This manuscript brings together material I have written for my students on closed-economy macroeconomics. Since the focus of my courses is always open-economy, this material is assigned towards the end to provide an understanding of the basics of closed-economy analysis. Because of the tools of open-economy analysis already developed, the analysis here is largely a repetition in a different context of previously presented ideas.

As is fitting for intermediate-level students, the analytical framework they are left with is the traditional IS-LM model, albeit a refined and modernized version that incorporates what has been learned in recent years. Nevertheless, I regard the presentation as incomplete in many respects. Once rational expectations is incorporated and the intuitive presentation of the analytical tools is properly based on maximizing behavior that takes account of the intertemporal nature of macroeconomic equilibrium, we are still left with a model that has developed very little during the past twenty years, despite continuous research in the field. This reflects three difficulties. The first is the perennial problem of aggregation which can only be dealt with in a mathematically rigorous fashion in models that are too parsimonious to provide an overview of how the whole system functions. The second is the dependency of any dynamic analysis on arbitrary assumptions about how fast people learn about the nature and implications of exogenous shocks to the economy. The third is the fact that all real-world economies are open economies, most of them small, operating in a world where capital is highly mobile internationally. Dealing with interrelationships between the economies of several countries requires mathematical models that are too complex to solve easily and transparently. As a result, the IS-LM approach remains the workhorse for practical analysis of current economic conditions and government policies that respond to and generate those conditions.
Nevertheless, it is important for even intermediate level students to achieve a general understanding of recent technical developments. Accordingly, a number of chapters need to be added to what is presented here. Students should understand what we mean by the microeconomic foundations of macroeconomics and should be able to work through at least one very simple intertemporal representative agent maximizing model. They should also be able to work through at least one simple overlapping generations model, a rudimentary real business cycle model, and a simple random matching model. Expositional efforts along these lines will not be easy because even the simplest models are complex in relation to the technical proficiencies of most second and third year undergraduates.

In completing the work to date, I would like to thank my colleague Alan Hynes for helpful discussions on these topics over many hears.

J. E. Floyd
May 13, 2002
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Chapter 1

Introduction: Basic Concepts

This book outlines the standard closed-economy model of money, prices and employment found in most current intermediate textbooks. The theory is developed from an historical perspective in steps, beginning with the early simple-minded classical model, proceeding to the crude Keynesian model of the late-nineteen thirties, and then refining both to present a unified modern treatment that incorporates contemporary notions of price adjustment and rational expectations.

The reader should be reminded that, apart from the world considered as a single unit, there are essentially no closed economies. In the modern world every economy trades with other economies and some of the capital stock employed in every economy is owned by residents of other economies.

Why then bother with closed-economy analysis? There are two reasons. First, some tools of analysis are easier to develop and understand without the complications of international trade and capital movements. Insights gained from the analysis of a theoretical closed economy carry over to the analysis of more realistic situations. Second, most modern courses in macroeconomics deal in considerable detail with closed-economy issues. Students who devote most of their energy to open economy analysis frequently have to bone up on features of closed-economy analysis in order to pass their exams. For this they should find this book useful. In addition, they will also improve their understanding of analytical concepts used in open economy analysis by seeing them presented in a different context.

In this chapter we begin by outlining briefly some basic concepts necessary for understanding the material presented in later chapters. We can think of the economy as a collection of resources together with the institutions that govern their use. The people in the economy own, individually
and collectively, a stock of capital which produces a flow of goods and services that can either be consumed or plowed back as an addition to capital. This stock of capital, the distinguishing feature of which is its ability to produce a flow of output of goods and services, represents the communities’ wealth and is the source of its income.

There are four main components to the capital stock: physical capital, human capital, knowledge, and money holdings. Physical capital consists of machinery, buildings and structures, materials in process and natural resources. A part of the physical capital existing at any point in time has been produced by redirecting output to that purpose rather than consuming it. The rest represents the powers of nature—earth, coal, water, sunshine, etc.—that are freely available in the environment. Producible capital normally deteriorates from use. The powers of nature may be exhaustible (e.g., coal and oil) or inexhaustible (e.g., air and water). Human capital is skills and knowledge embodied in people. It is acquired partly through formal education and on-the-job training, and partly by osmosis as a by-product of the process of growing up in a home and community. The stock of knowledge can be thought of as the understanding of how the natural and social environment works, what might be called basic knowledge, and the understanding of how the resources at the society’s disposal can be modified, extended and combined to produce various kinds of goods and services. This ability to apply basic knowledge in using resources to produce goods and services is called technology or technological capital, and increase in it are commonly referred to as technical change. The stock of knowledge and technology is possessed by the community as a whole but not embodied in all of its members. It is the set of skills, techniques and attributes available for embodiment in individuals and physical capital. The ‘quality’ of human and physical capital depends on the technology actually embodied in them and on the knowledge base that permits that level of technology.

