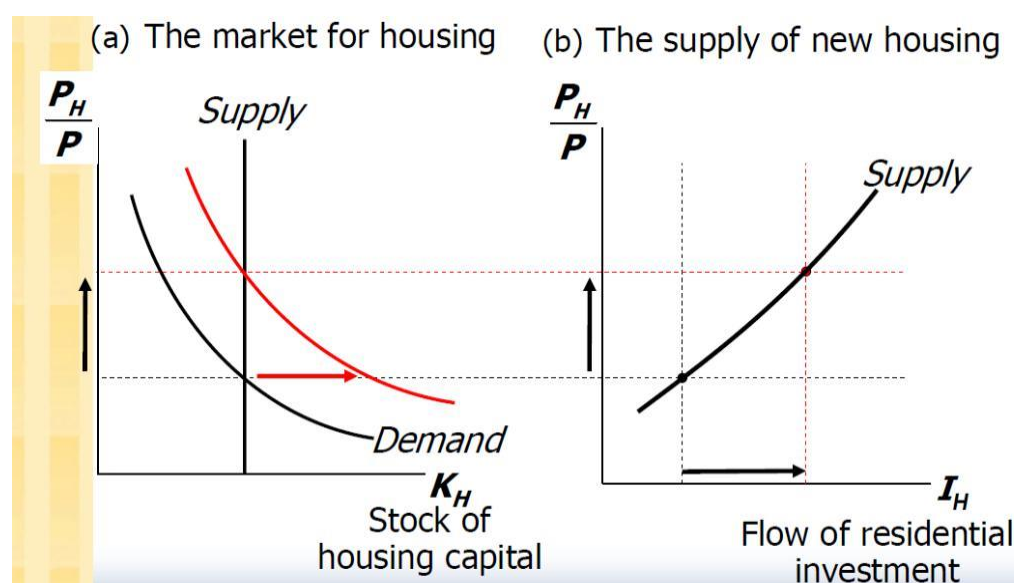
Their costs depend on the overall price level P (which reflects the cost of wood, bricks, plaster, etc.), and their revenue depends on the price of houses. The higher the relative price of housing, the greater the incentive to build houses and the more houses are built. The flow of new houses—residential investment—therefore depends on the equilibrium price set in the market for existing houses. According to this model of the housing market, residential investment depends on the relative price of housing. The relative price of housing, in turn, depends on the demand for housing, which depends on the imputed rent that individuals expect to receive from their housing. Hence, the relative price of housing plays much the same role for residential investment.

Changes in Housing Demand

When the demand for housing shifts, the equilibrium price of housing changes, and this change in turn affects residential investment. The demand curve for housing can shift for various reasons. An economic boom raises national income and therefore the demand for housing. A large increase in the population, perhaps because of immigration, also raises the demand for housing. Panel (a) of Figure 2.3 shows that an expansionary shift in demand raises the equilibrium price. Panel (b) shows that the increase in the housing price increases residential investment. One important determinant of housing demand is the real interest rate. Many people take out loans—mortgages—to buy their homes; the interest rate is the cost of the loan. Even the

few people who do not have to borrow to purchase a home will respond to the interest rate, because the interest rate is the opportunity cost of holding their wealth in housing rather than putting it in a bank. A reduction in the interest rate therefore raises housing demand, housing prices, and residential investment. Another important determinant of housing demand is credit availability. When it is easy to get a loan, more households buy their own homes, and they buy larger ones than they otherwise might, thus increasing the demand for housing. When credit conditions become tight, fewer people buy their own homes or trade up to larger ones, and the demand for housing falls.

Figure 2.3



An Increase in Housing Demand: An increase in housing demand, perhaps attributable to a fall in the interest rate, raises housing prices and residential investment.

2.7. Inventory Investment

The last category of investment that we will study is inventory investment. It is not that large compared to the other forms of investment, but as mentioned at the beginning of this topic there is a strong relationship between changes in inventory investment and changes in output over the business cycle. Inventory investment is normally high during a boom and low during a recession.

Reasons for Holding Inventors

Before developing a theory of inventory investment we will study the reasons why inventories are held. Knowing the reasons for holding inventories will help us understand better the factors which influence the level of inventory investment. There are four reasons for holding inventories:

1) Production Smoothing

One use of inventories is to smooth the level of production over time. Consider a firm that experiences temporary booms and busts in sales. Rather than adjusting production to match the fluctuations in sales, the firm may find it cheaper to produce goods at a steady rate. When sales are low, the firm produces more than it sells and puts the extra goods into inventory. When sales are high, the firm produces less than it sells and takes goods out of inventory. This motive for holding inventories is called *production smoothing*.

2) Inventories as a Factor of Production

Firms carry inventories of spare parts in case a machine breaks down, so that the entire assembly line does not come to a stop. E.g. car assembly factory. These forms of inventories tend to be high in a boom and low in a recession, mirroring the amount of output being produced and thus the need for spare parts.

3) Stock-Out Avoidance

A third reason for holding inventories is to avoid running out of goods when sales are unexpectedly high. Firms often have to make production decisions before knowing the level of customer demand. For example, a publisher must decide how many copies of a new book to print before knowing whether the book will be popular. If demand exceeds production and there are no inventories, the good will be out of stock for a period, and the firm will lose sales and profit. Inventories can prevent this from happening. This motive for holding inventories is called *stock-out avoidance*.

4) Work in Process

Partly completed products are counted as inventories e.g. cheese making where cheeses are aging. These are normally high in a boom and low in a recession, reflecting the amount of output being produced.

Accelerator Theory of Inventory Investment

Theory behind the Accelerator Model

The basic idea is that firms might hold stocks of inventories that are proportional to their levels of output, for the reasons mentioned above which are directly related to the level of output being produced and sold. For example, say output is high and the economy is booming then production firms require more supplies, and have more work in process and retail firms want more merchandise to keep up with the higher sales.

Furthermore, it is likely that firms can change their inventory investment much more quickly than they can change their fixed investments.

The Formal Model

We will now write the basic idea described above as a formal model. First, define the following variables:

= actual stock of inventories by the firm at time t .

= desired stock of inventories by the firm at time

= inventory investment by the firm at time t .

= output of the firm at time t .

β = the desired inventory to output ratio of the firm.

Next, we need to specify the two key assumptions used by the model:

1. There exists an desired amount of inventories related to the amount of output, or,

There may be short-run deviations from this amount because of output fluctuations, but on average, this relationship holds.

2. All inventory investment undertaken today is assumed to be ready for use today

(Note that again this differs from the —standard assumption that investment today only becomes productive in the future), or that,

or

-

And notice the different time subscripts as to why this is true. This is not a strong behavioral assumption in this context as if we are thinking of periods of time being a year then most firms can alter their inventories to changing conditions very quickly if they choose to do so.

Now, put everything together. The logical implication of the second assumption is that the capital stock each period equals the desired capital stock because inventories can be changed very fast, or that,

=

Using (2), and substituting in (3) and (1) we can rewrite the determination of net inventory investment in the following way:

-

=

=)

=

So what we find is that a firm's inventory investment is determined by changes in output. This is called the naive accelerator model, since all the change happens in one period.

2.8. The Impact of Government Policy on Investment

The Issue

Currently, a very important issue facing the world is what to do about the likely global warming that is occurring and is forecast to occur. One important measure is the introduction of a carbon tax in some countries. The reason for the tax is that it penalizes carbon energy intensive production and consumption, reducing the quantities of them and thus of carbon being introduced into the atmosphere, and mitigate the extent of global warming.

An important implication of the policy is on investment. Why? Because all production processes use energy, in order to convert matter in one state into matter in other states. And production normally requires capital, which uses the energy to transform the matter. As a result, the carbon tax is effectively a tax on forms of production and of the associated capital, and hence of investment in that capital.

An Economic Analysis of the Effects of the Carbon Tax

To include the impact of the carbon tax we can use the amended profit rate relationship we derived previously. The carbon tax is really a tax on capital's r as it is a tax on output of carbon, which is determined by the amount of output, which depends on the level of K which produces the carbon. Let τ be the effective tax rate on firm revenues due to the carbon tax. Then the after-tax profit rate of capital equals,

$$\text{Profit rate} = r(1 - \tau)$$

So that we can see that the tax reduces the profits earned from capital by reducing the r of using and owning capital.

The net impact is to lower the benefit of using and owning capital, and hence for a given user cost of capital, will lower the level of desired capital. This will lead to a lower level of investment. Growth of material output will thus fall.

A carbon tax will likely lower investment and the capital stock. This would lead to lower levels of material output and a reduction in economic growth. It is the reduction in output that is needed to cause a reduction in energy use, and thus of carbon produced. Whether or not this is a —good thing depends on the stream of benefits from any mitigating of the effects of global warming versus the stream of costs from reduced material output, and people's valuation of these.

As with pensions and savings, government policies have economic effects. When weighing up and deciding which policies to implement it is important to think about all the effects of these policies.

Chapter Summary

- ✓ Investment is the most volatile component of GDP over the business cycle.
- ✓ All types of investment are negatively related to real interest rate.
- ✓ The marginal product of capital determines the real rental price of capital. The real interest rate, the depreciation rate, and the relative price of capital goods determine the cost of capital. According to the neoclassical model, firms invest if the rental price is greater than the cost of capital, and they disinvest if the rental price is less than the cost of capital.
- ✓ There are three types of investment. Namely, i) Business fixed investment: businesses' spending on equipment and structures for use in production ii) Residential Investment: Purchases of new housing, and iii) Inventory investment: the value of the change in inventories of finished goods, materials and supplies, and work in progress.
- ✓ Technological improvements increase in population, and economic policies like corporate income tax shift the investment function.
- ✓ Firms have various motives for holding inventories of goods: smoothing production, using them as a factor of production, avoiding stock-outs, and storing work in process. How much inventories firms hold depends on the real interest rate and on credit conditions
- ✓ Residential investment depends on the relative price of housing. Housing prices in turn depend on the demand for housing and the current fixed supply. An increase in housing demand, perhaps attributable to a fall in the interest rate, raises housing prices and residential investment

Review Questions

1. In the neoclassical model of business fixed investment, under what conditions will firms find it profitable to add to their capital stock?

2. Write at least three motives for holding inventories

3. List at least three causes that can shift the investment function outward

4. List factors which can shift the demand curve for housing

5. Explain the three costs of capital that rental firms bear

Chapter Three

Supply and Demand for Money

3.1. Introduction

Dear learners! In this chapter we examine the classical theory of the causes, effects, and social costs of inflation. But, to understand inflation we must understand money. Therefore, we address the concept of money, what affects the supply and demand of money, the influence of money on the economy, and how the government controls the quantity of money in the hand of the public.

Chapter Objectives:

At the end of this chapter, students will be able to:

- *Know the functions of money*
- *Understand the definition of inflation and how the government controls the quantity of money in the hands of the public.*
- *Recognize factors determining the rate of inflation.*
- *Know the concept of inflation tax.*
- *Realize effects of inflation on nominal interest rate and vice-versa*
- *Comprehend whether inflation is a major social problem or not.*
- *Know extreme case of inflation i.e. hyperinflation.*

Chapter Outline:

- *What is money*
- *Quantity theory of money*
- *Demand for money*
- *Money supply*
- *Inflation and money growth*
- *Hyperinflation*

3.2. What Is Money?

Activity

Dear student, define money. Please, reflect your answer on the space given below.

Good! Compare your result with the following explanation.

When we say that a person has a lot of money, we usually mean that he or she is wealthy. By contrast, economists use the term money in a more specialized way. To an economist, money does not refer to all wealth but only to one type of it: that is, **Money** is the stock of assets that can be readily used to make transactions. Roughly speaking, the dollars in the hands of the public make up the nation's stock of money.

The Functions of Money

Money has three purposes. It is a store of value, a unit of account, and a medium of exchange.

As a **store of value**, money is a way to transfer purchasing power from the present to the future. If I work today and earn 100 birr, I can hold the money and spend it tomorrow, next week, or next month. Of course, money is an imperfect store of value: if prices are rising, the amount you can buy with any given quantity of money is falling. Even so, people hold money because they can trade the money for goods and services at some time in the future.

As a **unit of account**, money provides the terms in which prices are quoted and debts are recorded. Microeconomics teaches us that resources are allocated according to relative prices—the prices of goods relative to other goods—yet stores post their prices in dollars and cents. A car dealer tells you that a car costs 200,000 birr, not 400 shirts (even though it may amount to the same thing). Similarly, most debts require the debtor to deliver a specified number of dollars in

the future, not a specified amount of some commodity. Money is the yardstick with which we measure economic transactions.

As a **medium of exchange**, money is what we use to buy goods and services. —This note is legal tender for all debts, public and private“ is printed on the U.S. dollar. When we walk into stores, we are confident that the shopkeepers will accept our money in exchange for the items they are selling. The ease with which money is converted into other things—goods and services—is sometimes called money’s liquidity. To better understand the functions of money, try to imagine an economy without it: a barter economy. In such a world, trade requires the double coincidence of wants—the unlikely happenstance of two people each having a good that the other wants at the right time and place to make an exchange. A barter economy permits only simple transactions. Money makes more indirect transactions possible. A professor uses her salary to buy books; the book publisher uses its revenue from the sale of books to buy paper; the paper company uses its revenue from the sale of paper to pay the lumberjack; the lumberjack uses his income to send his child to college; and the college uses its tuition receipts to pay the salary of the professor. In a complex, modern economy, trade is often indirect and requires the use of money.

The Types of Money

Money takes many forms. In the Ethiopian economy we make transactions with an item whose sole function is to act as money: the birr. These pieces of different colored (yellow, red, green) paper with small portraits of birds, farmer, etc would have little value if they were not widely accepted as money. Money that has no intrinsic value is called **fiat money** because it is established as money by government decree, or fiat. Although fiat money is the norm in most economies today, most societies in the past have used for money a commodity with some intrinsic value. Money of this sort is called **commodity money**. The most widespread example of commodity money is gold. When people use gold as money (or use paper money that is redeemable for gold), the economy is said to be on a **gold standard**. Gold is a form of commodity money because it can be used for various purposes—jewelry, dental fillings, and so on—as well as for transactions. The gold standard was common throughout the world during the late nineteenth century.

Activity

Dear student, discuss the different types of money that have been used in Ethiopian history as a transaction.

The Development of Fiat Money

It is not surprising that some form of commodity money arises to facilitate exchange: people are willing to accept a commodity currency such as gold because it has intrinsic value. The development of fiat money, however, is more perplexing. What would make people begin to value something that is intrinsically useless? To understand how the evolution from commodity money to fiat money takes place, imagine an economy in which people carry around bags of gold. When a purchase is made, the buyer measures out the appropriate amount of gold. If the seller is convinced that the weight and purity of the gold are right, the buyer and seller make the exchange.

The government might first get involved in the monetary system to help people reduce transaction costs. Using raw gold as money is costly because it takes time to verify the purity of the gold and to measure the correct quantity. To reduce these costs, the government can mint gold coins of known purity and weight. The coins are easier to use than gold bullion because their values are widely recognized. The next step is for the government to accept gold from the public in exchange for gold certificates—pieces of paper that can be redeemed for a certain quantity of gold.

If people believe the government's promise to redeem the paper bills for gold, the bills are just as valuable as the gold itself. In addition, because the bills are lighter than gold (and gold coins), they are easier to use in transactions. Eventually, no one carries gold around at all, and these gold-backed government bills become the monetary standard.

Finally, the gold backing becomes irrelevant. If no one ever bothers to redeem the bills for gold, no one cares if the option is abandoned. As long as everyone continues to accept the paper bills in exchange, they will have value and serve as money. Thus, the system of commodity money evolves into a system of fiat money. Notice that in the end, the use of money in exchange is a social convention: everyone values fiat money because they expect everyone else to value it.

Activity

Dear student, how do you trust to exchange commodities with paper money? Or where does the paper money drives its value?

How the Quantity of Money Is Controlled

The quantity of money available is called the **money supply**. In an economy that uses commodity money, the money supply is the quantity of that commodity. In an economy that uses fiat money, such as most economies today, the government controls the supply of money: legal restrictions give the government a monopoly on the printing of money. Just as the level of taxation and the level of government purchases are policy instruments of the government, so is the supply of money. The control over the money supply is called **monetary policy**.

In the United States and many other countries, monetary policy is delegated to a partially independent institution called the **central bank**. The central bank of the United States is the **Federal Reserve**—often called the Fed. If you look at a U.S. dollar bill, you will see that it is called a Federal Reserve Note. Decisions over monetary policy are made by the Federal Open Market Committee. This committee is made up of members of the Federal Reserve Board, who are appointed by the president and confirmed by Congress, together with the presidents of the regional Federal Reserve Banks. The Federal Open Market Committee meets about every six weeks to discuss and set monetary policy.

The primary way in which the Fed controls the supply of money is through **open-market operations**—the purchase and sale of government bonds. When the Fed wants to increase the money supply, it uses some of the dollars it has to buy government bonds from the public. Because these dollars leave the Fed and enter into the hands of the public, the purchase increases the quantity of money in circulation. Conversely, when the Fed wants to decrease the money supply, it sells some government bonds from its own portfolio. This open-market sale of bonds takes some dollars out of the hands of the public and, thus, decreases the quantity of money in circulation.

Thus it is assumed (and the experience) that the Central Bank (Fed in the case of USA) directly controls the supply of money.

How the Quantity of Money Is Measured

One goal of this chapter is to determine how the money supply affects the economy; we turn to that problem in the next section. As background for that analysis, let's first discuss how economists measure the quantity of money. Because money is the stock of assets used for transactions, the quantity of money is the quantity of those assets. How can one measure the quantity of money in more complex economies such as ours? The answer is not obvious, because no single asset is used for all transactions. People can use various assets, such as cash or checks, to make transactions, although some assets are more convenient than others. This ambiguity leads to numerous measures of the quantity of money.

The most obvious asset to include in the quantity of money is **currency**, the sum of outstanding paper money and coins. Most day-to-day transactions use currency as the medium of exchange.

A second type of asset used for transactions is **demand deposits**, the funds people hold in their checking accounts. If most sellers accept personal checks, assets in a checking account are almost as convenient as currency. In both cases, the assets are in a form ready to facilitate a transaction. Demand deposits are, therefore, added to currency when measuring the quantity of money.

Once we admit the logic of including demand deposits in the measured money stock, many other assets become candidates for inclusion. Funds in savings accounts, for example, can be easily transferred into checking accounts; these assets are almost as convenient for transactions. Money market mutual funds allow investors to write checks against their accounts, although restrictions sometimes apply with regard to the size of the check or the number of checks written. Since these assets can be easily used for transactions, they should arguably be included in the quantity of money.

Because it is hard to judge which assets should be included in the money stock, various measures are available. Table 3.1 presents the four measures of the money stock that the Federal Reserve calculates for the U.S. economy, together with a list of which assets are included in each measure. From the smallest to the largest, they are designated C , $M1$, and $M2$. The most common measures for studying the effects of money on the economy are $M1$ and $M2$. The Fed used to calculate another, even more extensive measure called $M3$ but discontinued it in March 2006. There is no consensus, however, about which measure of the money stock is best. Disagreements about monetary policy sometimes arise because different measures of money are moving in different directions.

Table 3.1

The Measures of Money		
Symbol	Assets Included	Amount in October 2008 (billions of dollars)
C	Currency	\$ 794
$M1$	Currency plus demand deposits, traveler's checks, and other checkable deposits	1465
$M2$	$M1$ plus retail money market mutual fund balances, saving deposits (including money market deposit accounts), and small time deposits	7855
Source: Federal Reserve.		

Activity

What is money supply?

Who prints money and control the money supply?

3.3. The Quantity Theory of Money

Having defined what money is and described how it is controlled and measured; we can now examine how the quantity of money affects the economy. To do this, we must see how the quantity of money is related to other economic variables, such as prices and incomes.

Transactions and the Quantity Equation

People hold money to buy goods and services. The more money they need for such transactions, the more money they hold. Thus, the quantity of money in the economy is related to the number of dollars exchanged in transactions. The link between transactions and money is expressed in the following equation, called the **quantity equation**:

Let's examine each of the four variables in this equation.

The right-hand side of the quantity equation tells us about transactions. represents the total number of transactions during some period of time, say, a year. In other words, is the number of times in a year that goods or services are exchanged for money. is the price of a typical transaction—the number of dollars exchanged. The product of the price of a transaction and the number of transactions, , equals the number of dollars exchanged in a year.

The left-hand side of the quantity equation tells us about the money used to make the transactions. Q is the quantity of money. V is called the **transactions velocity of money** and measures the rate at which money circulates in the economy. In other words, velocity tells us the number of times a dollar bill changes hands in a given period of time.

For example, suppose that 60 loaves of bread are sold in a given year at \$0.50 per loaf. Then Q equals 60 loaves per year, and P equals \$0.50 per loaf. The total number of dollars exchanged is:

$$Q \times P = 60 \text{ loaves/year} \times \$0.50 \text{ per loaf} = \$30 \text{ per year}$$

The right-hand side of the quantity equation equals \$30 per year, which is the dollar value of all transactions.

Suppose further that the quantity of money in the economy is \$10. By rearranging the quantity equation, we can compute velocity as

That is, for \$30 of transactions per year to take place with \$10 of money, each dollar must change hands 3 times per year.

The quantity equation is an identity: the definitions of the four variables make it true. The equation is useful because it shows that if one of the variables changes, one or more of the others must also change to maintain the equality. For example, if the quantity of money increases and the velocity of money stay unchanged, then either the price or the number of transactions must rise.

From Transactions to Income

When studying the role of money in the economy, economists usually use a slightly different version of the quantity equation than the one just introduced. The problem with the first equation

is that the number of transactions is difficult to measure. To solve this problem, the number of transactions is replaced by the total output of the economy .

Transactions and output are related, because the more the economy produces, the more goods are bought and sold. They are not the same, however. When one person sells a used car to another person, for example, they make a transaction using money, even though the used car is not part of current output. Nonetheless, the dollar value of transactions is roughly proportional to the dollar value of output.

If Y denotes the amount of output and P denotes the price of one unit of output, then the dollar value of output is PY . We encountered measures for these variables when we discussed the national income accounts in the previous chapter: Y is real GDP, P is the GDP deflator, and PY is nominal GDP. The quantity equation becomes

Because PY is also total income, in this version of the quantity equation is called the **income velocity of money**. The income velocity of money tells us the number of times a dollar bill enters someone's income in a given period of time. This version of the quantity equation is the most common, and it is the one we use from now on.

The Money Demand Function and the Quantity Equation

When we analyze how money affects the economy, it is often useful to express the quantity of money in terms of the quantity of goods and services it can buy. This amount, M/P , is called **real money balances**.

Real money balances measure the purchasing power of the stock of money. For example, consider an economy that produces only bread. If the quantity of money is \$10, and the price of a loaf is \$0.50, then real money balances are 20 loaves of bread. That is, at current prices, the stock of money in the economy is able to buy 20 loaves.

A **money demand function** is an equation that shows what determines the quantity of real money balances people wish to hold. A simple money demand function is

where k is a constant that tells us how much money people want to hold for every dollar of income. This equation states that the quantity of real money balances demanded is proportional to real income.

The money demand function is like the demand function for a particular good. Here the “good” is the convenience of holding real money balances. Just as owning an automobile makes it easier for a person to travel, holding money makes it easier to make transactions. Therefore, just as higher income leads to a greater demand for automobiles, higher income also leads to a greater demand for real money balances.

This money demand function offers another way to view the quantity equation. To see this, add to the money demand function the condition that the demand for real money balances

must equal the supply M^s . Therefore,

$$M/P = kY.$$

A simple rearrangement of terms changes this equation into

$$M(1/k) = PY,$$

which can be written as

$$MV = PY,$$

where V is the velocity of circulation. This simple mathematics shows the link between the demand for money and the velocity of money. When people want to hold a lot of money for each dollar of income (k is large), money changes hands infrequently (V is small). Conversely, when people want to hold only a little money (k is small), money changes hands frequently (V is large). In other words, the money demand parameter and the velocity of money are opposite sides of the same coin.

The Assumption of Constant Velocity

The quantity equation can be viewed as a definition: it defines velocity V as the ratio of nominal GDP, Y , to the quantity of money, M . Yet if we make the additional assumption that the velocity of money is constant, then the quantity equation becomes a useful theory of the effects of money, called the **quantity theory of money**.

As with many of the assumptions in economics, the assumption of constant velocity is only an approximation to reality. Velocity does change if the money demand function changes. For example, when automatic teller machines were introduced, people could reduce their average money holdings, which meant a fall in the money demand parameter and an increase in velocity. Nonetheless, experience shows that the assumption of constant velocity provides a good approximation in many situations. Let's therefore assume that velocity is constant and see what this assumption implies about the effects of the money supply on the economy.

Once we assume that velocity is constant, the quantity equation can be seen as a theory of what determines nominal GDP. The quantity equation says

where the bar over V means that velocity is fixed. Therefore, a change in the quantity of money must cause a proportionate change in nominal GDP. That is, if velocity is fixed, the quantity of money determines the dollar value of the economy's output.

Money, Prices, and Inflation

We now have a theory to explain what determines the economy's overall level of prices. The theory has three building blocks:

1. The factors of production and the production function determine the level of output Y .
2. The money supply determines the nominal value of output, MY . This conclusion follows from the quantity equation and the assumption that the velocity of money is fixed.
3. The price level P is then the ratio of the nominal value of output, MY , to the level of output Y . In other words, the productive capability of the economy determines real GDP, the quantity of money determines nominal GDP, and the GDP deflator is the ratio of nominal GDP to real GDP.

This theory explains what happens when the Fed changes the supply of money. Because velocity is fixed, any change in the supply of money leads to a proportionate change in nominal GDP. Because the factors of production and the production function have already determined real GDP, the change in nominal GDP must represent a change in the price level. Hence, the quantity theory implies that the price level is proportional to the money supply.

Because the inflation rate is the percentage change in the price level, this theory of the price level is also a theory of the inflation rate. The quantity equation, written in percentage-change form, is

Consider each of these four terms. First, the percentage change in the quantity of money is under the control of the central bank. Second, the percentage change in velocity reflects shifts in money demand; we have assumed that velocity is constant, so the percentage change in velocity is zero. Third, the percentage change in the price level is the rate of inflation; this is the variable in the equation that we would like to explain. Fourth, the percentage change in output depends on growth in the factors of production and on technological progress, which for our present purposes we can take as given. This analysis tells us that (except for a constant that depends on exogenous growth in output) the growth in the money supply determines the rate of inflation.

Thus, the quantity theory of money states that the central bank, which controls the money supply, has ultimate control over the rate of inflation. If the central bank keeps the money supply stable, the price level will be stable. If the central bank increases the money supply rapidly, the price level will rise rapidly.

3.4. Demand for Money

The demand for money arises from the important functions performed by money, such as units of account, store of value and medium of exchange. Money as a unit of account does not by itself generate any demand for money, because one can quote prices in dollars without holding any. By contrast, money can serve its other two functions only if people hold it.

The demand for money as explained by the famous quantity theory assumes that the demand for real balances is proportional to income. That is:

where, k is a constant. However, more general and realistic money demand function assumes that the demand for real balances depends on both the interest rate and income;

The purpose of studying money demand is to gain insight about the money demand functions. Just as studies of the consumption function rely on microeconomic models of the consumption decision, studies of the money demand function rely on micro economic models of the money-demand decision.

Theories of money demand emphasize the role of money either as a store of value or as a medium of exchange.

3.4.1 Portfolio Theories of Money Demand

Theories of money demand that emphasizes the role of money as a store of value are called ‘portfolio theories.’ These theories stress that people hold money as part of their portfolio of assets. The key insight is that money offers a different combination of risk and return than other assets. In particular, money offers a safe (nominal) return, whereas the prices of stocks and bonds may rise or fall. Thus, some economists have suggested that households choose to hold money as part of their optimal portfolio.

Portfolio theories predict that the demand for money should depend on the risk and return offered by money and by the various assets households can hold instead of money. In addition, money demand should depend on total wealth, because wealth measures the size of the portfolio to be allocated among money and the alternative assets. For example, we might write the money demand function as:

where r^e is the expected real return on stock, r^e_b is the expected real return on bonds, π^e is the expected inflation rate, and W is real wealth. An increase in r^e or r^e_b reduces money demand, because other assets become more attractive. An increase in π^e also reduces money demand, because money becomes less attractive. An increase in W raises money demand, because higher wealth implies a larger portfolio.

From the stand point of portfolio theories, we can view our money demand function as a useful simplification. First, it uses real income as a proxy for real wealth (). Second, the only return variable it includes is the nominal interest rate, which is the sum of the real return on bonds and expected inflation (that is $r^e_b + \pi^e$). According to portfolio theories, however, the money demand function should include the expected returns on other assets as well.

3.4.2 Transactions Theories of Money Demand

Theories of money demand that emphasizes the role of money as a medium of exchange are called 'transactions theories.' These theories acknowledge that money is a dominated asset and emphasize that money, unlike other assets, is held to make purchases.

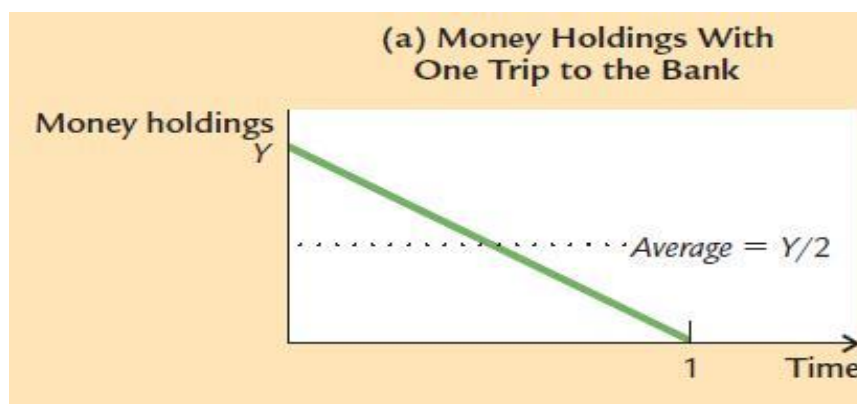
Transactions theories of money demand take many forms, depending on how one model the process of obtaining money and making transactions. All these theories assume that money has the cost of earning a low rate of return and the benefit of making transactions more convenient. People decide how much money to hold by trading off these costs and benefits. A prominent model of this type is the 'Baumol- Tobin Model', developed in 1950s by economists William Baumol and James Tobin, and it remains a leading theory of money demand.

The Baumol-Tobin Model of Cash Management

The Baumol-Tobin model analyses the costs and benefits of holding money. The benefit of holding money is convenience; people hold money to avoid making a trip to the bank every time they wish to buy something. The cost of this convenience is the forgone interest they would have received had they left the money deposited in a savings account that paid interest.

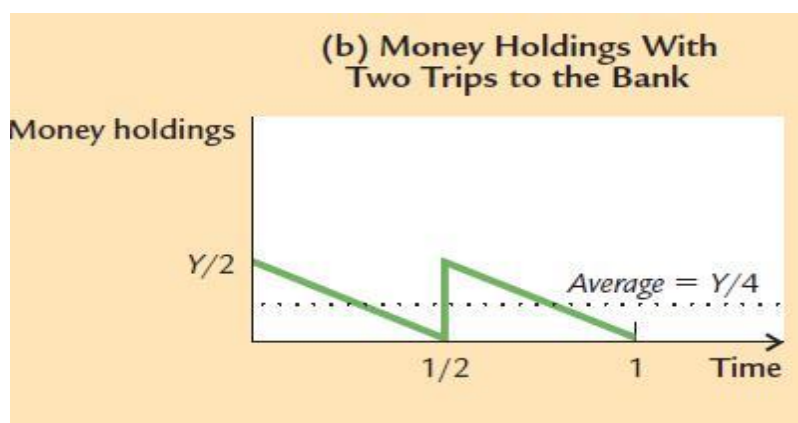
Consider a person who plans to spend dollars gradually over the course of year (For simplicity, assume that the price level is constant, so real spending is constant over the year). There are different possibilities. The person could withdraw the dollars at the beginning of the year and gradually spend the money. Figure 3.1 shows the money holding over the course of the year under this plan. The money holding begin the year at Y and end the year at zero, averaging over the year.

Figure 3.1



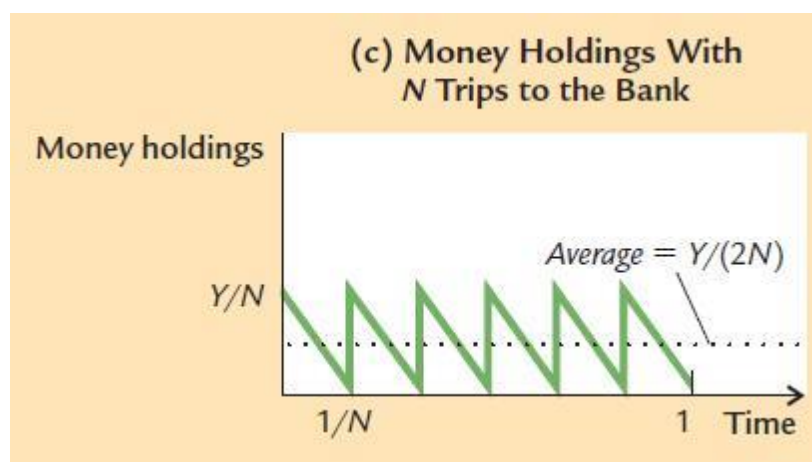
A second possible plan is to make two trips to the bank. In this case, the person withdraws dollars at the beginning of the year, gradually spends this amount over first half of the year, and then makes another trip to withdraw $Y/2$ for the second half of the year. Figure-3.2 shows that money holdings over the year vary between and zero, averaging . This plan has the advantage that less money is held on average, so less interest is forgone, but it has the disadvantage of requiring two trips to the bank rather than one.

Figure 3.2



Generally, suppose the individual makes N trips to the bank over the course of the year. On each trip, he/she withdraws Y/N dollars; then spends the money gradually over the following $1/N$ of the year. Figure-3.3 shows that money holdings vary between Y/N and zero, averaging $Y/(2N)$.

Figure 3.3



The optimal choice of N is determined by different factors. The greater N is, the less money is held on average and the less interest is forgone. But as N increases, so does the inconvenience of making frequent trips to the bank.

Suppose that the cost of going to the bank is some fixed amount c . c represents the value of the time spent traveling to and from the bank and waiting in line to make the withdrawal (For example, if a trip to the bank takes 15 minutes and a person's wage is \$12 per hour, then c is \$3). Also let i denote the interest rate; because money does not bear interest, i measures the opportunity cost of holding money.

For any N , the average amount of money held is $Y/(2N)$, so the forgone interest is $iY/(2N)$. Because c is the cost per trip to the bank, the total cost of making trips to the bank is cN . The total cost the individual bears is the sum of forgone interest and the cost of trips to the banks.

The larger the number of trips, the smaller the forgone interest, and the larger the cost of going to the bank. Figure-3.4 shows how total cost depends on . There is one value of that minimizes total cost. The optimal value of denoted by is:

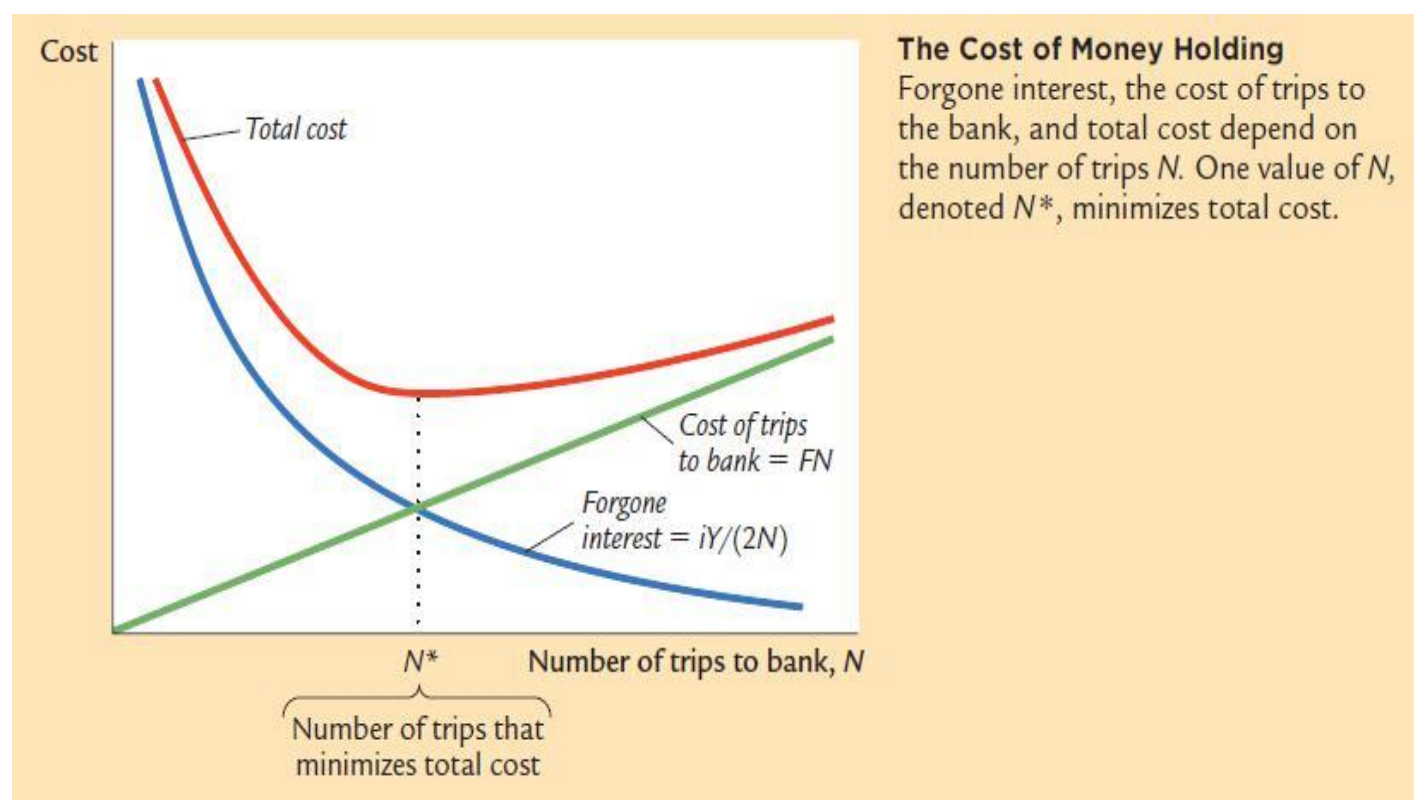
$$\sqrt{\frac{FY}{2i}}$$

Average money holding is

$$\frac{\sqrt{FY}}{2i}$$

This explanation shows that the individual holds more money if the fixed cost of going to the bank is higher, if expenditure is higher, or if the interest rate is lower.

Figure 3.4



3.4.3 Financial Innovation and the Rise of Near Money

Traditional macroeconomic analysis groups assets into two categories: those used as medium of exchange as well as store of value (currency, checking accounts) and those used only as a store of value (stocks, bonds, savings accounts). The first category of assets is called money.⁶ Although the distinction between monetary and non-monetary assets remains a useful theoretical tool, in recent years it has become more difficult to use in practice. In part because of deregulation of banks and other financial institutions, and in part because of improved computer technology, the past few decades have seen rapid financial innovation. Monetary assets such as checking accounts once paid no interest; today they earn market interest rates and are comparable to non-monetary assets as stores of value. Non-monetary assets such as stocks and bonds were once inconvenient to buy and sell; today mutual funds allow depositors to hold stocks and bonds and to make withdrawals simply by writing checks from their accounts. These non-monetary assets that have acquired some of the liquidity of money are called near money.⁶

The existence of near money complicates monetary policy by making the demand for money unstable. Since money and near money are close substitutes, households can easily switch their assets from one form to the other. Such changes can occur for minor reasons and do not necessarily reflect changes in spending. Thus, the velocity of money becomes unstable, and the quantity of money gives faulty signals about aggregate demand.

3.5 Money supply

The quantity of money supply in an economy is defined simply as the value of currencies held by the public, and the Central Banks control the supply of money by increasing or decreasing the quantity of currency in circulation through open market operations. But this definition of money supply omits the banking sector. Money supply includes the currency in the hands of the public and the deposits at banks that households can use on demand for transactions, such as checking accounts. That is, letting denote the money supply, currency and demand deposits;

To understand the money supply, we must understand the interaction between currency and demand deposits and how the Central bank policy influences these two components of the money supply.

Imagine a world without banks, where all money takes the form of currency, and the quantity of money is simply the amount of currency that the public holds (Say there is \$1000 of currency in the economy). Now introduce banks and at first assume that banks accept deposits but do not make loans. The only purpose of the banks is to provide a safe place for deposits to keep their money. The deposits that banks have received but have not lent out are called reserves. Some reserves are held at the Central bank. If all deposits are held as reserves, such a system is called as '100 percent reserve banking'.

Before the creation of the first Bank, the money supply was \$1000 of currency and after the creation of the bank the money supply is \$1000 of demand deposits; if the public is depositing the entire money in the bank. A dollar deposited in a bank reduces currency by one dollar and raises deposits by one dollar, so the money supply remains the same. If banks hold 100 percent of deposits in reserve, the banking system does not affect the supply of money.