A part of the output of the economy can be used to add to the stock of physical capital and human skills and to the stock of knowledge. Investment in knowledge, and associated expansions of technology, involves improving the understanding of how nature works as well as discovering new products, resources, skills and ways of combining human and physical capital in production.

The fourth type of capital is the public’s holdings of money balances. Money is held to facilitate exchange. Without it, anyone wanting to sell something would have to barter it for something else—this would require that another person be found with the right product to sell. These costs of barter can be avoided by making all exchanges in return for money. In a
modern economy, the stock of money is provided under government auspices at minimal cost in terms of resources that could produce other goods and services.

The process of adding the community’s capital stock—the investment process—increases the amount of goods and services the economy can produce in the future. Consumption is sacrificed today in order that more can be consumed in years to come.

Aggregate output, frequently referred to as gross national product (GNP) and denoted here by $X$, can be defined as the total flow of goods and services produced by the community’s stock of capital.\footnote{In an open economy, aggregate output produced by capital employed in the country is called gross domestic product (GDP). Gross national product is the aggregate output produced by resources owned by residents of the economy. It differs from GDP by the amount of earnings from domestically owned capital employed abroad minus the amount of earnings from domestically employed capital owned by foreign residents. In a closed economy, GNP and GDP are identical.} In the process of producing this output deterioration or depreciation of the stock of capital occurs. Let $D$ be the amount of output that would be required to produce sufficient new capital to compensate for this depreciation. The maximum amount of output that could be consumed without either adding to the capital stock or allowing it to decline would thus equal

\begin{equation}
Y = X - D.
\end{equation}

We define $Y$ as the level of aggregate income—the maximum amount the community could consume while holding its capital stock intact.

Consumption, which we represent by $C$, can now be defined as that portion of income that is used up in the form of goods and services absorbed by the public. The remaining portion represents savings, which is channelled into investment. Investment, denoted by $I$, is the rate of growth through time in the community’s stock of capital.\footnote{It is sometimes useful to distinguish between gross and net investment. The quantity of new capital goods produced can be divided into two parts: that which replaces the capital eaten up by depreciation, and that which constitutes a net addition to the stock of capital. Gross investment is defined as total production of new capital while net investment is the addition to the capital stock. Gross investment thus equals net investment plus depreciation and, alternatively, output minus consumption. Net investment equals income minus consumption.} Aggregate income can thus be divided into two parts—consumption, and net additions to the capital stock.

\begin{equation}
Y = C + I
\end{equation}
involved. The nominal levels of output, depreciation, income, consumption and investment are the money values of these aggregates. These can be denoted as $P \cdot X$, $P \cdot D$, $P \cdot Y$, $P \cdot C$ and $P \cdot I$, where $P$ is the average price of goods produced in the economy, often referred to as the general price level. In effect, we as assuming that the output of the economy can be treated as a single product. The price of a unit of this product is $P$. The quantity produced in the economy is $X$, of which an amount $Y$ is available for consumption after depreciation of the capital stock is taken into account. To obtain real income from nominal income, or the real values of consumption or investment from their nominal values, we divided the relevant nominal magnitudes by $P$.

It is also important to distinguish between real and nominal money holdings. The nominal money stock, represented by $M$, is the public’s holdings in current dollars. The real money stock is the public’s holdings measured in some past period’s dollars. It equals the nominal stock deflated by the price level and can be denoted by $M/P$. A doubling of prices, for example, will mean that any given nominal quantity of money will buy only half as much as before. If the nominal stock of money has remained constant in the face of this increase in the price level, the real stock of money will have fallen by half. Looking at it another way, a doubling of all prices will make it necessary to hold twice as much nominal money to maintain real money balances constant. For making decisions about the appropriate stock of money to hold it is the real rather than nominal money holdings that are relevant. Higher prices increase the nominal value of transactions in proportion, implying that nominal money holdings must increase in the same proportion to transact the original quantity of goods.