Now imagine that banks start to use some of their deposits to make loans – for example, to families who are buying houses or firms that are investing in new plants and equipment. The advantage to banks is that interest can be charged on the loans. The banks must keep some reserves on hand so that reserves are available whenever depositors want to make withdrawals. This kind of system is called as 'fractional reserve banking,' a system under which banks keep only a fraction of their deposits in reserve.

The first bank increases the supply of money by \$800 when it makes the loan. Before the loan is made the money supply was \$1000, equaling the deposits in first bank. After the loan is made, the money supply is \$1800; the depositors still has a demand deposit of \$1000, but now borrower holds \$800 in currency. Thus, in fractional reserve banking, banks create money. The creation of money does not stop with the first bank and it continues through various banks.

Although this process of money creation can continue forever; it does not create an infinite amount of money. Letting rr denote the reserve deposit ratio, the amount of money that the original \$1000 creates is as shown in Table-3.1.

Table-3.1**Money Supply Process**

Variables	Quantity (\$)
1. Original deposit	1000
2. First bank lending	$(1-rr) \times 1000$
3. Second bank lending	$(1-rr)^2 \times 1000$
4. Third bank lending	$(1-rr)^3 \times 1000$
Total money supply	$[1 + (1-rr) + (1-rr)^2 + (1-rr)^3 + \dots] \times 1000$ $= (1/rr) \times 1000$

Each \$1 of reserve generates $\$(1/rr)$ of money. In our above example $rr = 0.2$, so the original \$1000 generates \$5000 of money.

The banking systems ability to create money is the primary difference between banks and other financial institutions. Financial markets have the important function of transferring the economy's resources from those households and firms that wish to borrow to buy investment goods to be used in future production. This process is called 'financial intermediation.' Yet of these financial institutions, only banks have the legal authority to create assets that are part of the money supply, such as checking accounts. Therefore, banks are the only financial institutions that directly influence the money supply.

Note that although the system of fractional-reserve banking creates money, it does not create wealth. When a bank loans out some of its reserves, it gives borrowers the ability to make transactions and therefore increases the supply of money. The borrowers are also undertaking a debt obligation to the bank, however, so the loan does not make them wealthier. In other words, the creation of money by the banking system increases the economy's liquidity, not its wealth.

3.5.1 A Model of the Money Supply

The present model of the money supply is based on fractional-reserve banking. The model has the following three exogenous variables.

- i. *Monetary base* (): It is the total number of dollars held by the public as currency (C) and by the banks as reserves (R). It is directly controlled by the Central bank.
- ii. *Reserve-deposit ratio* (): It is the fraction of deposits that banks hold in reserve. It is determined by the business policies of banks and the laws regulating banks.
- iii. *Currency-deposit ratio* (): It expresses the preferences of the public about how much money to hold in the form of currency (C) and how much to hold in the form of demand deposits (D).

The present model shows how the money supply depends on the monetary base, the reserve-deposit ratio, and the currency-deposit ratio. It examines how Central bank policies and the choices of banks and households influence the money supply.

The model begins with the definition of money supply and monetary base.

The first equation states that the money supply is the sum of currency and demand deposits. The second equation states that the monetary base is the sum of currency and bank reserves. If we divide the first equation by the second, we get:

If we divide both the top and bottom of the expression on the right by $\frac{C}{D}$:

Note that c is the currency-deposit ratio (), and that r is the reserve-deposit ratio (). Making these substitutions, and bringing the M from the left to the right side of the equation, we obtain:

$$M = \frac{1}{1 - c - r} B$$

This equation shows how the money supply depends on the three exogenous variables. Money supply is proportional to the monetary base. The factor of proportionality is denoted by m and is called the money multiplier.⁴ That is,

Each dollar of the monetary base produces m dollars of money. Since the monetary base has a multiplier effect on the money supply, the monetary base is sometimes called high-powered money.⁴

Numerical Example:

If the monetary base is \$300 billion, the reserve deposit ratio is 0.1 and currency-deposit ratio is 0.4; calculate the money multiplier and the money supply.

Answer:

$$m = \frac{1}{1 - c - r} = \frac{1}{1 - 0.4 - 0.1} = 2.8$$

Money supply

Each dollar of the monetary base generates 2.8 dollars of money, so the total money supply is \$840 billion.

The influence of the three exogenous variables (B , c , and r) on the money supply can be summarized as follows.

- i. The money supply is proportional to the monetary base. Thus, an increase in the monetary base increases the money supply by the same percentage.
- ii. The lower the reserve-deposit ratio, the more loan banks make, and the more money banks create from every dollar of reserves. Thus, a decrease in the reserve-deposit ratio raises the money multiplier and the money supply.
- iii. The lower the currency-deposit ratio, the fewer dollars of the monetary base the public holds as currency, the more base dollars banks hold as reserves, and the more money banks can create. Thus, a decrease in the currency-deposit ratio raises the money multiplier and the money supply.

3.5.2 Instruments of Monetary Policy

The Central bank controls the money supply indirectly by altering either the monetary base or the reserve-deposit ratio. To do this the Central Bank has its disposal three instruments of monetary policy: open market operations, reserve requirements, and the discount rate.

- i. *Open market Operations:* These are the purchases and sales of government bonds by the Central bank. When the Central bank buys bonds from the public, the dollars it pays for the bonds increase the monetary base and thereby increase the money supply. When the Central bank sells bonds to the public, the dollars it receives reduce the monetary base and thus decrease the money supply. Open market operations are the policy instruments that the Central bank uses most often.
- ii. *Reserve requirements:* These are Central bank regulations that impose on banks a minimum reserve-deposit ratio. An increase in reserve requirements raises the reserve-deposit ratio and thus lowers the money multiplier and the money supply.
- iii. *Discount rate:* It is the interest rate that the Central bank charges when it makes loan to banks. Banks borrow from the Central bank when they find themselves with too few reserves to meet reserve requirements. The lower the discount rate, the cheaper are borrowed reserves, and the more banks borrow at the Central bank's discount window. Hence, reductions in the discount rate raise the monetary base and the money supply.

3.6 Inflation and Money Growth

Activity

Dear student, define inflation?

Good, compare your result with the explanations given below.

—*Inflation is always and everywhere a monetary phenomenon.*“ So wrote Milton Friedman, the great economist who won the Nobel Prize in economics in 1976. The quantity theory of money leads us to agree that the growth in the quantity of money is the primary determinant of the inflation rate. Yet Friedman’s claim is empirical, not theoretical. To evaluate his claim, and to judge the usefulness of our theory, we need to look at data on money and prices.

Friedman, together with fellow economist Anna Schwartz, wrote two treatises on monetary history that documented the sources and effects of changes in the quantity of money over the past century. Figure 3.5 uses some of their data and 3 Milton Friedman and Anna J. Schwartz, *A Monetary History of the United States, 1867–1960* plots the average rate of money growth and the average rate of inflation in the United States over each decade since the 1870s. The data verify the link between inflation and growth in the quantity of money. Decades with high money growth tend to have high inflation, and decades with low money growth tend to have low inflation.

3.7 Seigniorage: The Revenue from Printing Money

So far, we have seen how growth in the money supply causes inflation. But what might ever induce the government to increase the money supply? Here we examine one answer to this question.

Let's start with an indisputable fact: all governments spend money. Some of this spending is to buy goods and services (such as roads and police), and some is to provide transfer payments (for the poor and elderly, for example). A government can finance its spending in three ways. First, it can raise revenue through taxes, such as personal and corporate income taxes. Second, it can borrow from the public by selling government bonds. Third, it can print money.

The revenue raised through the printing of money is called **seigniorage**. The term comes from seigneur, the French word for —feudal lord. In the Middle Ages, the lord had the exclusive right on his manor to coin money. Today this right belongs to the central government, and it is one source of revenue.

When the government prints money to finance expenditure, it increases the money supply. The increase in the money supply, in turn, causes inflation. Printing money to raise revenue is like imposing an inflation tax. At first it may not be obvious that inflation can be viewed as a tax. After all, no one receives a bill for this tax—the government merely prints the money it needs. Who then pays the inflation tax? The answer is the holders of money. As prices rise, the real value of the money in your wallet falls. When the government prints new money for its use, it makes the old money in the hands of the public less valuable. Thus, inflation is like a tax on holding money.

The amount raised by printing money varies from country to country. In the United States, the amount has been small: seigniorage has usually accounted for less than 3 percent of government revenue. In Italy and Greece, seigniorage has often been more than 10 percent of government revenue. In countries experiencing hyperinflation, seigniorage is often the government's chief source of revenue—indeed, the need to print money to finance expenditure is a primary cause of hyperinflation.

Activity

What is seigniorage?

3.8 Inflation and Interest Rates

As we first discussed in the previous Chapter, interest rates are among the most important macroeconomic variables. In essence, they are the prices that link the present and the future. Here we discuss the relationship between inflation and interest rates.

Two Interest Rates: Real and Nominal

Suppose you deposit your savings in a bank account that pays 8 percent interest annually. Next year, you withdraw your savings and the accumulated interest. Are you 8 percent richer than you were when you made the deposit a year earlier?

The answer depends on what —richer— means. Certainly, you have 8 percent more dollars than you had before. But if prices have risen, so that each dollar buys less, then your purchasing power has not risen by 8 percent. If the inflation rate was 5 percent, then the amount of goods you can buy has increased by only 3 percent. And if the inflation rate was 10 percent, then your purchasing power has fallen by 2 percent.

Economists call the interest rate that the bank pays the **nominal interest rate** and the increase in your purchasing power the **real interest rate**. If i denotes the nominal interest rate, r the real interest rate, and π the rate of inflation, then the relationship among these three variables can be written as

$$r = i - \pi.$$

The real interest rate is the difference between the nominal interest rate and the rate of inflation.

The Fisher Effect

Rearranging the terms in our equation for the real interest rate, we can show that the nominal interest rate is the sum of the real interest rate and the inflation rate:

$$i = r + \pi.$$

The equation written in this way is called the **Fisher equation**, after economist Irving Fisher (1867–1947). It shows that the nominal interest rate can change for two reasons: because the real interest rate changes or because the inflation rate changes.

Once we separate the nominal interest rate into these two parts, we can use this equation to develop a theory that explains the nominal interest rate. In the previous chapter it was showed that the real interest rate adjusts to equilibrate saving and investment. The quantity theory of money shows that the rate of money growth determines the rate of inflation. The Fisher equation then tells us to add the real interest rate and the inflation rate together to determine the nominal interest rate.

The quantity theory and the Fisher equation together tell us how money growth affects the nominal interest rate. According to the quantity theory, an increase in the rate of money growth of 1 percent causes a 1-percent increase in the rate of inflation. According to the Fisher equation, a 1-percent increase in the rate of inflation in turn causes a 1-percent increase in the nominal interest rate. The one-for-one relation between the inflation rate and the nominal interest rate is called the **Fisher effect**.

Two Real Interest Rates: Ex Ante and Ex Post

When a borrower and lender agree on a nominal interest rate, they do not know what the inflation rate over the term of the loan will be. Therefore, we must distinguish between two concepts of the real interest rate: the real interest rate the borrower and lender expect when the loan is made, called the **ex-ante real interest rate**, and the real interest rate actually realized, called the **ex post real interest rate**.

Although borrowers and lenders cannot predict future inflation with certainty, they do have some expectation of the inflation rate. Let π denote actual future inflation and π^e the expectation of future inflation. The ex-ante real interest rate is $r = i - \pi^e$, and the ex post real interest rate is $r = i - \pi$. The two real interest rates differ when actual inflation π differs from expected inflation π^e .

How does this distinction between actual and expected inflation modify the Fisher effect? Clearly, the nominal interest rate cannot adjust to actual inflation, because actual inflation is not known when the nominal interest rate is set. The nominal interest rate can adjust only to expected inflation. The Fisher effect is more precisely written as

The ex-ante real interest rate is determined by equilibrium in the market for goods and services, as described by the model in previous chapter. The nominal interest rate moves one-for-one with changes in expected inflation .

Activity

What is the difference between real and nominal interest rate?

3.9 The Nominal Interest Rate and the Demand for Money

The quantity theory is based on a simple money demand function: it assumes that the demand for real money balances is proportional to income. Although the quantity theory is a good place to start when analyzing the effects of money on the economy, it is not the whole story. Here we add another determinant of the quantity of money demanded—the nominal interest rate.

The Cost of Holding Money

The money you hold in your wallet does not earn interest. If, instead of holding that money, you used it to buy government bonds or deposited it in a savings account, you would earn the nominal interest rate. The nominal interest rate is the opportunity cost of holding money: it is what you give up by holding money rather than bonds.

Another way to see that the cost of holding money equals the nominal interest rate is by comparing the real returns on alternative assets. Assets other than money, such as government bonds, earn the real return r . Money earns an expected real return of $-\pi^e$, because its real value declines at the rate of inflation. When you hold money, you give up the difference between these two returns. Thus, the cost of holding money is $r + \pi^e$, which the Fisher equation tells us is the nominal interest rate i .

Just as the quantity of bread demanded depends on the price of bread, the quantity of money demanded depends on the price of holding money. Hence, the demand for real money balances depends both on the level of income and on the nominal interest rate. We write the general money demand function as

$$M/P = L(i, Y)$$

The letter L is used to denote money demand because money is the economy's most liquid asset (the asset most easily used to make transactions). This equation states that the demand for the liquidity of real money balances is a function of income and the nominal interest rate. The higher the level of income Y , the greater the demand for real money balances. The higher the nominal interest rate i , the lower the demand for real money balances.

Future Money and Current Prices

Money, prices, and interest rates are now related in several ways. As the quantity theory of money explains, money supply and money demand together determine the equilibrium price level. Changes in the price level are, by definition, the rate of inflation. Inflation, in turn, affects the nominal interest rate through the Fisher effect. But now, because the nominal interest rate is the cost of holding money, the nominal interest rate feeds back to affect the demand for money.

Consider how the introduction of this last link affects our theory of the price level. First, equate the supply of real money balances M/P to the demand $L(i, Y)$:

$$M/P = L(i, Y)$$

Next, use the Fisher equation to write the nominal interest rate as the sum of the real interest rate and expected inflation:

$$M/P = L(r + \pi^e, Y).$$

This equation states that the level of real money balances depends on the expected rate of inflation.

The last equation tells a more sophisticated story than the quantity theory about the determination of the price level. The quantity theory of money says that today's money supply determines today's price level. This conclusion remains partly true: if the nominal interest rate and the level of output are held constant, the price level moves proportionately with the money supply. Yet the nominal interest rate is not constant; it depends on expected inflation, which in turn depends on growth in the money supply. The presence of the nominal interest rate in the money demand function yields an additional channel through which money supply affects the price level.

This general money demand equation implies that the price level depends not only on today's money supply but also on the money supply expected in the future. To see why, suppose the Fed announces that it will raise the money supply in the future, but it does not change the money supply today. This announcement causes people to expect higher money growth and higher inflation. Through the Fisher effect, this increase in expected inflation raises the nominal interest rate. The higher nominal interest rate reduces the demand for real money balances. Because the quantity of money has not changed, the reduced demand for real money balances leads to a higher price level. Hence, higher expected money growth in the future leads to a higher price level today.

3.10 The Social Costs of Inflation

Our discussion of the causes and effects of inflation does not tell us much about the social problems that result from inflation. We turn to those problems now.

The Layman's View and the Classical Response

If you ask the average person why inflation is a social problem, he will probably answer that inflation makes him poorer. —Each year my boss gives me a raise, but prices go up and that takes

some of my raise away from me.” The implicit assumption in this statement is that if there were no inflation, he would get the same raise and be able to buy more goods.

This complaint about inflation is a common fallacy. As we know from previous chapter, the purchasing power of labor—the real wage—depends on the marginal productivity of labor, not on how much money the government chooses to print. If the government reduced inflation by slowing the rate of money growth, workers would not see their real wage increasing more rapidly. Instead, when inflation slowed, firms would increase the prices of their products less each year and, as a result, would give their workers smaller raises.

According to the classical theory of money, a change in the overall price level is like a change in the units of measurement. It is as if we switched from measuring distances in feet to measuring them in inches: numbers get larger, but nothing really changes. Imagine that tomorrow morning you wake up and find that, for some reason, all dollar figures in the economy have been multiplied by ten. The price of everything you buy has increased tenfold, but so as your wage and the value of your savings. What difference would this make? All numbers would have an extra zero at the end, but nothing else would change. Your economic well-being depends on relative prices, not the overall price level.

Why, then, is a persistent increase in the price level a social problem? It turns out that the costs of inflation are subtle. Indeed, economists disagree about the size of the social costs. To the surprise of many laymen, some economists argue that the costs of inflation are small—at least for the moderate rates of inflation that most countries have experienced in recent years.

The Costs of Expected Inflation

Consider first the case of expected inflation. Suppose that every month the price level rose by 1 percent. What would be the social costs of such a steady and predictable 12-percent annual inflation?

One cost is the distortion of the inflation tax on the amount of money people hold. As we have already discussed, a higher inflation rate leads to a higher nominal interest rate, which in turn

leads to lower real money balances. If people are to hold lower money balances on average, they must make more frequent trips to the bank to withdraw money—for example, they might withdraw \$50 twice a week rather than \$100 once a week. The inconvenience of reducing money holding is metaphorically called the **shoeleather cost** of inflation, because walking to the bank more often causes one's shoes to wear out more quickly.

A second cost of inflation arises because high inflation induces firms to change their posted prices more often. Changing prices is sometimes costly: for example, it may require printing and distributing a new catalog. These costs are called **menu costs**, because the higher the rate of inflation, the more often restaurants have to print new menus.

A third cost of inflation arises because firms facing menu costs change prices infrequently; therefore, the higher the rate of inflation, the greater the variability in relative prices. For example, suppose a firm issues a new catalog every January. If there is no inflation, then the firm's prices relative to the overall price level are constant over the year. Yet if inflation is 1 percent per month, then from the beginning to the end of the year the firm's relative prices fall by 12 percent. Sales from this catalog will tend to be low early in the year (when its prices are relatively high) and high later in the year (when its prices are relatively low). Hence, when inflation induces variability in relative prices, it leads to microeconomic inefficiencies in the allocation of resources.

A fourth cost of inflation results from the tax laws. Many provisions of the tax code do not take into account the effects of inflation. Inflation can alter individuals' tax liability, often in ways that lawmakers did not intend.

One example of the failure of the tax code to deal with inflation is the tax treatment of capital gains. Suppose you buy some stock today and sell it a year from now at the same real price. It would seem reasonable for the government not to levy a tax, because you have earned no real income from this investment. Indeed, if there is no inflation, a zero tax liability would be the outcome. But suppose the rate of inflation is 12 percent and you initially paid \$100 per share for the stock; for the real price to be the same a year later, you must sell the stock for \$112 per share.

In this case the tax code, which ignores the effects of inflation, says that you have earned \$12 per share in income, and the government taxes you on this capital gain. The problem, of course, is that the tax code measures income as the nominal rather than the real capital gain. In this example, and in many others, inflation distorts how taxes are levied.

A fifth cost of inflation is the inconvenience of living in a world with a changing price level. Money is the yardstick with which we measure economic transactions. When there is inflation, that yardstick is changing in length.

For example, a changing price level complicates personal financial planning. One important decision that all households face is how much of their income to consume today and how much to save for retirement. A dollar saved today and invested at a fixed nominal interest rate will yield a fixed dollar amount in the future. Yet the real value of that dollar amount—which will determine the retiree's living standard—depends on the future price level. Deciding how much to save would be much simpler if people could count on the price level in 30 years being similar to its level today.

The Costs of Unexpected Inflation

Unexpected inflation has an effect that is more pernicious than any of the costs of steady, anticipated inflation: it arbitrarily redistributes wealth among individuals. You can see how this works by examining long-term loans. Most loan agreements specify a nominal interest rate, which is based on the rate of inflation expected at the time of the agreement. If inflation turns out differently from what was expected, the ex post real return that the debtor pays to the creditor differs from what both parties anticipated. On the one hand, if inflation turns out to be higher than expected, the debtor wins and the creditor loses because the debtor repays the loan with less valuable dollars. On the other hand, if inflation turns out to be lower than expected, the creditor wins and the debtor loses because the repayment is worth more than the two parties anticipated.

Unanticipated inflation also hurts individuals on fixed pensions. Workers and firms often agree on a fixed nominal pension when the worker retires (or even earlier). Because the pension is deferred earnings, the worker is essentially providing the firm a loan: the worker provides labor

services to the firm while young but does not get fully paid until old age. Like any creditor, the worker is hurt when inflation is higher than anticipated. Like any debtor, the firm is hurt when inflation is lower than anticipated.

These situations provide a clear argument against variable inflation. The more variable the rate of inflation, the greater the uncertainty that both debtors and creditors face. Because most people are risk averse—they dislike uncertainty—the unpredictability caused by highly variable inflation hurts almost everyone.

Given these effects of uncertain inflation, it is puzzling that nominal contracts are so prevalent. One might expect debtors and creditors to protect themselves from this uncertainty by writing contracts in real terms—that is, by indexing to some measure of the price level. In economies with high and variable inflation, indexation is often widespread; sometimes this indexation takes the form of writing contracts using a more stable foreign currency. In economies with moderate inflation, such as the United States, indexation is less common.

Finally, in thinking about the costs of inflation, it is important to note a widely documented but little understood fact: high inflation is variable inflation. That is, countries with high average inflation also tend to have inflation rates that change greatly from year to year. The implication is that if a country decides to pursue a high-inflation monetary policy, it will likely have to accept highly variable inflation as well. As we have just discussed, highly variable inflation increases uncertainty for both creditors and debtors by subjecting them to arbitrary and potentially large redistributions of wealth.

One Benefit of Inflation

So far, we have discussed the many costs of inflation. These costs lead many economists to conclude that monetary policymakers should aim for zero inflation. Yet there is another side to the story. Some economists believe that a little bit of inflation—say, 2 or 3 percent per year—can be a good thing.

The argument for moderate inflation starts with the observation that cuts in nominal wages are rare: firms are reluctant to cut their workers' nominal wages, and workers are reluctant to accept such cuts. A 2-percent wage cut in a zero inflation world is, in real terms, the same as a 3-percent raise with 5-percent inflation, but workers do not always see it that way. The 2-percent wage cut may seem like an insult, whereas the 3-percent raise is, after all, still a raise. Empirical studies confirm that nominal wages rarely fall.

This fact suggests that some inflation may make labor markets work better. The supply and demand for different kinds of labor are always changing. Sometimes an increase in supply or decrease in demand leads to a fall in the equilibrium real wage for a group of workers. If nominal wages can't be cut, then the only way to cut real wages is to allow inflation to do the job. Without inflation, the real wage will be stuck above the equilibrium level, resulting in higher unemployment.

For this reason, some economists argue that inflation —greases the wheels of labor markets. Only a little inflation is needed: an inflation rate of 2 percent lets real wages fall by 2 percent per year, or 20 percent per decade, without cuts in nominal wages. Such automatic reductions in real wages are impossible with zero inflation.

Activity

Is the cost from expected and unexpected inflation same? Explain.

3.11 Hyperinflation

Hyperinflation is often defined as inflation that exceeds 50 percent per month, which is just over 1 percent per day. Compounded over many months, this rate of inflation leads to very large increases in the price level. An inflation rate of 50 percent per month implies a more than 100-

fold increase in the price level over a year, and a more than 2-million-fold increase over three years. Here we consider the costs and causes of such extreme inflation.

The Costs of Hyperinflation

Although economists debate whether the costs of moderate inflation are large or small, no one doubts that hyperinflation extracts a high toll on society. The costs are qualitatively the same as those we discussed earlier. When inflation reaches extreme levels, however, these costs are more apparent because they are so severe.

The shoe leather costs associated with reduced money holding, for instance, are serious under hyperinflation. Business executives devote much time and energy to cash management when cash loses its value quickly. By diverting this time and energy from more socially valuable activities, such as production and investment decisions, hyperinflation makes the economy run less efficiently. Menu costs also become larger under hyperinflation. Firms have to change prices so often that normal business practices, such as printing and distributing catalogs with fixed prices, become impossible. In one restaurant during the German hyperinflation of the 1920s, a waiter would stand up on a table every 30 minutes to call out the new prices.

Similarly, relative prices do not do a good job of reflecting true scarcity during hyperinflations. When prices change frequently by large amounts, it is hard for customers to shop around for the best price. Highly volatile and rapidly rising prices can alter behavior in many ways. According to one report, when patrons entered a pub during the German hyperinflation, they would often buy two pitchers of beer. Although the second pitcher would lose value by getting warm over time, it would lose value less rapidly than the money left sitting in the patron's wallet.

Tax systems are also distorted by hyperinflation—but in ways that are quite different than under moderate inflation. In most tax systems there is a delay between the time a tax is levied and the time the tax is paid to the government. In the United States, for example, taxpayers are required to make estimated income tax payments every three months. This short delay does not matter much under low inflation. By contrast, during hyperinflation, even a short delay greatly reduces real tax revenue. By the time the government gets the money it is due, the money has fallen in

value. As a result, once hyperinflations start, the real tax revenue of the government often falls substantially.

Finally, no one should underestimate the sheer inconvenience of living with hyperinflation. When carrying money to the grocery store is as burdensome as carrying the groceries back home, the monetary system is not doing its best to facilitate exchange. The government tries to overcome this problem by adding more and more zeros to the paper currency, but often it cannot keep up with the exploding price level.

Eventually, these costs of hyperinflation become intolerable. Over time, money loses its role as a store of value, unit of account, and medium of exchange. Barter becomes more common. And more stable unofficial monies—cigarettes or the U.S. dollar—start to replace the official money.

The Causes of Hyperinflation

Why do hyperinflations start, and how do they end? This question can be answered at different levels.

The most obvious answer is that hyperinflations are caused by excessive growth in the supply of money. When the central bank prints money, the price level rises. When it prints money rapidly enough, the result is hyperinflation. To stop the hyperinflation, the central bank must reduce the rate of money growth.

This answer is incomplete; however, for it leaves open the question of why central banks in hyper inflating economies choose to print so much money. To address this deeper question, we must turn our attention from monetary to fiscal policy. Most hyperinflations begin when the government has inadequate tax revenue to pay for its spending. Although the government might prefer to finance this budget deficit by issuing debt, it may find itself unable to borrow, perhaps because lenders view the government as a bad credit risk. To cover the deficit, the government turns to the only mechanism at its disposal—the printing press. The result is rapid money growth and hyperinflation.

Once the hyperinflation is under way, the fiscal problems become even more severe. Because of the delay in collecting tax payments, real tax revenue falls as inflation rises. Thus, the

government's need to rely on seigniorage is self-reinforcing. Rapid money creation leads to hyperinflation, which leads to a larger budget deficit, which leads to even more rapid money creation.

The ends of hyperinflations almost always coincide with fiscal reforms. Once the magnitude of the problem becomes apparent, the government musters the political will to reduce government spending and increase taxes. These fiscal reforms reduce the need for seigniorage, which allows a reduction in money growth. Hence, even if inflation is always and everywhere a monetary phenomenon, the end of hyperinflation is often a fiscal phenomenon as well.

Summary

- ✓ Money is the stock of assets used for transactions. It serves as a store of value, a unit of account, and a medium of exchange. Different sorts of assets are used as money: commodity money systems use an asset with intrinsic value, whereas fiat money systems use an asset whose sole function is to serve as money. In modern economies, a central bank such as the Federal Reserve is responsible for controlling the supply of money.
- ✓ The quantity theory of money assumes that the velocity of money is stable and concludes that nominal GDP is proportional to the stock of money. Because the factors of production and the production function determine real GDP, the quantity theory implies that the price level is proportional to the quantity of money. Therefore, the rate of growth in the quantity of money determines the inflation rate.
- ✓ Seigniorage is the revenue that the government raises by printing money. It is a tax on money holding. Although seigniorage is quantitatively small in most economies, it is often a major source of government revenue in economies experiencing hyperinflation.
- ✓ The nominal interest rate is the sum of the real interest rate and the inflation rate. The Fisher effect says that the nominal interest rate moves one-for-one with expected inflation.
- ✓ The nominal interest rate is the opportunity cost of holding money. Thus, one might expect the demand for money to depend on the nominal interest rate. If it does, then the price level depends on both the current quantity of money and the quantities of money expected in the future.
- ✓ The costs of expected inflation include shoe leather costs, menu costs, and the cost of relative price variability, tax distortions, and the inconvenience of making inflation corrections. In addition, unexpected inflation causes arbitrary redistributions of wealth between debtors and creditors. One possible benefit of inflation is that it improves the

functioning of labor markets by allowing real wages to reach equilibrium levels without cuts in nominal wages.



During hyperinflations, most of the costs of inflation become severe. Hyperinflations typically begin when governments finance large budget deficits by printing money. They end when fiscal reforms eliminate the need for seigniorage.



According to classical economic theory, money is neutral: the money supply does not affect real variables. Therefore, classical theory allows us to study how real variables are determined without any reference to the money supply. The equilibrium in the money market then determines the price level and, as a result, all other nominal variables. This theoretical separation of real and nominal variables is called the classical dichotomy.

Review Questiones

1. Describe the functions of money.

2. What is fiat money? What is commodity money?

3. Who controls the money supply and how?

4. Write the quantity equation and explain it

5. Who pays the inflation tax?

6. If inflation rises from 6 to 8 percent, what happens to real and nominal interest rates according to the Fisher effect?

7. Explain the roles of monetary and fiscal policy in causing and ending hyperinflations.

8. Define the terms —real variable and —nominal variable, and give an example of each.

Chapter Four

Government Debt

4.1. Introduction

Dear learners! Under this chapter we mainly analyze whether the government debt is really a problem for a given economy or not using two viewpoints: the Traditional view and the Ricardian view. Furthermore, the chapter addresses the problems in measurements of the government budget deficit.

Chapter Objectives:

Up on the successful completion of this chapter, students will be able to:

- *Comprehend the traditional and the Ricardian view about government debt*
- *Explain the problems with the Ricardian equivalence*
- *Understand government budget constraints*
- *Identify problems that arise in measuring budget deficit*

Chapter Outline:

- *The concept of government debt*
- *Views on government debt*
- *Measurement of budget constraint*
- *Summary*
- *Review questions*

4.2. The Concept of Government Debt

Activity

Dear student, write down what you understand from the phrase government debt on the space given below.

Good! Compare your answer with the explanation given below.

When a government spends more than it collects in taxes, it borrows from the private sector to finance the budget deficit. The accumulation of past borrowing is the government debt. All governments have some debt, although the amount varies substantially from country to country.

4.3. Views on Government Debt

There are basically two views on government debt: the traditional and Ricardian view

4.3.1. The Traditional View of Government Debt

According to this view the government borrowing reduces national saving and crowds out capital accumulation. A tax cut financed by government borrowing would have many effects on the economy. The immediate impact of the tax cut would be to stimulate consumer spending. Higher consumer spending affects the economy in both the short run and the long run.

In the short run, higher consumer spending would raise the demand for goods and services and thus raise output and employment. Interest rates would also raise, however, as investors competed for a smaller flow of saving. Higher interest rates would discourage investment and would encourage capital to flow in from abroad.

In the long run, the smaller national saving caused by the tax cut would mean a smaller capital stock and a greater foreign debt. Therefore, the output of the nation would be smaller, and a greater share of that output would be owed to foreigners. The overall effect of the tax cut on

economic well-being is hard to judge. Current generations would benefit from higher consumption and higher employment, although inflation would likely be higher as well. Future generations would bear much of the burden of today's budget deficits: they would be born into a nation with a smaller capital stock and a larger foreign debt.

4.3.2 The Ricardian View of Government Debt

Modern theories of consumer behavior emphasize that, because consumers are forward-looking, consumption does not depend on current income alone. The forward-looking consumer is at the heart of Franco Modigliani's life cycle hypothesis and Milton Friedman's permanent income hypothesis. The Ricardian view of government debt applies the logic of the forward-looking consumer to analyze the impact of fiscal policy.

Basic Logic of Ricardian Equivalence

The forward looking consumer understands that government borrowing today means higher taxes in the future. A tax cut financed by government debt does not reduce the tax burden; it merely reschedules it. It does not raise the consumer's permanent income and therefore, does not increase consumption.

The general principle is that government debt is equivalent to future taxes, and if consumers are sufficiently forward-looking, future taxes are equivalent to current taxes. Hence, financing the government debt is equivalent to financing it by taxes. This view, called 'Ricardian equivalence', is named after the famous nineteenth century economist David Ricardo, because he first noted the theoretical argument.

The implication of Ricardian equivalence is that a debt-financed tax cut leaves consumption unaffected. Households save the extra disposable income to pay the future tax liability that the tax cut implies. This increase in private savings just offsets the decrease in public saving. National saving- the sum of private and public saving – remains the same. The tax cut therefore has none of the effects that the traditional analysis predicts.

The logic of Ricardian equivalence does not imply that all changes in fiscal policy are irrelevant. Changes in fiscal policy do influence consumer spending if they influence present or future government purchases. For example, suppose that the government cuts taxes today because it plans to reduce government purchases in the future. If the consumer understands that this tax cuts does not imply an increase in future taxes, he feels richer and raises his consumption. But note that it is the reduction in government purchases, rather than the reduction in taxes, that stimulates consumption: the announcement of a future reduction in government purchases would raise consumption today even if current taxes were unchanged, because it would imply lower taxes at some time in the future.

The Government Budget Constraint

To better understand the link between government debt and future taxes, it is useful to imagine that the economy lasts for only two periods. Period one represents the present and period two the future. In period one, the government collects taxes T_1 and makes purchases G_1 ; in period two, it collects taxes T_2 and makes purchases G_2 . Because the government can run a budget deficit or a budget surplus, taxes and purchases in any single period need not be closely related.

We want to see how the government's tax receipts in the two periods are related to its purchases in the two periods. In the first period, the budget deficit equals government purchases minus taxes. That is;

where D_1 is the deficit. The government finances this deficit by selling an equal amount of government bonds. In the second period, the government must collect enough taxes to repay the debt, including the accumulated interest, and to pay for its second period purchases. Thus,

where r is the interest rate

To derive the equation linking taxes and purchases, combine the two equations above. Substitute the first equation for into the second equation to obtain,

This equation relates purchases in the two periods to taxes in the two periods. To make the equation easier to interpret, we rearrange terms. After a little algebra, we obtain,

$$\frac{P_1}{1+r} + \frac{P_2}{1+r} = \frac{T_1}{1+r} + \frac{T_2}{1+r}$$

This equation is the **government budget constraint**.⁶ It states that the present value of government purchases must equal the present value of taxes.

The government budget constraint shows how changes in fiscal policy today are linked to changes in fiscal policy in the future. If the government cuts first-period taxes without altering first-period purchases, then it enters the second period owing a debt to the holders of government bonds. This debt forces the government to choose between reducing purchases and raising taxes.

Consumers and Future Taxes

The essence of the Ricardian view is that when people choose their consumption, they rationally look ahead to the future taxes implied by government debt. Defenders of the traditional view of government debt believe that future taxes do not have as large an influence on current consumption as the Ricardian view assumes. The following are some of their arguments:

1. Myopia

Economists who support the Ricardian view of fiscal policy assume that people are rational when making important decisions such as choosing how much of their income to consume and how much save. Ricardian consumers look ahead to the future taxes implied by current government borrowing. Thus, the Ricardian view presumes that people have substantial knowledge and foresight.

One argument for the traditional view of tax cuts is that people are short-sighted, perhaps because they do not fully comprehend the implications of government budget deficits. It is possible that some people follow simple and not fully rational rules of thumb when choosing

how much to save. Suppose, for example, that a person acts on the assumption that future taxes will be the same as current taxes. This person will fail to take account of future changes in taxes implied by current government policies. A debt-financed tax cut will lead this person to believe that his permanent income has increased, even if it hasn't. The tax cut will therefore lead to higher consumption and lower national savings.

2. Borrowing Constraints

The Ricardian view of government debt is based on the permanent-income hypothesis. This view assumes that consumption does not depend on current income alone, but on permanent income, which includes both current and expected future income, but it leaves permanent income and consumption unchanged.

Advocates of traditional view of government debt argue that we should not rely on the permanent income hypothesis, because some consumers face borrowing constraints. A person facing a binding borrowing constraint can consume only his current income. For this person; debt-financed tax cut raises current income and thus consumption, even though future income is lower. In essence, when the government cuts current taxes and raises future taxes, it is giving taxpayers a loan. For individuals who wanted to obtain a loan but were unable to, the tax cut raises consumption.

3. Future Generations

Besides myopia and borrowing constraints, a third argument for the traditional view of government debt is that consumers expect the implied future taxes to fall not on them but on future generations. Suppose, if the government cuts taxes today, issues 30 year bonds to finance case, the government debt represents a transfer of wealth from the next generation of tax-payers (which faces the tax hike) to the current generation of tax payers (which gets the tax cut). This transfer raises the lifetime resources of the current generation, so it raises their consumption. In essence, a debt-financed tax cut stimulates consumption because it gives the current generation the opportunity to consume at the expense of the next generation.

4.4. Measurement of Budget Constraint

Although the debate between the traditional and Ricardian views of government debt is central to the disagreement among economists over fiscal policy, it is not the only source of controversy. Many of the arguments concern the question of how the budget deficit should be measured. Some economists believe that the deficit as currently measured is not a good indicator of the stance of fiscal policy. They believe that the budget deficit does not accurately gauge either the impact of fiscal policy on today's economy or the burden being placed on future generations of tax-payers.

The general principle is that the government budget deficit should accurately reflect the change in the government's overall indebtedness. This principle seems simple enough. But its application is not as straightforward as one might expect. In this section we discuss four problems with the usual measure of the budget deficit.

Measurement Problem 1: Inflation

The least controversial of the measurement issues is the correction for inflation. Almost all economists agree that the government's indebtedness should be measured in real terms, not in nominal terms. The measured deficit should equal the change in the government's real debt, not the change in nominal debt.

The budget deficit as commonly measured, however, does not correct for inflation. Suppose that the real government debt is not changing in other words, in real terms, the budget is balanced. In this case, the nominal debt must be rising at the rate of inflation. That is,

where, π is the inflation rate and D is the stock of government debt. This implies,

The government would look at the change in the nominal debt ΔD and would report a budget deficit of ΔD . Hence, most economists believe that the reported budget deficit is overstated by the amount πD .

The deficit is government expenditure minus government revenue. Part of expenditure is the interest paid on the government debt. Expenditure should include only the real interest paid on the debt, not the nominal interest paid. Because the difference between the nominal interest rate and the real interest rate is the inflation rate, the budget deficit is overstated.

Measurement Problem 2: Capital Assets

Many economists believe that an accurate assessment of government's budget deficit requires accounting for the government's assets as well as its liabilities. In particular, when measuring the government's overall indebtedness, we should subtract government assets from government debt. Therefore, the budget deficit should be measured as the change in debt minus the change in assets.

Individuals and firms treat assets and liabilities symmetrically. When a person borrows to buy a house, we do not say that he is running a budget deficit. Instead, we offset the increase in assets (the house) against the increase in debt (the mortgage) and record no change in net wealth. Perhaps we should treat the government's finances the same way.

A budget procedure that accounts for assets as well as liabilities is called 'capital budgeting', because it takes into account changes in capital. For example, suppose that the government sells one of its office buildings or some of its land and use the proceeds to reduce the government debt. Under current budget procedures, the reported deficit would be lower. Under capital budgeting, the revenue received from the sale would not lower the deficit because the reduction in debt would be offset by a reduction in assets. Similarly, under capital budgeting, government borrowing to finance the purchase of a capital good would not raise the deficit.

The major difficulty with capital budgeting is that it is hard to decide which government expenditures should count as capital expenditures. For example, should the interstate highway system be counted as an asset or not. Proponents of capital budgeting argue that even an imperfect treatment of capital assets would be better than ignoring them altogether.

Measurement Problem 3: Uncounted Liabilities

Some economists argue that the measured budget deficit is misleading because it excludes some important government liabilities. For example, consider the pensions of government workers. These workers provide labor service to the government today, but part of their compensation is deferred to the future. In essence, these workers are providing a loan to the government. Their future pension benefits represent a government liability not very different from government debt. Yet the accumulation of this liability is not included as part of the budget deficit.

Similarly consider the social security system. In some ways, the system is similar to a pension plan. People pay some of their income into the system when young and expect to receive benefits when old. Perhaps accumulated future social security benefits should be included in the government's liabilities.

A particularly difficult form of government liability to measure is the 'contingent liability' – the liability that is due only if a specified event occurs. For example, the government guarantees many form of private credit, such as student loans, mortgages for low income families, and deposits in banks and savings and loan institutions. If the borrower repays the loan, the government pays nothing; if the borrower defaults, the government makes the repayment. When the government provides this guarantee, it undertakes a liability contingent on the borrower's default, yet this contingent liability is not reflected in the budget deficit, in part because it is not clear what currency value to attach.

Measurement Problem 4: The Business Cycle

Many changes in the government's budget deficit occur automatically in response to a fluctuating economy. When the economy goes into a recession, incomes fall, so people pay less in personal income taxes. Profits fall, so corporations pay less in corporate income taxes. Fewer people are employed, so payroll tax revenue declines. More people become eligible for government assistance, such as welfare and unemployment insurance, so government spending rises. Even without any change in the laws governing taxation and spending, the budget deficit increases.

These automatic changes in the deficit are not errors in measurement, because the government truly borrows more when a recession depresses tax revenue and boosts government spending. But these changes do make it more difficult to use the deficit to monitor changes in fiscal policy. That is, the deficit can rise or fall either because the government has changed policy or because the economy has changed direction. For some purposes, it would be good to know which is occurring.