An increase in the price level, and corresponding decline in the value in terms of goods of a unit of money, is referred to as inflation. We must

---

In practical terms, the level of output of a closed economy is measured by the real gross national product (see footnote 1). Gross national product is the aggregate money value of goods produced in the economy—a sum of the outputs of the various goods and services weighted by their prices. When prices in the current year are used as weights, nominal gross national product—i.e., gross national product in current dollars—is obtained. When prices from some base period in the past are chosen as weights, the result is gross national product in constant dollars. The latter is the customary measure of real output—output measured in the dollars of the chosen base period. By dividing nominal gross national product by real gross national product we obtain a measure of the price of output. This is defined as the implicit income deflator—the price level that nominal gross national product would have to be divided by to obtain real gross national product. These terms, together with the distinction between gross and net investment are discussed carefully in Robert J. Barro, *Macroeconomics*, 4th Edition, 1993, pp. 1–16.
distinguish between two different meanings of this term: an increase in the price level between two points in time, and an on-going year after year rate of change in prices. The latter is usually referred to as the inflation rate. At present, the inflation rate in Canada is about 1 percent. The increase in the price level between two dates in the past measures the amount of inflation that has occurred over that period. Since 1970 the price level has more than tripled. It has increased more than four-fold since 1953.

The interest rate is a very special price—the price one must pay to have a dollar today rather than tomorrow. When the interest rate is, say, 10 percent per year, $100 invested now will grow to $110 by this time next year. Alternatively, to borrow $100 today, one must be prepared to pay back $110 dollars in one year. Spending a dollar now rather than a year from now is thus worth about 10% of that dollar.

It is important to notice that the interest rate defined above is not the amount of goods one would have to give up to have a dollar’s worth of goods today rather than next year. The reason is that the price of goods in terms of dollars—the general price level—will normally change from this year to next. If the price level increases by 5 percent over the year, the $110 that can be obtained next year by not spending $100 now will buy only $105 worth of goods when it is received. The realized real interest rate will thus be only 5%, even though the contracted nominal interest rate is 10%. The difference between these two interest rates is the rate of inflation.

What really matters in any transaction involving time is the amount of real goods that can be obtained next year by sacrificing a given quantity of real goods now. When a sum of money is borrowed for a year, both the lender and the borrower are only interested in the amount of real goods the borrower is going to have to pay the lender to get him to forgo consuming the goods today. Thus, in agreeing on an interest rate for the loan, the borrower and lender will establish an acceptable real interest rate and then add on an inflation premium to cover the expected decline over the year in the real value of the amount borrowed. This premium will equal the inflation rate the lender and borrower expect over the year. The nominal contracted interest rate, which we will denote by $i$, will thus be composed of two parts: a real interest rate, denoted by $r$, and the expected rate of inflation, denoted by $E_p$. That is

$$i = r + E_p$$

Note that the real interest rate as defined above will normally differ from the interest rate that will actually be realized on the transaction. This
difference between the realized and contracted real interest rates will arise whenever the parties to the loan are incorrect in their expectation of the inflation rate. If the inflation rate is higher than expected, the realized real interest rate will be below \( r \). If it is lower than expected, the realized real interest rate will be above \( r \).

We can observe nominal interest rates but not contracted real rates. The latter depend on the expectations of borrowers and lenders as to the future inflation rate. After the event, we can calculate the realized real interest rate by subtracting the actual rate of inflation from the nominal interest rate. For example, suppose that the lending rate of the Canadian chartered banks is 7.75% and the actual rate of inflation is around 3%. The real interest rate at which borrowing and lending is currently taking place equals 7.75% minus the inflation rate expected by borrowers and lenders over the next year. Since we have no way of knowing what this expected inflation rate is, we cannot observe the contracted real interest rate. We can, however, observe the realized real interest rate. If the rate of inflation over the next year actually turns out to be 3%, the realized real interest rate will be 4.75%. If the inflation rate turns out to be 2% the realized real rate of interest will be 5.75%.

The study of the behaviour of economic aggregates has tended to divide into two branches. One branch deals with the growth of the economy over long periods of a decade or more and from one generation to the next. The other deals with fluctuations in economic activity around its long-run trend. The former deals with long-run capital accumulation and the determinants of the growth rates of aggregate output, population, and per capita income. The latter is concerned with short-term variations in output, in the fraction of the labour force employed, in nominal and real interest rates and in the level of prices. Although it is quite often a long-term phenomenon, inflation is usually analyzed in conjunction with the fluctuations in economic activity as well as long-term growth.

Our focus in this book will be almost entirely on short-run fluctuations in output, employment and prices within the framework of given rates of long-term output growth and inflation. Some attention will nevertheless be devoted to the short-run effects on economic activity of changing the long-term inflation rate.

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\(^4\)For a simple but rigorous discussion of the distinction between real and nominal interest rates, see pages 173–182 of Barro’s book cited above.
Exercises

1. Explain the distinction between stocks and flows. Which of the following are stocks and which are flows: clothes, money, government bonds, interest on a loan, income taxes, inheritance taxes? Briefly explain your reasoning in each case.

2. Write brief one or two sentence explanations of the following concepts: human capital, physical capital, stock of knowledge, technological change, stock of money, income, aggregate income, consumption, saving, investment, depreciation, real vs. nominal magnitudes, general price level, inflation, nominal interest rate, real interest rate, expected rate of inflation, inflation premium.

3. True or False: Explain your answer briefly.
   a) Real and nominal income differ only by the price level.
   b) In a closed economy there is no useful distinction between income and output.
   c) Savings and investment are quite different concepts—the former represents an addition to wealth while the latter is simply an addition to the capital stock.
   d) Inflation means that all prices are rising together.
   e) People hold money because it is a riskless asset—i.e., it never increases or decreases in value.
   f) “What with the recent inflation and all, bonds are a good investment because interest rates are high.”
   g) “Since the inflation rate is currently around 5 percent while the interest rates on treasury bills and other short-term securities are over 12 percent, real interest rates are currently very high.”
   h) In an environment where inflation is ongoing at 15% per year, observed interest rates of less than 15% will imply real interest rates that are negative.
Chapter 2

The Crude Classical Model

We begin by developing what might be broadly viewed as the traditional classical short-run aggregative model. The classical economists that preceded Keynes, of course, were much more sophisticated than this model might suggest. Indeed, the model presented here might be viewed as a Keynesian caricature of classical economics—the straw man that Keynes attacked in his ‘general theory’. Nevertheless, since our purpose is to develop the modern theory step by step, this conceptualization is an appropriate starting point.

Because we are dealing with the short run, technology can be assumed constant—this implies that the stocks of capital taking the form of knowledge and technology do not grow during the time interval to which our analysis applies. Moreover, while the capital stock is expanding at a rate equal to the net investment in human and physical capital, the ratio of net investment to the capital stock is small. So for practical purposes the capital stock will be increasing so slowly from period to period that it can be treated as essentially constant at any point in time. Population is also assumed constant. We can make these assumptions because we are not interested here in the effects of population growth, technological change and capital accumulation on the growth of aggregate income per capita.

Constancy of technology, population and the capital stock implies that human capital per worker is constant. The quantity of labour and the stock of human capital employed can therefore be viewed as one and the same thing. Given that the physical capital stock is always fully employed—being as it does not pay to leave it idle—the level of output depends strictly

on the level of employment of labour. Thus, ignoring depreciation we can express income as

$$Y = F(N)$$

(2.1)

where $Y$ is output and income and $N$ is the quantity of labour employed. It is understood that physical capital is also an argument in the production function but since we are assuming it to be constant it can be incorporated into the form of the function. The production function is shown in Figure 2.1. An increase in the level of employment causes output and income to rise, but at a decreasing rate with successive increases in the quantity of labour employed.

Firms in the economy will employ additional labour as long as it is profitable for them to do so. The real revenue from employing another unit of labour is its marginal physical product. The real cost of employing another unit is the real wage rate—that is, the wage rate measured in units of output. As can be seen from Figure 2.1, the marginal physical product of labour, represented by the slope of the output curve, declines as the level of employment increases—this is the principle of diminishing returns.\(^2\) Firms

\(^2\)For a discussion of the production function and the marginal physical product of
in the economy will expand employment until the marginal physical product of labour has fallen to equal the wage rate. A reduction of the real wage rate will thus lead to an increase in the quantity of labour demanded.