To solve this problem, the government calculates a cyclically adjusted budget deficit (sometimes called the full-employment budget deficit). The cyclically adjusted deficit is based on estimates of what government spending and tax revenue would be if the economy were operating at its natural level of output and employment. The cyclically adjusted deficit is a useful measure because it reflects policy changes but not the current stage of the business cycle.

Summary

- ✓ Government debt is the accumulation of past borrowing.
- ✓ There are two viewpoints on government debt, viz. traditional view and Ricardian view.
- ✓ According to the traditional view of government debt, a debt-financed tax cut stimulates consumer spending and lowers national saving. This increase in consumer spending leads to greater aggregate demand and higher income in the short run, but it leads to a lower capital stock and lower income in the long run.
- ✓ According to the Ricardian view of government debt, a debt-financed tax cut does not stimulate consumer spending because it does not raise consumers' overall resources; it merely reschedules taxes from the present to the future.
- ✓ Standard figures on the deficit are imperfect measures of fiscal policy because they are not corrected for inflation, do not account for changes in government assets, omit some liabilities, and do not account for effects of business cycles.

Review Questions

1. According to the traditional view of government debt, how does a debt-financed tax cut affect public saving, private saving, and national saving?

2. According to the Ricardian view of government debt, how does a debt-financed tax cut affect public saving, private saving, and national saving?

3. Discuss briefly the arguments forwarded by proponents of traditional view against the notion of forward-looking consumers by Ricardian.

4. Describe four problems affecting measurement of the government budget deficit

Chapter Five

Economic Growth

5.1. Introduction

Dear students! In this chapter we deeply discuss about the Solow growth model and we try to explain the reason behind the difference in standard of living across different countries using the model. Mainly, we will try to analyze how a countries standard of living depend on its saving, population growth rate and technological progress.

Chapter Objectives:

At the end of this chapter, students will be able to:

- *Understand the Solow growth model*
- *Enlighten why some countries are richer than other countries*
- *Explain why some countries do exhibit sustained growth while others don't.*
- *Comprehend how changes in capital stock, labor force, and technology affect economic growth*

Chapter Outline:

- *The Accumulation of capital*
- *How saving affects growth*
- *The Golden Rule level of capital*
- *How population growth affects economic growth*
- *Technological progress in the Solow model*

5.2. The Accumulation of capital

The Solow growth model is designed to show how growth in the capital stock, growth in the labor force, and advances in technology interact in an economy, and how they affect a nation's total output of goods and services.

To build this model in steps, we assume that the labor force and technology are fixed in the first step. We then relax these assumptions by introducing changes in the labor force and by introducing changes in technology.

The supply and demand for goods

The supply and demand for goods play a central role in the Solow model, as they do in the static model. By considering the supply and demand for goods, we can see what determines how much output is produced at any given time and how this output is allocated among alternative uses.

The supply of goods and the Production function, which states that output depends on the capital stock and the labor force:

The Solow growth model assumes that the production function has constant returns to scale; i.e. ,
for any positive

Production functions with constant returns to scale allow us to analyze any quantities in the economy relative to the size of labor force. To see that this is true, set in the preceding equation to obtain

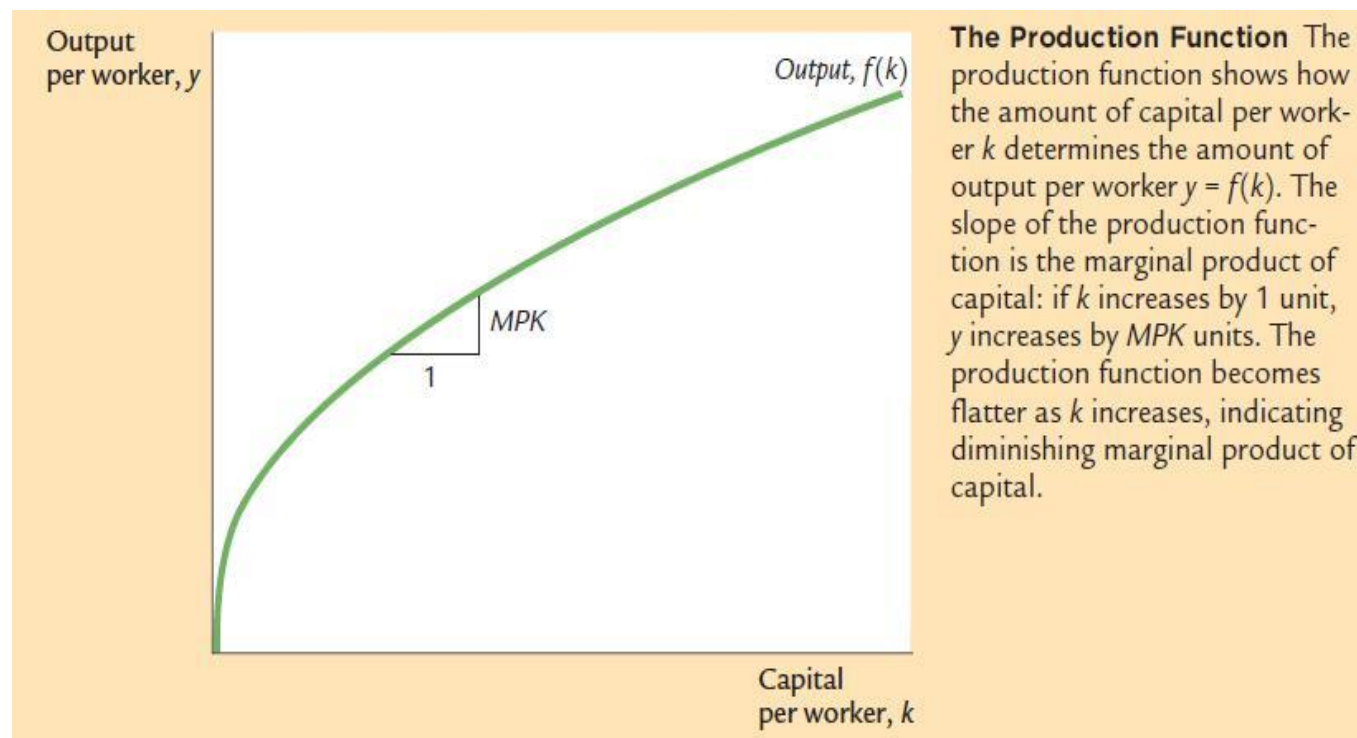
This equation shows that the amount of output per worker is a function of the amount of capital per worker . The number 1 is, of course, constant and thus can be ignored.

We can use lower case letters to denote quantities per worker, so is output per worker, and is capital per worker. We can then write the production function as

Where we define .

Graphically, the production function is depicted as follows

Figure 5.1



The slope of this production function shows how much extra output worker produces when given an extra unit of capital. This amount is the marginal product of capital. Mathematically, we write

Diminishing marginal product of capital is due to the fact that, when k is low, the average worker has only a little capital to work with, so an extra unit of capital is very useful and produces a lot of additional output. When k is high, the average worker has a lot of capital, so an extra unit increases production only slightly.

The demand for Goods and the consumption Function

The demand for goods in the Solow model comes from consumption and investment. Put the other way, output per worker is divided between consumption per worker and investment per worker :

This equation is per-worker version of the national income accounts identity for an economy. Note that it omits government purchases and net exports (due to the assumption of closed economy). The Solow model assumes that each year people save a fraction s of their income and consume a fraction $1-s$. i.e.

Where s , the saving rate, is a number between zero and one.

To see what this consumption function implies for investment substitute sY for c in the national income account identity:

Rearrange the terms we obtain

This equation shows that investment equals saving. Thus, the rate of saving s is also the fraction of output devoted to investment.

We have now introduced the two main ingredients of the Solow model (the production function and the consumption function) which describe the economy at any moment in time. For any given capital stock K , the production function $Y = F(K, L)$ determines how much output the economy produces, and the saving rate determines the allocation of that output between consumption and investment.

Growth in the capital stock and the steady state

At any moment, the capital stock is a key determinant of the economy's output, but the capital stock can change over time and those changes can lead to economic growth. In particular, two forces influence the capital stock: **Investment and Depreciation**.

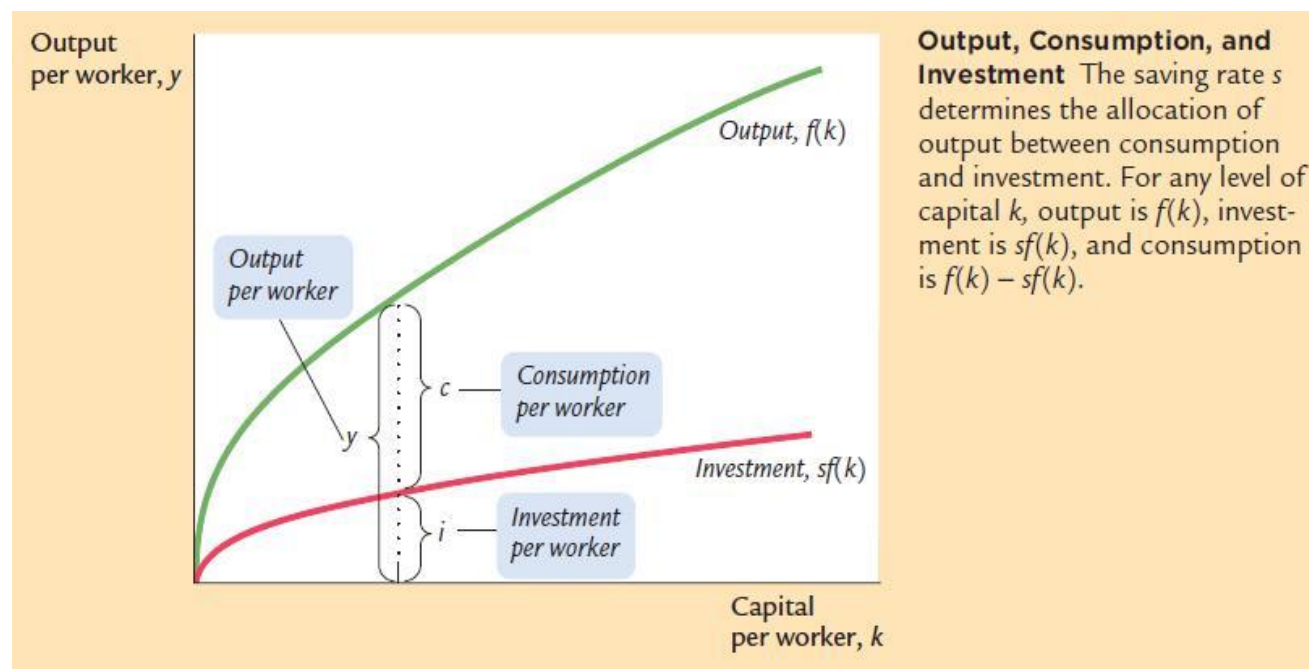
Investment refers to the expenditure on new plant and equipment, and it causes the capital stock to rise. **Depreciation** refers to the wearing out of old capital, and it causes the capital stock to fall.

We already noted that $y = Y/L$. By substituting the production function for Y , we can express investment per worker as a function of the capital stock per worker:

This equation relates the existing stock of capital to the accumulation of new capital .

Figure 5.2 shows this relationship

Figure 5.2



This figure illustrates how, for any value of k , the amount of output is determined by the production function $f(k)$, and the allocation of the output between consumption and saving is determined by the saving rates.

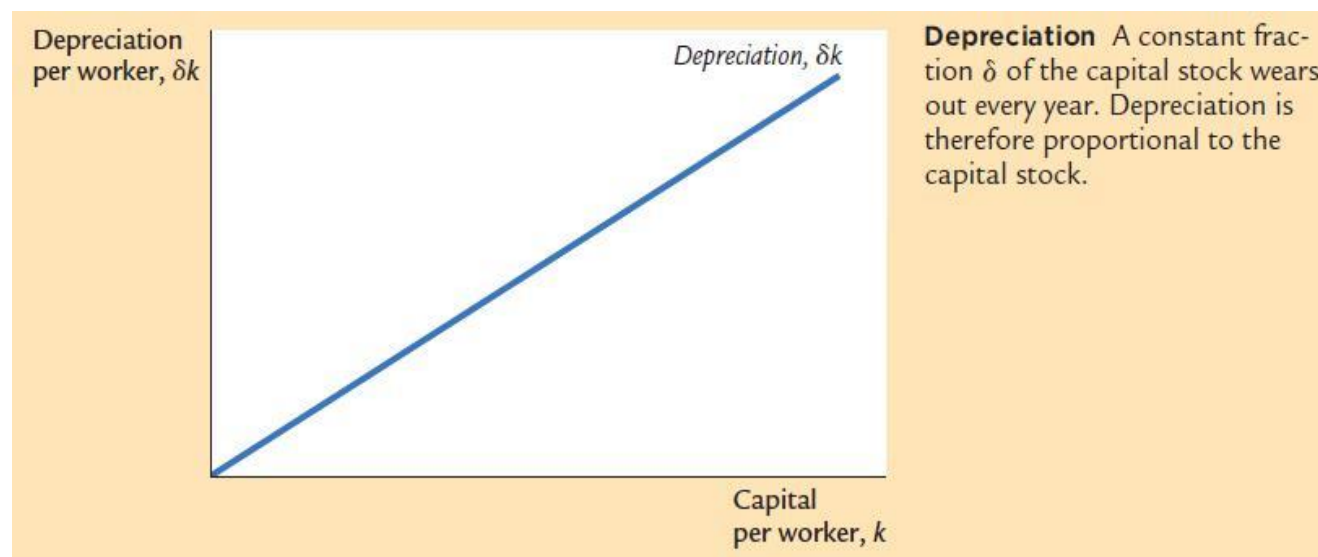
To incorporate depreciation in to the model, we assume that a certain fraction of the capital stock wears out each year (the depreciation rate).

We can express the impact of investment and depreciation on the capital stock with this equation

Where Δk is the change in the capital stock between one year and next. Because investment equals $sf(k)$, we can write this as

Figure 5.3 shows the level of investment and depreciation for different levels of capital stock. The higher the capital stock, the greater the amounts of output and investment, and also the greater the amount of depreciation.

Figure 5.3

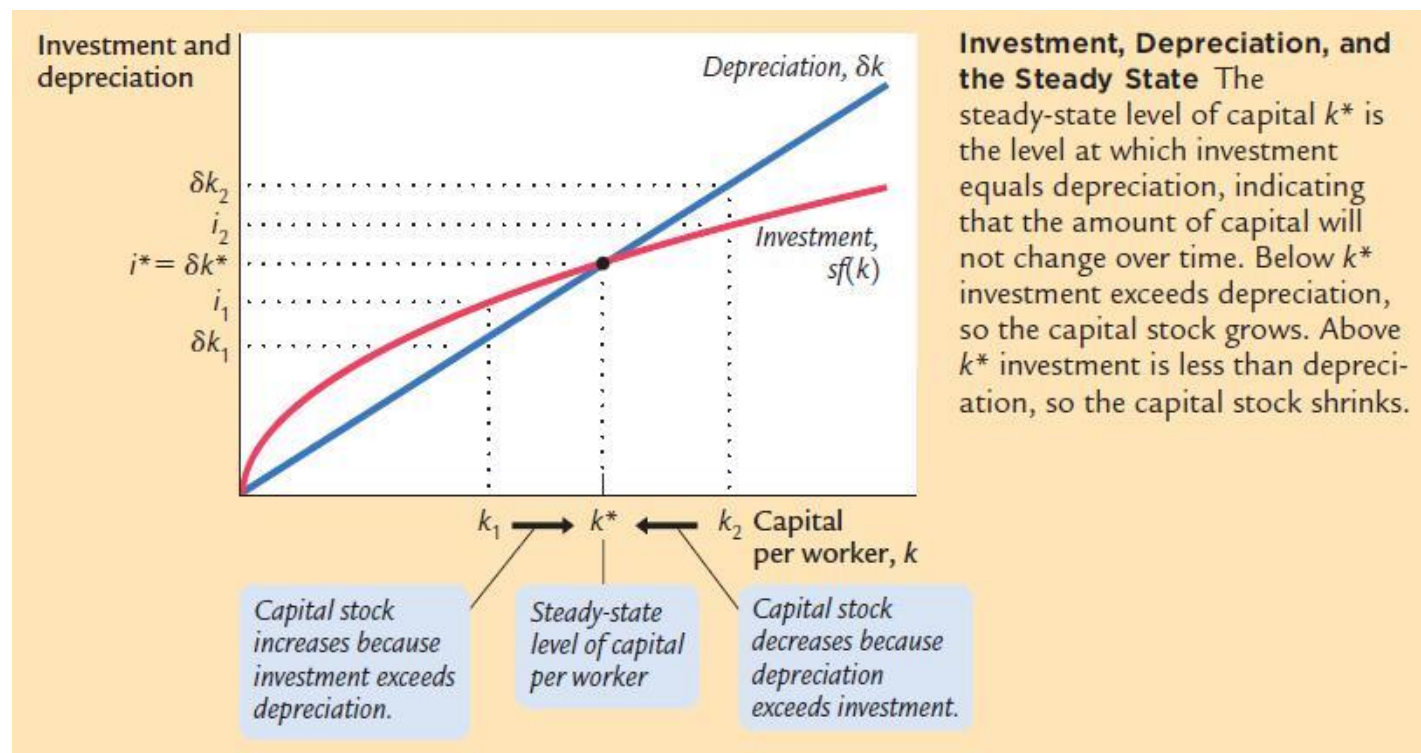


As figure 5.4 shows, there is a single capital stock k^* at which the amount of investment equals the amount of depreciation. If the economy ever finds itself at this level of the capital stock, the capital stock will not change because the two forces acting on it—investment and depreciation—just balance. That is at k^* , so the capital stock k and output y are steady over time (rather than growing or shrinking). We therefore call the **steady-state** level of capital.

Regardless of the level of capital with which the economy begins, it ends up with the steady-state level of capital. In this sense, *the steady state represents the long-run equilibrium of the economy*.

Example: Assume that country X has a production function given by $y = k^{1/2}$. And also assume that the annual saving rate is 30%, the rate of depreciation is 10 % per annum, and the economy starts-off with 4 units of capital per worker. Find the steady-state capital per-worker for this economy.

Figure 5.4

**Solution:**

- ❖ To obtain the per-worker production function, divide both side of the production function by the labor force i.e.

— —

By rearranging terms and substituting — and — we get

$\sqrt{\quad}$

- ❖ We know that, —, but at the steady state per-worker capital value —, so we get —,

Rearranging terms we obtain

— —

- ❖ Substituting in the numbers and production function from our example, we obtain



Now, by solving the above equation for $\bar{k}$, we get

Therefore, the steady-state capital stock is 9 units per worker.

5.3. How Saving Affects Growth

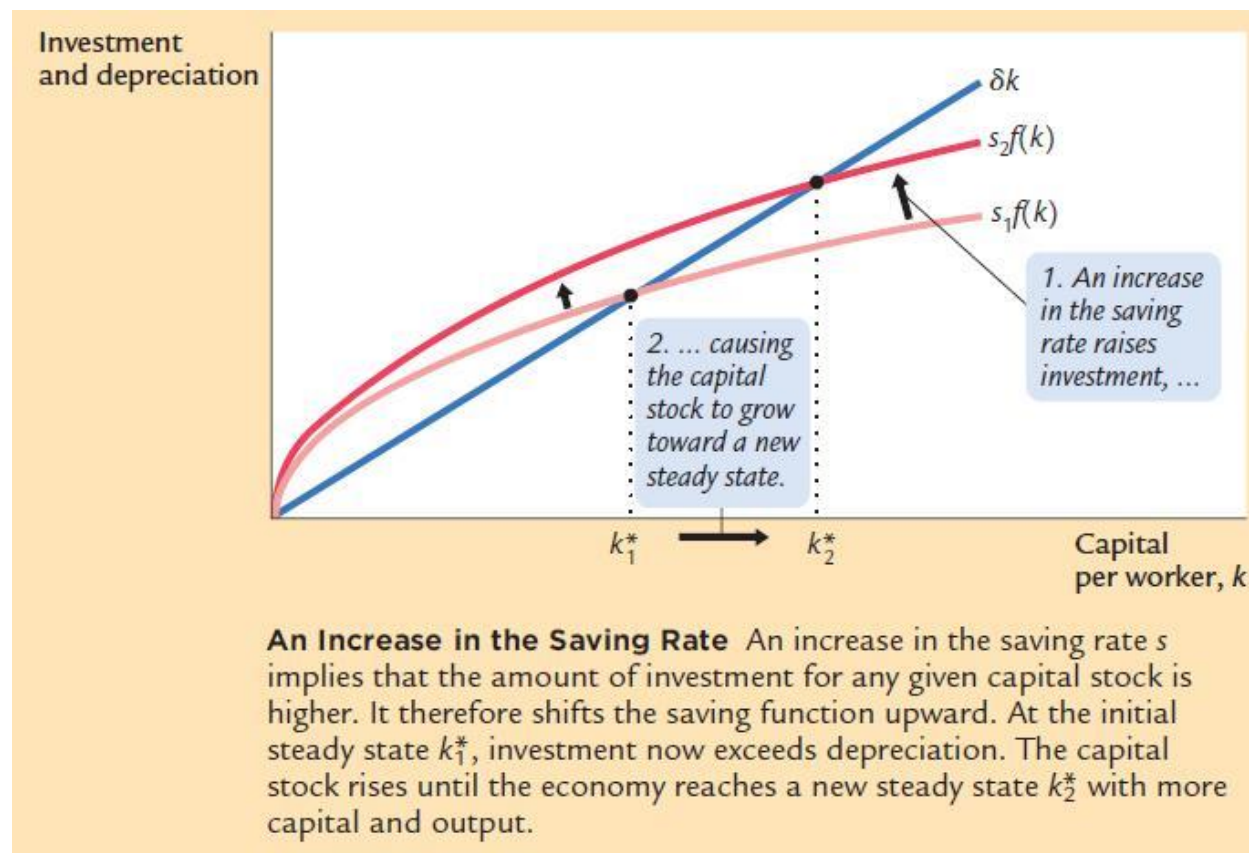
Activity

Dear student, explain how saving rate affects total output in an economy. Please, use the space provided below.