The demand for labour is thus given by the marginal physical product of labour, which is the derivative of the production function

\[
\frac{W}{P} = w = \frac{dF(N)}{dN} = F'(N),
\]

and can be expressed as the curve DD in Figure 2.2. In that figure, the real wage rate is on the vertical axis and the quantity of labour employed is on the horizontal one. \(W\) is the money wage rate and \(w\) is the real wage rate. The real wage rate is equal to the money wage rate paid per unit of labour divided by the price of output—a money wage of $10 per hour, for example, divided by a price level of $2 per unit of output will yield a real wage rate of 5 units of output per hour. The vertical distance of DD from the horizontal axis equals the marginal physical product of labour. DD is negatively sloped because the marginal physical product of labour declines as the quantity of labour employed increases.

\^labour, see pp. 41–44 of the Barro book cited previously.
CHAPTER 2. THE CRUDE CLASSICAL MODEL

The quantity of labour supplied will depend upon how people choose to allocate their time between work and leisure. Two general forces are present. A rise in the real wage rate will increase the opportunity cost of leisure, inducing a substitution in the direction of more work. At the same time, the rise in the real wage rate increases the amount of income that can be obtained from the existing amount of work. If leisure is a normal good, this increase in real income will induce workers to increase their consumption of both goods and leisure and to reduce the amount worked. It is generally believed that at low levels of income the first effect, called the substitution effect, dominates while the second effect, called the wealth effect, dominates at high levels of income. Thus, the supply function for labour, which we formally express as

\[ N = N(w) = N\left(\frac{W}{P}\right), \]

(2.3)
can be represented by a curve like SS in Figure 2.2. At low wages the quantity of labour supplied increases as the real wage rate rises but beyond some point a rise in the real wage rate leads to a decline in the quantity of labour offered for employment. For most of our analysis nothing will be lost by simply assuming that the classical supply curve for labour is vertical—that is, that the full-employment quantity of labour offered is independent of the real wage rate.

Labour market equilibrium is given by the solution of equations (2.2) and (2.3). If the labour market functions properly, the real wage rate will adjust until everyone who wishes to work is employed. At real wages above \( w_1 \) in Figure 2.2, the amount of labour people want to supply will exceed the amount firms are demanding. The money wage rate will be bid down until the real wage rate has fallen to \( w_1 \). Similarly, if the real wage rate is below \( w_1 \) there will be an excess demand for labour and nominal wages will be bid up until the real wage rate has risen to \( w_1 \). The equilibrium quantity of labour employed will thus be \( N_f \). This can be referred to as full employment. Full employment of labour results in a full-employment level of output of \( Y_f \) in Figure 2.1.

While the model developed thus far determines the equilibrium level of real wages, it says nothing about what determines the nominal wage rate and the price level. Equilibrium in Figure 2.2 is consistent with any level of nominal wages and prices as long as the ratio of \( W \) to \( P \) equals \( w_1 \). Our model tells us that, in order to maintain equilibrium real wages, the level of money wages determined in the labour market would double if something should happen to cause the price level to double. It does not tell us what
determines the price level. Since the price level is the price of output, it is only appropriate that it be determined by the supply of and demand for output—by aggregate supply and aggregate demand.

The line AS\(_f\) in Figure 2.3 gives the aggregate supply curve. That curve, which can be represented formally as

\[
Y = F(N_f),
\]

is vertical at the output level \(Y_f\) because the workings of the labour market will produce the level of employment \(N_f\) regardless of the level of prices—if the price level is higher the money wage rate will be higher in the same proportion to maintain the real wage rate \(w_1\).

The aggregate demand curve traces out the quantities of output that will be demanded in the economy at various price levels. It is derived from the demand function for money, which the classical economists represented in a very simple fashion.\(^3\) They postulated that the public will choose to

\(^3\)As in the rest of the model, the presentation here is stereotypical—many classical economists had a much more sophisticated understanding of the issues than is implied by the discussion that follows.
Chapter 2. The Crude Classical Model

Hold a stock of real money balances equal to some constant fraction of real income. The demand for real money balances could thus be expressed as

\[
\left( \frac{M}{P} \right)^d = kY
\]  

(2.5)

where \( k \) is the public’s desired ratio of real money holdings to real income. This implies that the nominal quantity of money demanded will equal \( k \) times nominal income—that is,

\[
M^d = kPY.
\]  

(2.6)

If the public wants to hold more nominal money balances than are in existence it will attempt to sell goods in return for money. This will cause the price of goods to be bid down. As \( P \) falls in Equation (2.6) the amount of nominal money balances demanded will fall. Equilibrium will occur where \( P \) has fallen sufficiently to reduce the nominal quantity of money demanded to the point where it equals the amount of money in circulation. Similarly, if the quantity of money in circulation exceeds the quantity the public wishes to hold, people will try to spend these excess money holdings on goods. While any one person can do this, everyone together cannot. The price level will be bid up, increasing the nominal quantity of money demanded until it equals the quantity of money in circulation.

When the nominal quantity of money demanded is equal to the quantity in circulation, equation (2.6) can be rearranged to yield

\[
P = \frac{M}{kY}.
\]  

(2.7)

or alternatively,

\[
Y = \frac{M}{kP},
\]  

(2.8)

where \( M \) is the nominal quantity of money that the authorities have created. This latter equation gives the amount of output flow the public will demand for each level of the nominal money stock, prices and the parameter \( k \). Equation (2.7) is the equation of the aggregate demand curve AD in Figure 2.3. This curve is a rectangular hyperbola—a rise in \( P \) will reduce the flow of output the public will demand at each level of the nominal money stock in the same proportion.

The aggregate supply and demand functions, given by equations (2.4) and (2.7) solve for the equilibrium price level, given by \( P_0 \) in Figure 2.3. If
$P$ falls below $P_0$, the public will try to rid itself of excess money holdings by purchasing more output than is being produced, and the general price level will be bid up. If $P$ rises above $P_0$, there will be an excess supply of output (accompanied by an excess demand for money) and the price level will be bid down. An increase in the nominal money stock as a result of the monetary policy of the government will increase the amount of output the public will want to buy at the initial price level—the curve AD shifts to AD' in Figure 2.3. The price level will be bid up to $P_1$. Since output must be constant at $Y_f$ in the face of the increase in money and prices, it is clear from equation (2.8) that the price level must rise in proportion to the increase in the nominal money stock. This is also evident from the demand function for money given by (2.5)—if $Y$ and $k$ are constant the ratio $M/P$ must also be constant. In classical models such as this, money is said to be neutral in the sense that changes in the size of the nominal money supply will have no effect on real output or real money holdings.

Interest rates are determined in the classical analysis by the supply and demand for loanable funds. The demand for loanable funds arises from the investment process while the supply is generated by savings. Firms finance their investment plans by issuing new securities in one form or other. Savers purchase these securities either directly or through the intermediation of banks and other financial institutions. The level of investment, and hence the borrowing of firms, is generally regarded as negatively related to the real interest rate. As the real rate of interest falls firms can borrow at lower rates. More potential investment projects become profitable and the level of investment expands. The supply of new securities coming on the market, or alternatively, the demand for loanable funds, can thus be represented by a negatively sloped curve such as II in Figure 2.4. For the time being we can think of the level of savings as being positively related to the rate of interest, as indicated by the curve SS in Figure 2.4. In general, a rise in the real interest rate will have two opposing effects on the level of savings. On the one hand, the rise in $r$ makes future consumption more attractive relative to current consumption since more future goods can be obtained by sacrificing a unit of current goods. This will cause people to substitute future consumption for current consumption by saving more. On the other hand, a rise in $r$ will increase the amount of future consumption that will be obtained from peoples' initial levels of saving, thereby increasing the opportunities for present and future consumption and, hence, the level of wealth. Normally we would expect people to increase both their current and their future consumption in response to these expanded opportunities. This would have a positive effect on current consumption. Consumption
will therefore decrease, and savings will increase, in response to an increase in the real interest rate if the first (substitution) effect is bigger than the second (wealth) effect.

The real interest rate in the economy is determined by the intersection of the II and SS curves—at that intersection, the demand for loanable funds on the part of investors will equal the supply of loanable funds made available by savers, and the level of desired savings will equal the desired level of investment. The equilibrium real interest rate will be \( r_0 \) and the level of investment \( I_0 \). This equilibrium condition can be expressed as

\[
S = Y - C = I, \tag{2.9}
\]

which will be recognized as a rearrangement of equation (1.2). The real interest rate and the division of income between consumption and investment—that is, the composition of output—are thus simultaneously determined by the public’s preferences with respect to present and future consumption and by the profitability of investment in the economy.