To understand more fully the international differences in economic performance, we must consider the effects of different saving rates. Consider what happens to an economy when its saving rate increases. Figure 5-5 shows such a change. The economy is assumed to begin in a steady state with saving rate and capital stock $\bar{k}$. When the saving rate increases from s to s' , the sY curve shifts upward. At the initial saving rate s and the initial capital stock $\bar{k}$, the amount of investment just offsets the amount of depreciation. Immediately after the saving rate rises, investment is higher, but the capital stock and depreciation are unchanged. Therefore, investment exceeds depreciation. The capital stock will gradually rise until the economy reaches the new steady state $\bar{k}'$, which has a higher capital stock and a higher level of output than the old steady state.

The Solow model shows that the saving rate is a key determinant of the steady-state capital stock. *If the saving rate is high, the economy will have a large capital stock and a high level of output in the steady state. If the saving rate is low, the economy will have a small capital stock and a low level of output in the steady state.*

Figure 5.5



5.4. The Golden Rule Level of Capital

This section uses the Solow model to discuss what amount of capital accumulation is optimal from the stand point of economic well-being.

Comparing steady states

To keep our analysis simple, let's assume that a policy maker can set the economy's saving rate at any level.

Individuals do not care about the amount of capital in the economy, or even the amount of output. They care on the amount of goods and services they can consume. Thus, a benevolent policy maker would want to choose the steady state with the highest level of consumption. The

steady state value of k that maximizes consumption is called the **Golden Rule level of capital** and is denoted by k^* .

To find steady state consumption per worker, we begin with the national income identity.

Because we want to find steady state consumption, we substitute steady-state values for output and investment. Steady-state per worker is y , where k is the steady-state capital stock per worker. Furthermore, because the capital stock is not changing in the steady state, investment is equal to depreciation δk . Substituting y for Y/L and δk for I/L , we can write steady state consumption per worker as

$$c = y - \delta k$$

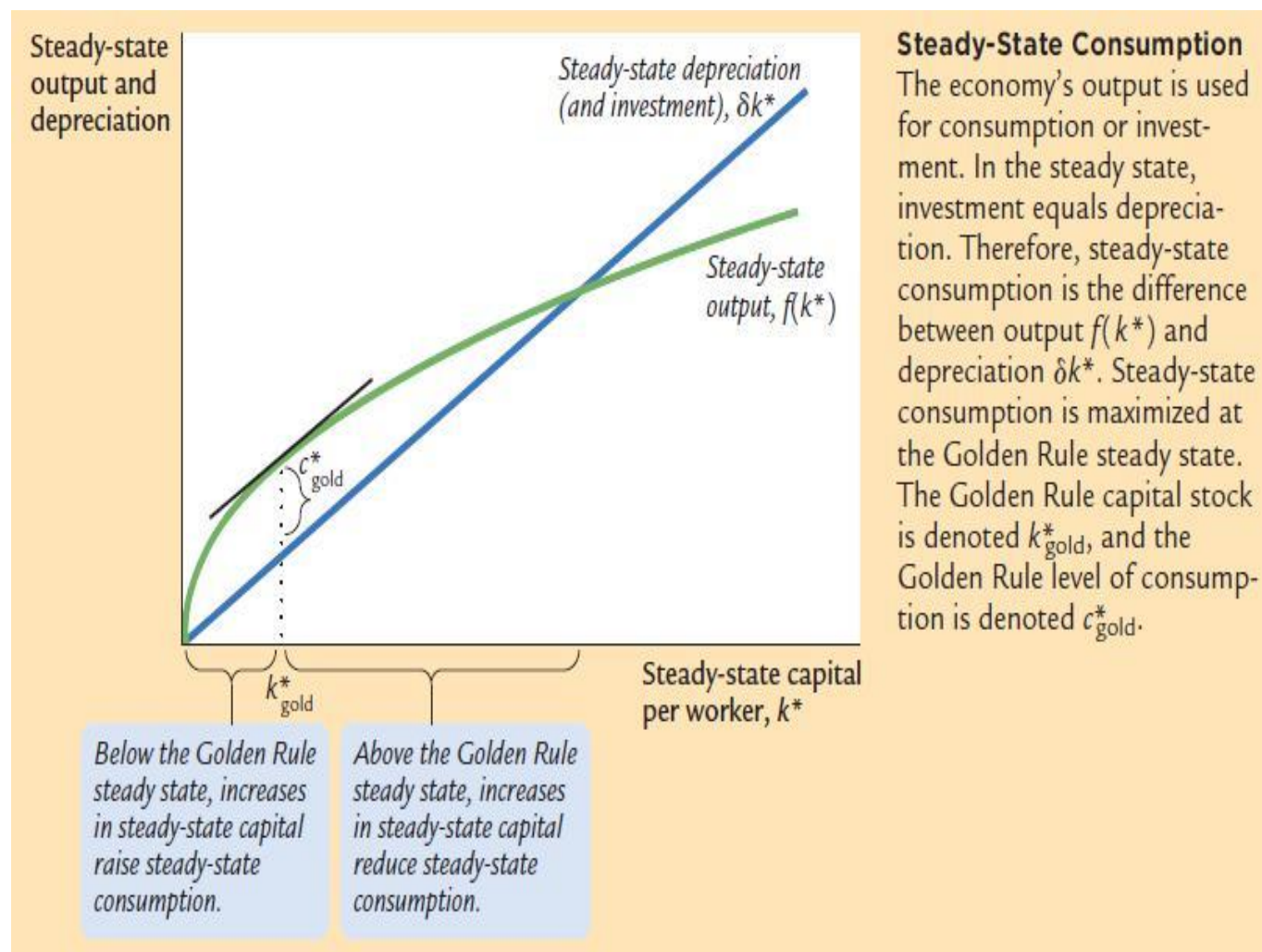
According to this equation, steady – state consumption is what is left of steady state output after paying for steady state depreciation. This equation shows that an increase in consumption. On the one hand, more capital means more output. On the other hand, more capital means more output must be used to replace capital that is wearing out.

Figure 5.6 graphs steady-state output and steady-state depreciation as a function of the steady-state capital stock. Steady-state consumption is the gap between output and depreciation. This figure shows that there is one level of the capital stock—the Golden Rule level k^* —that maximizes consumption.

If the capital stock is below the Golden Rule level, an increase in the capital stock raises output more than depreciation, so consumption rises. In this case, the production function is steeper than the 45° line, so the gap between these two curves, which equals consumption, grows as k rises. By contrast, if the capital stock is above the Golden Rule level, an increase in the capital stock reduces consumption, since the increase in output is smaller than the increase in depreciation. In this case, the production function is flatter than the 45° line, so the gap between

the curves, consumption, shrinks as k^* rises. At the golden Rule level of capital, the production function and the δk^* line have the same slope, and consumption is at its greatest level.

Figure 5.6

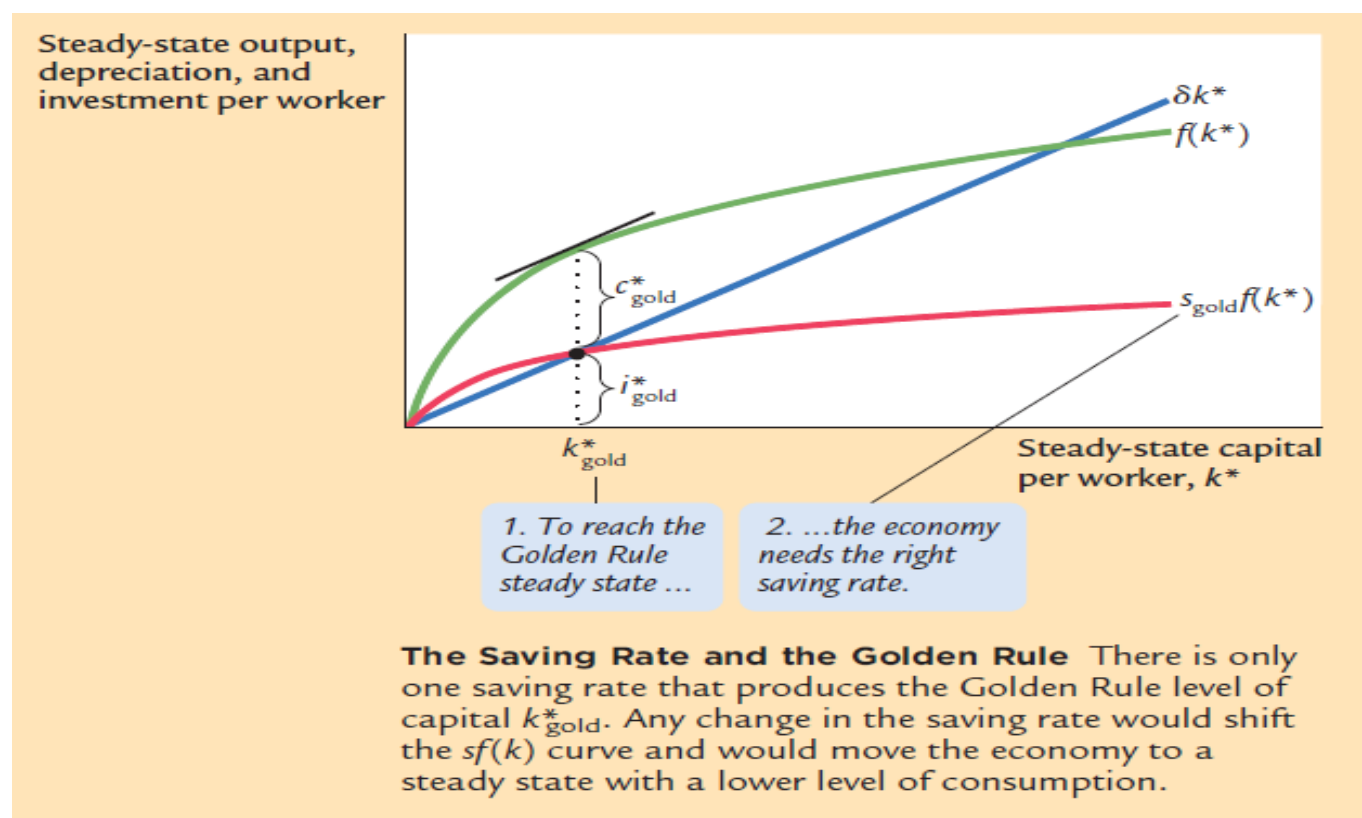


We can now derive a simple condition that characterizes the golden Rule level of capital. Recall that the slope of the production function is the marginal product of capital $f'(k)$. The slope of the δk line is δ . Because these two slopes are equal at k_{gold}^* , the Golden Rule is described by the equation.

To make the point somewhat differently, suppose that the economy starts at some steady-state capital stock k and the policy maker is considering increasing the capital stock to $k + 1$. The amount of extra output from this increase in capital would be $f'(k)$, which is the marginal product of capital. The amount of extra depreciation from having 1 more unit of capital is the depreciation rate δ . Thus, the net effect of this extra unit of capital on consumption is then $f'(k) - \delta$. Hence; the golden rule is described as

Keep in mind that the economy does not automatically gravitate toward the Golden Rule steady state. If we want any particular steady-state capital stock, such as the Golden Rule, we need a particular saving rate to support it. Figure 5.7 shows the steady state if the saving rate is set to produce the Golden Rule level of capital. If the saving rate is higher than the one used in this figure, the steady-state capital stock will be too high. If the saving rate is lower, the steady state capital stock will be too low. In either case, steady-state consumption will be lower than it is at the Golden Rule steady state

Figure 5.7



The Transition to the Golden Rule Steady State

So far, we have been assuming that the policy maker can simply choose the economy's steady state and jump there immediately. In this case, the policy maker would choose the steady state with highest consumption the Golden Rule steady state. But now suppose that the economy has reached a steady state other than the golden Rule

Starting with too much capital – In this case, the policy maker should pursue policies aimed at reducing the rate of saving in order to reduce the capital stock. Suppose that these policies succeed and that at some point, call it time t_0 , the saving rate falls to the level that will eventually lead to the Golden Rule steady state.

Figure 5.8

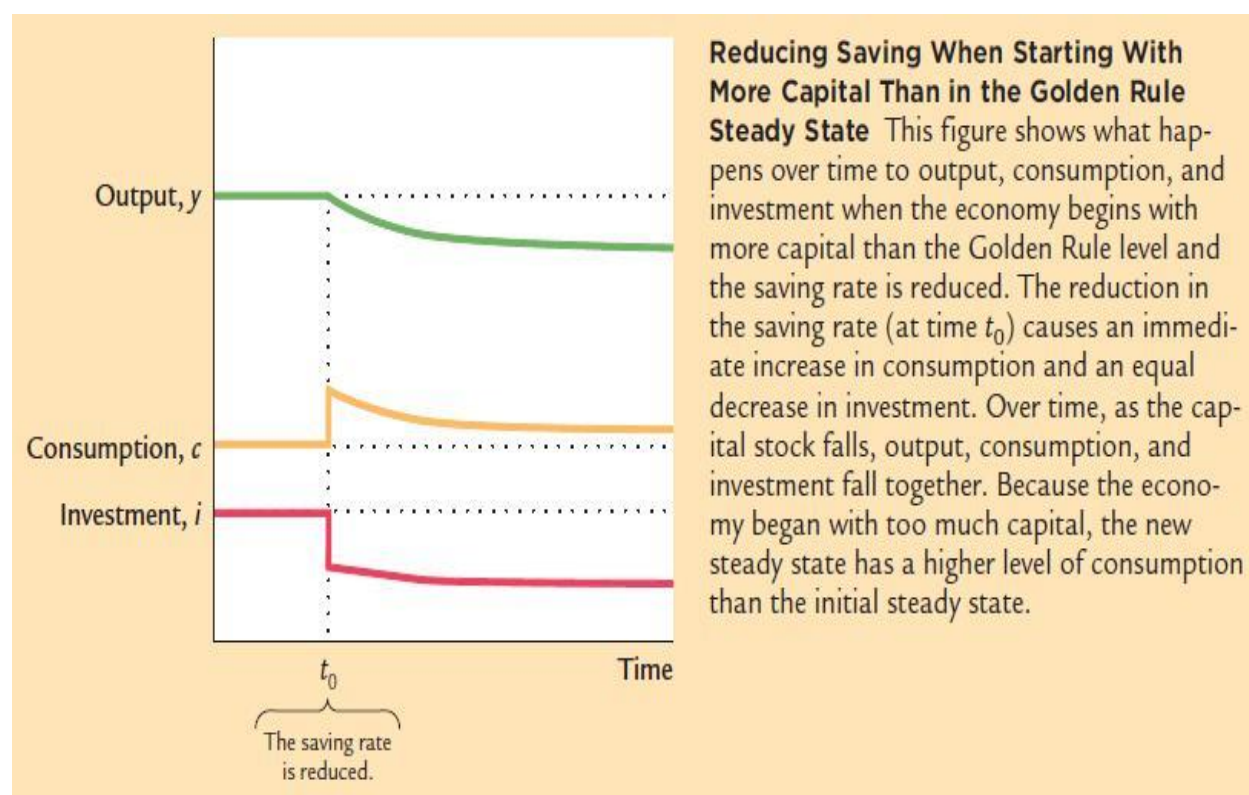
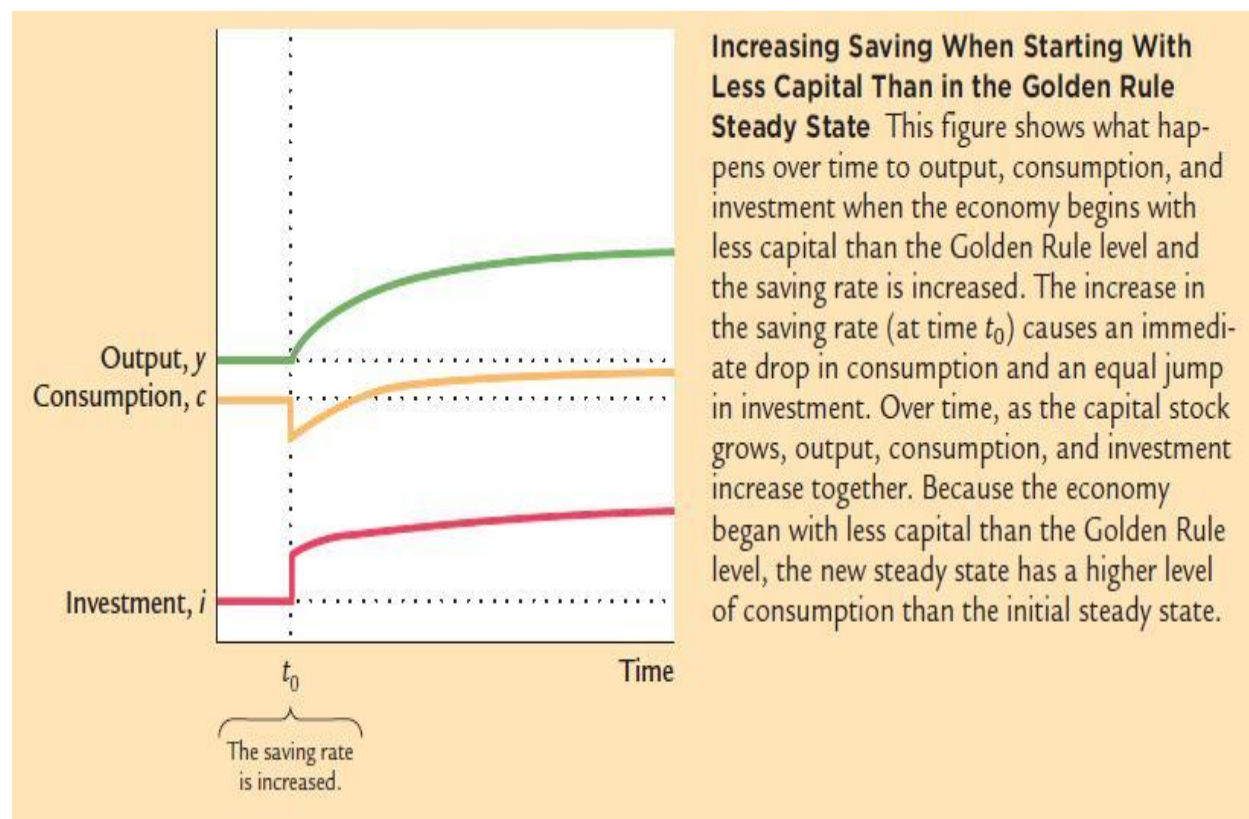


Figure 5.8 shows what happens to output, consumption, and investment when the saving rate falls. The reduction in the saving rate causes an immediate increase in consumption and a decrease in investment. Because investment and depreciation were equal in the initial steady state, investment will now be less than depreciation, which means the economy is no longer in a

steady state. Gradually, the capital stock falls, leading to reductions in output, consumption, and investment.

Starting with too little capital- when the economy begins with less capital than in the Golden rule steady state, the policy maker must raise the saving rate to reach the Golden Rule. Figure 5.9 show what happens.

Figure 5.9



The increase in the saving rate at time t_0 causes an immediate fall in consumption and a rise in investment. Over time, higher investment causes the capital stock to rise. As capital stock accumulates, output, consumption, and investment gradually increase, eventually approaching the new steady state levels. Because the initial steady state was below the Golden Rule, the increase in saving eventually leads to a higher level of consumption than that which prevailed initially.

5.5. How Population Growth Affects Economic Growth

The basic Solow model shows that capital accumulation, by itself, cannot explain sustained economic growth temporarily, but the economy eventually approaches a steady state in which capital and output are constant. To explain the sustained economic growth that we observe in most parts of the world, we must expand the Solow model to incorporate the other two sources of growth population growth and technological progress.