Two very important features of the classical model must be emphasized—they turn out to be crucial in our later comparisons of classical and Keynesian analysis. First, the real quantity of money demanded is a fixed pro-
portion of real income—$k$ is constant in equations (2.7) and (2.8). In many classical models $k$ is replaced by the reciprocal of the income velocity of circulation of money. The latter, denoted by $V$, is defined as the ratio of nominal income to nominal money holdings—it equals the number of times each dollar would have to be spent for the existing stock of money to purchase current nominal output. Thus,

$$V = \frac{PY}{M} = \frac{1}{k},$$  \hspace{1cm} (2.10)

and we can alternatively express equation (2.8) as

$$Y = \frac{MV}{P}$$  \hspace{1cm} (2.11)

or

$$MV = PY.$$  \hspace{1cm} (2.12)

The latter expression is often referred to as the equation of exchange.

The main consequence of the constancy of $k$ (and $V$) is the conclusion that aggregate demand and the price level are unaffected by the division of aggregate income between consumption and capital accumulation. In fact, the empirical evidence suggests that the real quantity of money demanded depends inversely on the rate of interest—an increase in the interest rate increases the opportunity cost of holding money instead of non-monetary assets, causing the public to reduce desired money holdings. Increases in the profitability of investment or declines in desired savings, which appear as upward shifts in II and SS in Figure 2.4 and lead to a rise in the equilibrium rate of interest, therefore bring about a decline in $k$. This will reduce the quantity of money demanded and shift the aggregate demand curve upward in Figure 2.3 causing the equilibrium level of prices to rise. The dependency of the level of aggregate demand on its composition, ruled out by the classical assumption of constant $k$, is crucial for Keynesian arguments about the effectiveness of fiscal policy, which can be interpreted as a government sponsored increase in aggregate (public plus private) investment or reduction in (private plus public) savings.

The second very important feature of the classical analysis that must be emphasized is the assumption that nominal wage rates adjust instantaneously to changes in the demand and supply of labour. Suppose, for example, that the real wage is stuck at $w_0$ in Figure 2.2—that for some reason, workers do not bid the real wage rate down when there is excess
supply in the labour market. At the real wage rate \( w_0 \) firms will employ only \( N_0 \) units of labour and there will be unemployment in the economy. The level of output will be \( Y_0 \) in Figure 2.1, and the aggregate supply curve will be \( AS'Y_0 \) in Figure 2.3.\(^4\) If the nominal quantity of money and the income velocity of circulation are the same as before, the equilibrium price level will be \( P_2 \). the level of money wages will be equal to \( w_1 \) times \( P_2 \). This inability of the real wage rate to find its equilibrium level is the essential basis for less than full employment in Keynesian models.

\(^4\)Note here that we are assuming that the real wage rate is fixed. It will be seen later that rigidity of the nominal wage rate will imply a quite different aggregate supply curve.
Exercises

1. True or False: Explain your answer briefly.
   
a) In the short run, when the quantity of capital is fixed, an increase in employment will be associated with a more or less equivalent increase in aggregate output.

b) The aggregate demand curve for labour is negatively sloped because the marginal product of labour declines as more output is produced.

c) Generally speaking, higher wages induce people to work more and take less leisure. The aggregate supply curve of the economy is therefore upward sloped.

d) When the labour market is in equilibrium, there will be full employment in the sense that everyone wanting to work at the existing wage rate has a job.

e) When there is full employment in the economy the aggregate supply curve is vertical.

f) The aggregate demand function is the relationship between the aggregate quantity of goods and services the public wants to buy and the level of employment.

g) Inflation is a fall in the value of money caused by an increase in the supply of money relative to the demand for it.

2. Given the demand function for money

\[ \frac{M}{P} = kY, \]

derive the aggregate demand function. How is the price level determined when labour is fully employed? Show that the aggregate demand function is unitary elastic, given the nominal stock of money.

3. Let the demand for labour be given by

\[ L = 1000 - 100 \left( \frac{W}{P} \right) \]

and the supply of labour by

\[ L = 900 \left( \frac{W}{P} \right). \]
Find the equilibrium wage rate and demonstrate that a law that forces money wages above the equilibrium level will create unemployment.