Instead of assuming that the population is fixed, we now suppose that the population and the labor-force grow at a constant rate .

Steady state with population Growth

As we noted before, investment raises the capital stock, and depreciation reduces it. But now there is a third force acting to change the amount of capital per worker to fall. The change in the capital stock per worker is

.

We have seen this equation earlier in this chapter for the special case of a constant population

.

We can think of the term as defining break- even investment – the amount of investment necessary to keep the capital stock per worker constant. Break even investment includes the depreciation of existing capital, which equals . It also includes the amount of investment necessary for this purpose is , because there are new workers for each existing worker, and because is the amount of capital for each worker.

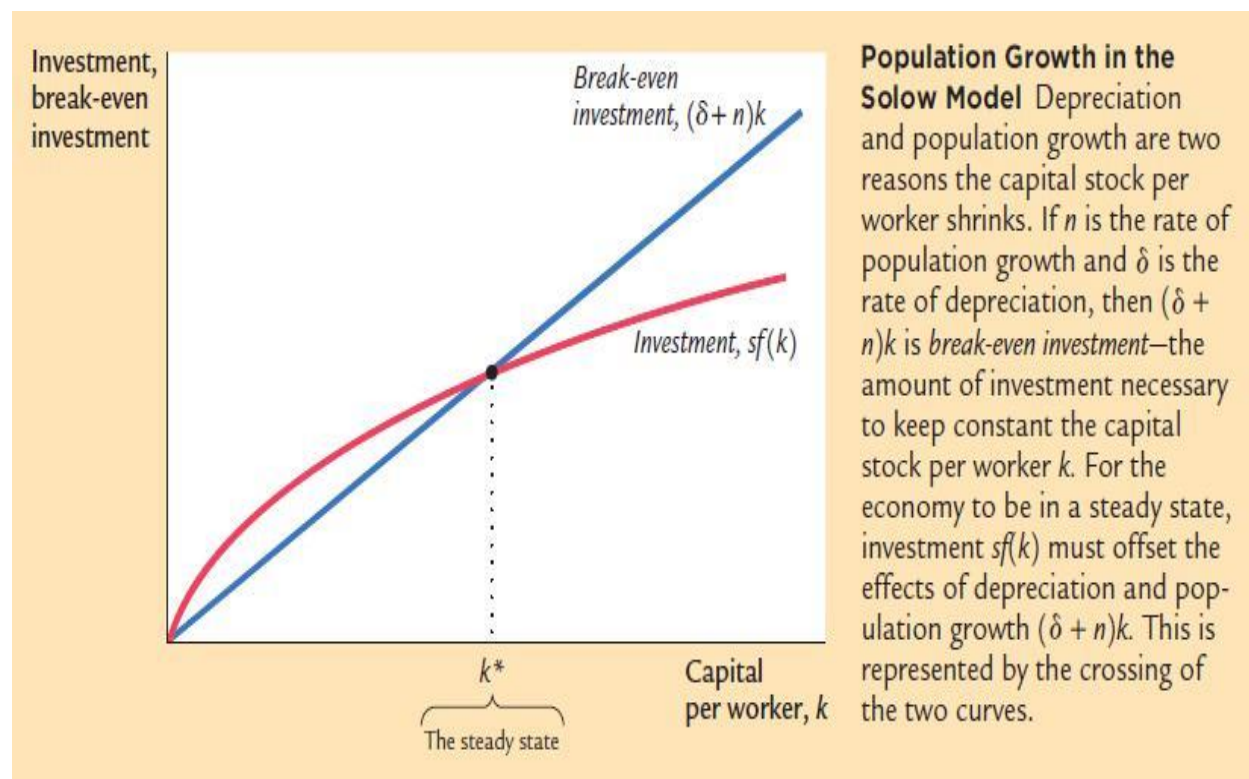
Our analysis with population growth now proceeds much as it did previously. First, we substitute for . The equation can then be written as

To see what determines the steady-state level of capital per worker, we use Figure 5.10.

An economy is in a steady state if capital per worker k is unchanging. As before, we designate the steady-state value of k as k^* . If k is less than k^* , investment is greater than break-even investment, so k rises. If k is greater than k^* , investment is less than break-even investment, so k

falls. In the steady state, the positive effect of investment on the capital stock per worker exactly balances the negative effects of depreciation and population growth. That is, at k^* , and . Once the economy is in the steady state, investment has two purposes. Some of it replaces the depreciated capital, and the rest provides the new workers with the steady-state amount of capital.

Figure 5.10



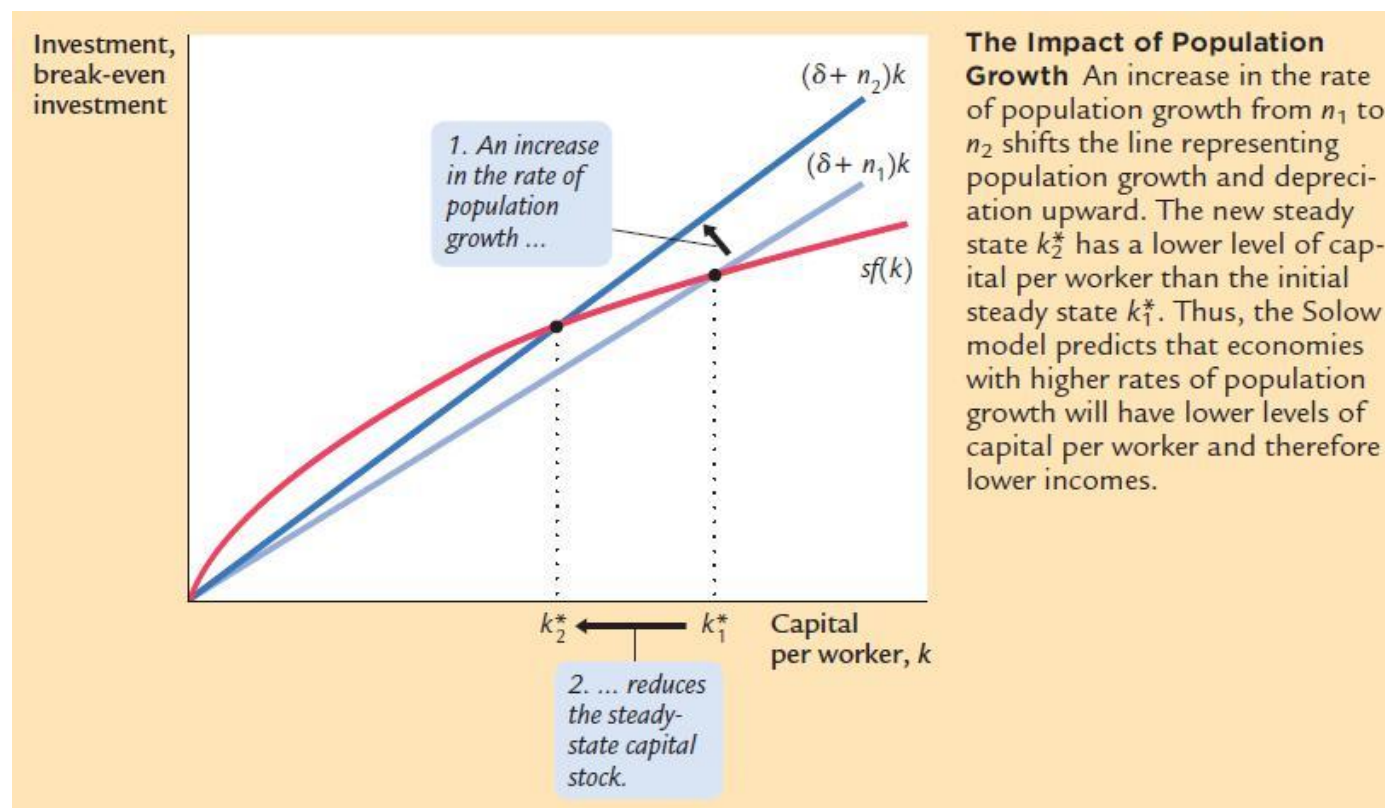
The Effects of Population Growth

Population growth alters the basic Solow model in three ways.

First, it brings us closer to explaining sustained economic growth. In the steady state with population growth, capital per worker and output per worker are constant. Because the number of workers is growing at rate n , however, total capital and total output must also be growing at rate n . Hence, while population growth cannot explain sustained growth in the standard of living (because output per worker is constant in the steady state), it can help explain sustained growth in total output.

Second, Population growth gives us another explanation for why some countries are rich and others are poor. Figure 5.11 shows that an increase in the rate of population growth from n_1 to n_2 reduces the steady-state level of capital per worker from k_1^* to k_2^* . Because k^* is lower, and because $y = f(k)$, the level of output per worker y^* is also lower. Thus, the Solow model predicts that countries with higher population growth will have lower levels of income per person.

Figure 5.11



Finally, Population growth affects our criterion for determining the Golden Rule (Consumption maximizing) level of capital. To see how this criterion changes, note that consumption per worker is

Because steady state output is $y^* = f(k^*)$ and steady state investment is $s f(k^*)$, we can express steady state consumption as

The level of k^* that maximizes consumption is the one at which

Or equivalently,

In the Golden Rule steady state, the marginal product of capital net of depreciation equals the rate of population growth

5.6. Technological Progress in the Solow Model

Activity

Dear student, explain how technical progress can affect output in a given economy. Please, give your reflection on the space below.

So far, our presentation of the Solow model has assumed an unchanging relationship between the inputs of capital and labor and the output of goods and services. Yet the model can be modified to include exogenous technological progress, which over time expands society's production capabilities

The Efficiency of Labor

Thus far, the production function has been

We now write the production function as

),

where E is a new (and somewhat abstract) variable called the **efficiency of labor**. The efficiency of labor is meant to reflect society's knowledge about production methods: as the available technology improves, the efficiency of labor rises, and each hour of work contributes more to the production of goods and services

The term can be interpreted as measuring the *effective number of workers*. It takes into account the number of actual workers L and the efficiency of each worker E . In other words, L measures the number of workers in the labor force, whereas $L \times E$ measures both the workers

and the technology with which the typical worker comes equipped. This new production function states that total output Y depends on the inputs of capital K and effective workers $L \times E$.

The simplest assumption about technological progress is that it causes the efficiency of labor E to grow at some constant rate g . This form of technological progress is called *labor augmenting* and g is called the rate of labor-augmenting technological progress. Because the labor force L is growing at rate n , and the number of effective workers is growing at rate $n + g$.

The Steady state with Technological progress

Previously, when there was no technological progress, we analyzed the economy in terms of quantities per worker; now we can generalize that approach by analyzing the economy in terms of quantities per effective worker. We now let k stand for capital per effective worker and y stand for output per effective worker. With these definitions, we can again write

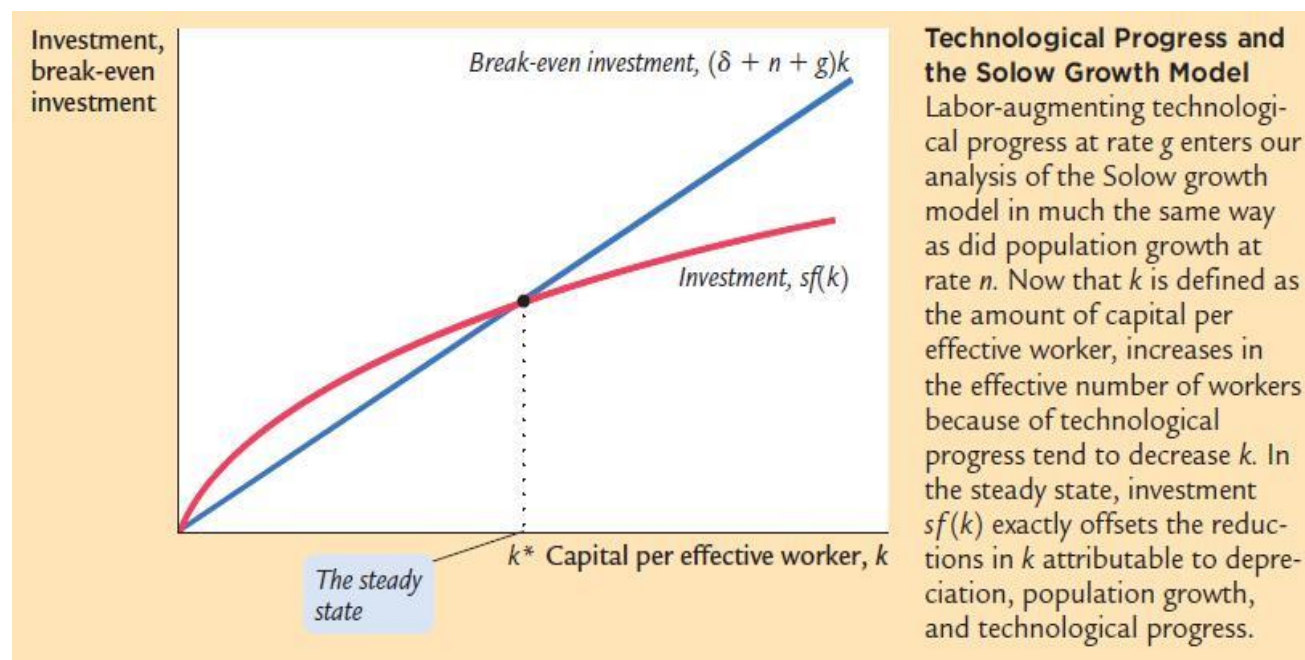
The equation showing the evolution of k over time becomes

As shown in Figure 5.12, the inclusion of technological progress does not substantially alter our analysis of the steady state. There is one level of k , denoted k^* , at which capital per effective worker and output per effective worker are constant. As before, this steady state represents the long-run equilibrium of the economy.

The Effects of Technological progress

As we have just seen, capital per effective worker is constant in the steady state. Because k is constant, output per effective worker is also constant. It is these quantities per effective worker that are steady in the steady state

Figure 5.12



From this information, we can also infer what is happening to variables that are not expressed in units per effective worker. For instance, consider output per actual worker

Because y is constant in the steady state and E is growing at rate g , output per worker must also be growing at rate g in the steady state. Similarly, the economy's total output is

. Because y is constant in the steady state, E is growing at rate g , and L is growing at rate n , total output grows at rate $n + g$ in the steady state.

With the addition of technological progress, our model can finally explain the sustained increases in standards of living that we observe. That is, we have shown that technological progress can lead to sustained growth in output per worker. By contrast, a high rate of saving leads to a high rate of growth only until the steady state is reached. Once the economy is in steady state, the rate of growth of output per worker depends only on the rate of technological progress.

According to the Solow model, only technological progress can explain sustained growth and persistently rising living standards.

The introduction of technological progress also modifies the criterion for the Golden Rule. The Golden Rule level of capital is now defined as the steady state that maximizes consumption per effective worker. Following the same arguments that we have used before, we can show that steady-state consumption per effective worker is

Steady-state consumption is maximized if

or

.

That is, at the Golden Rule level of capital, the net marginal product of capital, $f'(k)$, equals the rate of growth of total output, $n + g$. Because actual economies experience both population growth and technological progress, we must use this criterion to evaluate whether they have more or less capital than they would at the Golden Rule steady state.

Summary

- ✓ The Solow growth model shows that in the long run, an economy's rate of saving determines the size of its capital stock and thus its level of production. The higher the rate of saving, the higher the stock of capital and the higher the level of output
- ✓ In the Solow model, an increase in the rate of saving has a level effect on income per person: it causes a period of rapid growth, but eventually that growth slows as the new steady state is reached. Thus, although a high saving rate yields a high steady-state level of output, saving by itself cannot generate persistent economic growth
- ✓ The level of capital that maximizes steady-state consumption is called the Golden Rule level. If an economy has more capital than in the Golden Rule steady state, then reducing saving will increase consumption at all points in time. By contrast, if the economy has less capital than in the Golden Rule steady state, then reaching the Golden Rule requires increased investment and thus lower consumption for current generations
- ✓ The Solow model shows that an economy's rate of population growth is another long-run determinant of the standard of living. According to the Solow model, the higher the rate of population growth, the lower then steady-state levels of capital per worker and output per worker. Other theories highlight other effects of population growth. Malthus suggested that population growth will strain the natural resources necessary to produce food; Kremer suggested that a large population may promote technological progress
- ✓ In the steady state of the Solow growth model, the growth rate of income per person is determined solely by the exogenous rate of technological progress

Review Questions

1. In the Solow model, how does the saving rate affect the steady-state level of income?

2. Compare and contrast the steady-state level of capital with the Golden Rule level of capital

3. Explain the different ways in which population growth affect the basic Solow model

4. Consider an economy described by the production function: _____.

Assume that there is no population growth or technological progress. Also assume that the depreciation rate is 10% per year, saving rate is 20% per annum, and the economy starts-off with 5 units of capital per worker. Find

- A) The steady-state capital per worker.
B) The steady-state levels of income per worker and consumption per worker.
C) The Golden Rule level of capital per worker.

Chapter Six

Rational Expectation

6.1 Introduction

Dear students! This chapter enlightens the different models about how economic agents form expectations. It also explores the effects of monetary policy under each model.

Chapter Objectives:

At the end of the chapter you will be able to:

- *Understand the simplified version of AS-AD model with exogenously given price expectations*
- *Know the perfect-foresight model*
- *Know the rational expectations model*
- *Comprehend the effects of monetary policy in the perfect-foresight and rational expectation models.*

Chapter Outline:

- *A Simple Aggregate Supply-Aggregate Demand Model*
- *A Perfect Foresight Model*
- *A Rational Expectations Model*

6.2 A Simple Aggregate Supply-Aggregate Demand Model

In each step of the model's development, you should focus on the link between specification of expectations and the monetary policy multiplier. In the simplified model with exogenous expectations, the monetary policy multiplier is relatively large. In the perfect-foresight model, where expectations adjust perfectly, the monetary policy multiplier is zero.

Finally, the rational expectations model combines the assumptions of the and perfect-foresight models. Expectations adjust perfectly with respect to anticipated changes in the money supply, but not at all to unanticipated changes; the monetary policy multiplier is zero with respect to anticipated changes in the money supply and relatively large with respect to unanticipated changes

We begin with a simplified version of the aggregate supply-aggregate demand model, stripping out much of the details developed in other chapters. We begin by specifying a simple aggregate demand schedule:

$$(1)$$

Equation (1) is the quantity theory equation: is (log of) the money supply; is —velocity and is assumed to be constant; is the price level; and is . We employ here a quite technical, but quite useful, trick. Equation (1), and the equations that follow, are written using the natural logarithms of the indicated variables. The quantity equation is usually written , where is the money supply, is the price level, and so on. We use lowercase letters to represents logarithms, so , and so on. Thus we get to equation (1) by writing

Using logarithms has the advantage that a change in can be interpreted as the percentage change in . We next specify a simple short-run aggregate supply curve, one that emphasizes the role of price expectations:

$$p = p^e + \lambda(y - y^*) \quad (2)$$

Where p is again the price level, p^e is the expected price level, y is again output, and y^* potential output. The parameter λ gives the slope of the aggregate supply curve. If λ is large, an increase in output above potential output causes a steep rise in prices above what had been expected. If λ is small, the short-run response of prices to output is small.

The aggregate demand and aggregate supply equations can be combined to solve for output [equation (3)] and price [equation (4)] in terms of the money supply and other variables.

$$y = \frac{1}{1+\lambda}m + \frac{1}{1+\lambda}(v - p^e) + \frac{\lambda}{1+\lambda}y^* \quad (3)$$

$$p = \frac{\lambda}{1+\lambda}(m + v - y^*) + \frac{1}{1+\lambda}p^e \quad (4)$$

Together, equations (3) and (4) tell us the equilibrium output and prices in our model economy. If the money supply rises by 1 percent, output rises by _____ percent and price rises by _____ percent. To be concrete, suppose λ is 0.5; then 1 percent increase in money supply causes _____ percent increase in output and _____ percent increase in the price level.

Now we use equations (3) and (4) to illustrate the standard approach to making an economic —forecast.¶ For our fabricated example, suppose that λ equals 0.5 and the values for the money supply, velocity, and potential output are $m = 2$, $v = 3$, $y^* = 4$, respectively. Most particularly, we assume that agents in the economy expect the price level to be 2. What do you expect the price level to be? What do you expect output to be?

Plugging the given values into equation (3), we find output to be

$$\frac{\frac{1}{1+0.5} \cdot 2 + \frac{1}{1+0.5} \cdot (3 - 2) + \frac{0.5}{1+0.5} \cdot 4}{1}$$

Plugging the given values into equation (4), we find price to be

$$\frac{1}{1} = \frac{1}{1} \quad \frac{1}{1} = \frac{1}{1}$$

So the output from our model is that we expect the price to be 5, taking as an input to the model that the expected price is 5. Shouldn't rational agents, who have a great deal at stake, make forecasts that are consistent with the way the economy (represented here by our simple model) actually operates? This is the essence of the **Lucas critique**: the standard aggregate supply-aggregate demand model assumes that economic agents make predictions for the economy that are inconsistent with the prediction the model itself makes.

Suppose that economic decision makers accept our forecast and change their expectation of the price level of 5. Reworking equations (3) and (4) would then lead to predicting

$$\frac{1}{1} = \frac{1}{1} \quad \left(\frac{1}{1} \right) \quad \frac{1}{1}$$

Now the expected price input to the model and the price predicted as output from the model are closer, but they are still not the same. Modifying the model so that the predicted value of and the input value are equal leads to the idea of a perfect-foresight model.

6.3. A Perfect Foresight Model

We now assume that agents do use the perfect-foresight model to forecast prices and that they have all the information necessary to make the perfect forecast. Then the agents are said to have perfect

foresight. Rather than assuming p^e is given from outside the model, we assume agents use the model itself to compute p^e . In other words, agents compute p^e based on m, v, y^* , the two must be solved for simultaneously.

Assume that our model correctly describes the economy, so economic decision makers use equation (4) to predict prices and compute p^e , so

$$p^e = p = \frac{\lambda}{1+\lambda}(m + v - y^*) + \frac{\lambda}{1+\lambda} p^e \quad (5)$$

Collecting terms containing p^e , i.e. write

$$\left(1 - \frac{\lambda}{1+\lambda}\right) p^e = \frac{\lambda}{1+\lambda} (m + v - y^*), \text{ and then multiplying through by } 1 + \lambda,$$

We can rearrange equation (5) to give the perfect-foresight forecast and solution for the price level and the corresponding solution for output:

$$p^e = p = m + v - y^* \quad (6)$$

$$y = y^* \quad (7)$$

The perfect-foresight predictions in equations (6) and (7) are quite different from the original predictions embodied in equations (4) and (3). The latter assumes exogenously given price expectations; the former assumes that price expectations are formed endogenously and, specifically, that expectation formation is consistent with the predictions of the model.

The switch to such consistently formed expectations has dramatic implication for the effectiveness of monetary policy. According to equation (4), a 1 percent increase in the money supply increase prices by $\frac{\lambda}{1+\lambda}$ percent, but under perfect-foresight a 1 percent increase in the money supply leads to exactly a 1 percent increase in the price level. According to equation (3), a 1 percent increase in the money supply increases output by $\frac{\lambda}{1+\lambda}$ percent, but under perfect-foresight a 1 percent increase in the money supply leads to no increase at all in output.

Notice that these perfect-foresight short-run results are the same as the long-run results. Under perfect foresight, prices rise not only as a direct result of the increase in the money supply but also because of the increase in price expectations. This extra boost raises prices just enough to completely offset the increase in the money supply.

Under perfect foresight, monetary policy is neutral in the short run as well as in the long run.

A perfect-foresight model has two important shortcomings. First, it requires that economic decision makers know everything about the economy. Second, it implies that the economy is always at full employment. Neither of these shortcomings is really critical, as we will see when we consider a rational expectations model in the next section.

6.4 A Rational Expectations Model

A rational expectation model assumes that agents make the best use of whatever information is available to them and that expectations are formed in a manner consistent with the way the economy actually operates. A rational expectations model is much like a perfect-foresight model in which some of the key variables are uncertain. To illustrate, suppose that before the money supply is known, economic decision makers expect the money supply to equal m^e . If the money supply actually turns out to be m , we can define the difference between the agents' expectation and the actual money supply,

as the agents' money forecast error. (Analogously, suppose agents expect potential output to be y^e , the agents' potential output forecast error is $\varepsilon_{y^*} = y^* - y^e$.) We show below that the monetary policy multiplier with respect to anticipated money, m^e , is zero, just as in the perfect-foresight model. The monetary policy multiplier with respect to unanticipated money, ε_m , is positive, just as in the IS-PC model.

The forecast errors in a particular quarter may be either positive (the money supply, for instance, turned out to be larger than anticipated) or negative (the money supply turned out to be smaller than anticipated), but on average rational forecast errors equal zero. The argument here is

straightforward. Suppose ε_m averaged 7. So while rational forecast errors may be either large or small, depending on the quality of information available, they average zero. Another way to express this is $(\varepsilon_m)^e = 0$.

We next ask what the price level will be in equilibrium. We begin by repeating equation (4) but substituting $m^e + \varepsilon_m$ for m and y^{*e} ;

$$p = \frac{\lambda}{1 + \lambda} [(m^e + \varepsilon_m) + v - (y^{*e} + \varepsilon_{y^*})] + \frac{1}{1 + \lambda} p^e \quad (8)$$

We assume that agents form their expectations, p^e , on the basis of the price forecast in equation (8). However, we recognize that forecasts are based only on the information the agent have:

$$p^e = \frac{\lambda}{1 + \lambda} (m^e + v - y^{*e}) + \frac{1}{1 + \lambda} p^e \quad (9)$$

simplifyin g equation (9) gives

$$p^e = m^e + v - y^{*e} \quad (10)$$

Notice that the expected price under rational expectation, in equation (10), is the same as that under perfect foresight, in equation (6), except that it is based only on the limited information available to those making the forecast: m^e rather than m , for example. The equilibrium solutions for price and output are:

Replacing _____ in the price level equation (8), with value from equation (10) to find _____

Simplify and make the analogous substitution for output in equation (3) to derive equations (11) and (12).

$$y = y^{*e} + \frac{1}{1 + \lambda} \varepsilon_m + \frac{\lambda}{1 + \lambda} \varepsilon_{y^*} \quad (11)$$

$$p = m^e + v - y^{*e} \frac{\lambda}{1 + \lambda} (\varepsilon_m - \varepsilon_{y^*}) \quad (12)$$

What is the effect of an increase in the money supply under rational expectation? The question must now be broken down into two parts. What is the effect of an anticipated increase in the money supply?

From examination of equation (11), we see that under ***rational expectation an anticipated increase in money supply has no effect at all on output but an unanticipated increase in the money supply increase output***, by . Notice that anticipated changes operate just as predicated by the perfect-foresight model above and that unanticipated changes operate just as predicted by our initial, exogenous price expectation, AS-AD model. In effect, anticipated monetary policy is neutral; unanticipated policy has its full AS-AD effects.

Summary

- ✓ Short-run results of perfect-foresight are the same as the long-run AS-AD results.
- ✓ Rational expectations models predict that anticipated changes to the money supply change the overall price level proportionately, leaving output unchanged.
- ✓ With respect to anticipated money growth, rational expectations models operates as if the long-run aggregate supply curve applied instantaneously, not just in the long run.

Review Questions

1. What is rational expectation? How do rational expectations differ from perfect-foresight?

2. Explain the shortcomings of perfect-foresight model

3. Does monetary policy have the same effect under both rational expectations and perfect-foresight? Explain.

4. State the Lucas critique

Chapter Seven

The Theory of Real Business Cycle

7.1 Introduction

Dear learners! Welcome to the last chapter of this module. Under this chapter we explore the theory of real business cycle, short-run fluctuations in output and employment, in a very simplified way.

Chapter Objectives:

Upon a through completion of this chapter, students will be able to:

- *Identify the best way to explain short run fluctuation in output and employment*
- *Understand How should monetary and fiscal policy respond to short-run fluctuations*

Chapter Outline:

- *Introduction to business cycle*
- *The real business cycle theory*

7.2 Introduction to Business Cycle

Activity

Dear students, Define business cycle.

Good! Compare your answer with the definition given below.

Definition: Business cycle, in a nutshell, is the short-run fluctuations in output and employment.

- *What is the best way to explain short run fluctuation in output and employment?*
- *How should monetary and fiscal policy respond to these fluctuations?*

Most economists believe that these questions are best answered using the model of aggregate demand and aggregate supply, which were discussed in Macroeconomics I. Yet as we approach the end of the course, let's take a step closer to the frontier of modern economic research and examine the continuing debate over the theory of short run economic fluctuation.

We begin by examining the theory of real business cycle- a viewpoint held by a small but significant minority of economists. According to this theory, short run economic fluctuations should be explained while maintaining the assumptions of the classical model, which we used to study the long run. Most importantly real business theory assumes that prices and wages are fully flexible, even in the short run. Almost every macroeconomic analysis is based on the premise that prices adjust to clear markets.

Then we see the New Keynesian economics which is based on the premise that market clearing models such as the Real business cycle theory cannot explain short run economic fluctuations. In the *General theory*, Keynes urged economists to abandon the classical assumption that prices and wages adjust quickly to equilibrate markets. He emphasized that aggregate demand is the primary determinant of income in the short run. New Keynesian economics accept these basic conclusions, and so they advocate models with sticky prices and wages.

In presenting the work of these two schools of thought, this chapter takes an approach that is more descriptive than analytic. Studying recent theoretical developments in detail would require more mathematics than is appropriate for this module. Yet without formal models, we can discuss the direction of this research and get a sense of how different economists are applying microeconomic thinking to better understand Macroeconomic fluctuations.

7.3 The Real Business Cycle Theory

When we studied economic growth in chapter five, we described a relatively smooth process. Output grew as population, capital and the available technology evolved over time. In the Solow growth model, the economy approaches a steady state in which most variables grow together at a rate determined by the constant rate of technological progress.

But is the process of economic growth necessarily as steady as the Solow model assumes? Perhaps technological progress and economic growth occur evenly. Perhaps there are shocks that induce short run fluctuations in the natural levels of output and employment. To see how this might be so, we consider a famous story that economists have borrowed from author Daniel Defoe.

The Economics of Robinson Crusoe

Robinson Crusoe is a sailor stranded on the desert island. Because Crusoe lives alone, his life is simple. He has to make many economic decisions. Considering Crusoe's decisions- sheds light on the decisions that people face in larger, more complex economies.

To keep things simple, imagine that Crusoe engages in only few activities. Crusoe spends some of his time enjoying leisure, perhaps swimming at his island's beaches. He spends the rest of his time working, either catching fish or collecting vines to make fishing nets. Both forms of work produce a valuable good: fish are Crusoe's consumption and nets are Crusoe's investment. If we were to compute GDP for Crusoe's island, we would add together the number of fish caught and the number of nets made.

Crusoe allocates his time among swimming, fishing and making nets based on his preferences and the opportunities available to him. It is reasonable to assume that Crusoe optimizes. That is, he chooses the quantities of leisure, consumption and investment that are best of him given the constraints that nature imposes.

Overtime, Crusoe's decisions change as shocks impinge on his life. For example, suppose that one day a big school of fish passes nearby the island. GDP rises in the Crusoe economy for two reasons. First, Crusoe's productivity rises: with a large school in the water, Crusoe catches more fishes per hour of fishing. Second, Crusoe's employment increases. That is, he decided to reduce temporarily his enjoyment of leisure to work harder and take advantage of this unusual opportunity to catch fish. The Crusoe's economy is booming.

Similarly, suppose that a storm arrives one day. Because the storm makes outdoor activity difficult, productivity falls: each hour spent fishing or making nets yields a smaller output. In response, Crusoe decides to spend less time working and to wait out the storm in his hut. Consumption of fish and investment in nets both fall, so GDP falls as well. The Crusoe economy is in recession.

What is notable about this story of booms and recessions is its simplicity. *In this story, fluctuations in output, employment, consumption, investment, and productivity are all the natural and desirable response of an individual to the inevitable changes in his environment.* In the Crusoe economy, fluctuations have nothing to do with monetary policy, sticky prices, or any type of market failure.

According to the real business cycle theory, fluctuations in our economy are much the same as fluctuations in Robinson Crusoe's. Shocks to our ability to produce goods and services change the natural levels of output and employment. These shocks are not necessarily desirable, but they are inevitable. Once the shocks occur, it is desirable to GDP, employment and other real macroeconomic variables to fluctuate in response.

At the heart of the debate are four basic issues:

- The interpretation of the labor market: Do fluctuations in employment reflect voluntary changes in the quantity of labor supplied?
- The importance of technology shocks: Does the economy's production function experience large, exogenous shifts in the short run?
- The neutrality of money: Do changes in the money supply have only nominal effects?
- The flexibility of wages and prices: Do wages and prices adjust quickly and completely to balance supply and demand?

Regardless of whether you view the parable of Robinson Crusoe as a plausible allegory of the business cycle, considering these four issues is instructive, because each of them raises fundamental questions about how the economy works.

The Interpretation of the Labor Market

Real business cycle theory emphasizes on the idea that the quantity of labor supplied at any given time depends on the incentives that workers face. Just as Crusoe changes his work effort voluntarily in response to changing circumstances, workers are willing to work more hours when they are well rewarded and are willing to work fewer hours when they are poorly rewarded. Sometimes, if the reward for working is sufficiently small, workers choose to forgo working altogether- at least temporarily. This willingness to reallocate hours of work over time is called the intertemporal substitution of labor.

To see how intertemporal substitution of labor affects labor supply, consider the following example.

A college student finishing his sophomore year has two summer vacations left before graduation. He wishes to work for one of these summers and relax at the beach during the other summer. How should he choose which summer to work?

Let W_1 be his real wage in the first summer and W_2 in the second summer. To choose which summer to work the student compares these two wages and the interest earned on money earned earlier. A dollar earned in the first summer is more valuable than a dollar earned in the second summer because of the interest earned in the dollar earned in the first summer. Let r be the interest rate.

$$\text{Intertemporal relative wage} = \frac{(1+r)W_1}{W_2}$$

Working in the first summer is more attractive if the interest rate or W_1 are high.

Real business cycle theory uses intertemporal substitution of labor to explain why employment and output fluctuate. Shocks in the economy that cause interest rate or wage to raise, cause people to want to work more and vice versa.

Importance of technology Shocks

The Crusoe economy fluctuates because of changes in weather, which induce Crusoe to alter his work effort. In the real business cycle theory, the analogous variable is technology, which determines the economy's ability to turn input in to output. The theory assumes that our economy experience fluctuation in technology in that these fluctuation in technology cause fluctuation in output and employment. When the variable technology improved, the economy produces more output and real wage raise. Because of intertemporal substitution of labor the improved technology also leads to greater employment. Real business cycle theorists often explain recession as a period of technological regress. Technological regress may take the form of bad weather, passage of strict environmental regulations, and increase in world oil price. They all reduce our ability to turn inputs in to outputs.

The Neutrality of Money

Just as money has no role in the Crusoe's economy, real business cycle theory assumes money in our economy is neutral even in the short run. That is monetary policy is assumed not to affect real variables such as output and employment. Not only does the neutrality of money give real business cycle theory its name, but neutrality is also the theory's most radical assumption.

They claim money supply is endogenous: fluctuation in output might cause fluctuation in money supply. Example, when output rises because of technological improvement, the quantity of money demanded rises. The national bank may respond by raising the money supply to accommodate the greater demand.

The Flexibility of Wages and Prices

Real business cycle theory assumes that wages and prices adjust quickly to clear markets, just as Crusoe always achieves his optimal level of GDP without any impediment from a market imperfection. They believe that the assumption of flexible prices is superior methodologically to the assumption of sticky prices, because it ties macroeconomic theory more closely to microeconomic theory.

New Keynesian Economics

Most economists are skeptical of the theory of real business cycle and believe that short run fluctuations in output and employment represent deviations from the natural levels of these variables. They think these deviations occur because wages and prices are slow to adjust to changing economic conditions. This stickiness makes the short run aggregate supply curve upward sloping rather than vertical. As a result, fluctuations in aggregate demand cause short run fluctuations in output and employment.

Why exactly are prices sticky? New Keynesian research has attempted to answer this question by examining the microeconomics behind short run price adjustment.

Small Menu Costs and Aggregate Demand Externalities

One reason prices do not adjust immediately in the short run that there are costs to price adjustment. To change its prices, a firm may need to send out new catalogs to customers, distribute new price lists to its sales staff. This cost of price adjustment, called Menu costs, lead firms to adjust prices intermittently rather than continuously.

According to the proponents of the menu cost hypothesis, to understand why prices adjust slowly, we must acknowledge that there are externalities to price adjustment: a price reduction of one firm benefits other firms in the economy. When a firm reduces the price it charges, it slightly lowers the average price level and thereby raises real money balances. The increase in real money balances expands aggregate income (by shifting the LM curve out ward). The economic expansion in turn raises the demand for the products of all firms. This macroeconomic impact of one firm's price adjustment on the demand for all other firms' products is called Aggregate demand externality.

In the presence of this aggregate demand externality, small menu costs can make prices sticky, and this stickiness can have large cost to the society. Suppose that a firm originally sets its price to high and latter must decide whether to cut its price. The firm makes this decision by comparing the benefit of a price cut- high sales and profit- to the cost of price adjustment. Yet because of the aggregate demand externality, the benefit to the society of the price cut would exceed the benefit to the firm. The firm ignores this externality when making decision, so it may

decide not to pay the menu cost and its price even though the price cut is socially desirable. Hence, the sticky prices may be optimal for those setting prices, even though they are undesirable to the economy as a whole.

Recessions as a coordination failure

Some new Keynesian economists suggest that recessions result from a failure of coordination among economic decision makers. In recessions, output is low, workers are unemployed and factories sit idle.

To see how coordination failure results in recession and thereby makes price sticky consider the following example.

Table 8.1: the game between two firms in pricing decision

Firm 1	Firm 2		
		Cut price	Keep prices high
Cut price		Firm 1, 30 Firm2, 30	Firm1, 5 Firm2, 15
		Firm1, 15 Firm2, 5	Firm1, 15 Firm2, 15

The economy is made up of two firms. After the fall in money supply, each firm must decide whether to cut price, based on its goal of maximizing profit. Each firm's profit, however, depends not only on its pricing decision but also on the decision made by the other firm.

What outcome should we expect in this economy? On the one hand, if each firm expects the other firm to cut price, resulting in the preferred outcome in which each make a profit of dollar 30. On the other hand, if each expects the other to maintain their prices, resulting in the inferior outcome in which each firm makes a profit of dollar 15.

The inferior outcome, in which each firm makes dollar 15, is an example of a coordination failure. If the two firms could coordinate, they would both cut their prices and reach the preferred outcome. In the real world, unlike in our parable, coordination is often difficult because the number of firms setting prices is large. The moral of the story is that prices can be sticky simply because people expect them to be sticky, even though stickiness is no one's interest.

References

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Mankiw, N.G. (2009). Macroeconomics. Ed. USA: Worth publishers.

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8. Which one of the following tax policy will encourage the accumulation of capital
- A) Tax on income earned from owning capital
 - B) Investment tax credit
 - C) Tax treatment of depreciation
 - D) A&B
 - E) B&C
9. Which one of the following is / are true about Ricardian assumption
- A) All changes in fiscal policy are irrelevant
 - B) Changes in fiscal policy cannot influence consumer spending
 - C) A debt-financed tax cut leaves consumption unaffected
 - D) All except C
 - E) None
10. Theories of money that emphasizes the role of money as a medium of exchange is known as?
- A) Transaction theory
 - B) Baumol-Tobin theories
 - C) Portfolio theories
 - D) All
 - E) None
11. Identify the wrong statement about Solow growth model.
- A) It assumes that each year people save amount and consume fraction
 - B) It assumes that the production function has constant returns to scale
 - C) It assumes that production function has increasing returns to scale
 - D) A & B
 - E) None
12. What is the reason for holding inventories
- A) Production Smoothing
 - B) Inventory as a factor of production
 - C) Stock out avoidance
 - D) Work in progress
 - E) all

13. The cost of capital depends on
- A) Price of capital
 - B) Interest rate
 - C) Depreciation rate
 - D) All
 - E) None
14. The purchase and sale of government bonds by central bank is referred to as
- A) Open market operation
 - B) Reserve requirement
 - C) Discount rate
 - D) All
 - E) None
15. Identify the correct statement
- A) According to rational expectation model, anticipated increase in money supply has no effect on output.
 - B) According to rational expectation model, unanticipated increase in money supply increase output.
 - C) According to rational expectation model, anticipated change to the money supply changes the overall price level proportionately.
 - D) All
 - E) None

Part III: Essay Questions(5 pts)

1. Explain factors that determine the marginal product of capital.(3pts)
2. Discuss the determinants of business fixed investment.(3pts)
3. What makes the golden rule steady state different from non-golden rule steady state? (2pts)
4. What is rational expectation? How does the rational expectation differ from perfect foresight? (2pts).

Part IV: Work out (10 pts)

1. Assume that a consumer has already lived 30 years and expects to live for more 40 years of which he intends to work 20 years. According to the life-cycle hypothesis, estimate the consumption function of the consumer. (3 pts)

2. Assume that a car rental company buys cars at \$ 10,000 each and rents them out to other Businesses. Given
 - ✓ Nominal interest rate of 10% per year
 - ✓ An increase in car prices by 6% per year
 - ✓ Car depreciation of 20% per year

Calculate the cost of capital. (2pts)