4. Consider a simple economy in which a single output good is produced by the production function

\[ X = L^{1/2}, \]

where \( L \) is the quantity of labour employed and \( X \) is output. This implies a demand function for labour

\[ \frac{W}{P} = \frac{1}{2} L^{-1/2} = \frac{1}{2\sqrt{L}}, \]

where \( W \) is the money wage rate and \( P \) is the price level. Assume that the economy is endowed with 100 workers, all of whom chose to work a fixed amount independently of the real wage rate. Suppose, in addition, that the public tends to hold one dollar of money balances for every two dollars of money income. Finally, assume that the government has created a stock of money equal to 5 dollars.

a) Write down the equation giving the demand function for money.

b) Calculate the level of real income, the price level, the level of nominal income and the money wage rate.

c) Show the effects on real income, the price level, nominal income and the money wage rate of an increase in the stock of money from 5 dollars to 10 dollars.

d) Show the equilibrium of the economy on two graphs, one portraying the market for labour and the other the market for output.

Suppose that a single union successfully organizes the entire labour force and manages to impose on employers a cost of living clause that establishes a nominal wage rate according to the formula

\[ W = .1P \]

e) Calculate the equilibrium levels of output, nominal income, the price level, the money wage rate and employment when the money stock is alternatively 5 dollars and 10 dollars.

f) Show the effect of the union on equilibrium in the labour and output markets respectively using two graphs like those in d) above.
Chapter 3

The Keynesian Model

We now turn to a characterization of early Keynesian models—a model that would reflect the thinking of those economists who called themselves ‘Keynesians’ in the early to mid 1940s. The starting point is the income-expenditure equation, presented as equation (1.2) in Chapter 1. Since output (and, ignoring depreciation, income) is divided into consumption and additions to the capital stock, one way to analyze the determination of output is to begin with the determinants of consumption and investment. In doing this, the Keynesians decomposed consumption and investment into its private and public components. Equation (1.2) would thus be rewritten as

$$Y = C + I + G$$  \hspace{1cm} (3.1)

where $C$ and $I$ now refer to the quantities of consumption and investment goods absorbed by the public through private market transactions, and $G$ refers to the quantities of these goods absorbed through the actions of government. The government may directly produce the goods in question or may arrange to have them produced by private firms. In either case, the goods are usually supplied to the public at minimum or zero charge.

Income determination in the Keynesian model thus reduces to the analysis of the factors determining $C$, $I$, and $G$. Government provision of goods and services is equated with real government expenditure (net of income transfers) and viewed in traditional Keynesian models as set exogenously by government policy—that is, set independently of interest rates, income and other variables that are ultimately determined by the equations of the model. Here we distinguish between *exogenous* and *endogenous* variables. Endogenous variables are solved for by the equations of the model while exogenous variables are determined outside the model. Government expen-
diture is an exogenous variable that drives the model and is not solved for within it.

Consumption, by contrast, is an endogenous variable. Keynes argued that it depends on consumers’ current income. The early Keynesians posited a consumption function of the form

$$C = C(Y_d) = C(Y - T)$$

(3.2)

where $T$ is government tax revenues and $Y_d$ is disposable income, equal to current income minus taxes. Keynes argued that the marginal propensity to consume, which is represented by the derivative of $C(Y_d)$ with respect to $Y_d$, is less than the average propensity to consume, defined as the ratio of consumption to income $C/Y_d$. The crude Keynesian consumption function, which is usually presented as a linear relationship between consumption and income, is shown in Figure 3.1 where income on the horizontal axis is viewed as disposable income. The marginal propensity to consume is the slope of the consumption line running from $B$ through $A$ and beyond while the average propensity to consume at the consumption-income point $(C_0, Y_0)$ is the slope of the line $0A$. It is easy to see that no matter where the point $A$ happens to be along the consumption line the slope of the line $0A$ will be less than the slope of the consumption line.

The level of investment is also endogenous. In the crudest Keynesian models it was assumed to depend on the interest rate and business expectations. The interest rate was assumed to be exogenously determined by central bank policy. Business expectations were also exogenous, reflecting the degree of confidence in the future profitability of capital. One could in principal rank all investment projects according to the interest rate that would make their respective present values positive and hence make them profitable to undertake. In Figure 3.2 the interest rate $r_m$ is the interest rate at which the best available project has a positive present value. As the interest rate falls the present values of all projects rise and more and more projects will be worth undertaking, so the level of investment increases. At a zero real interest rate, no projects beyond an investment level of $I_m$ are worth undertaking.

The investment function can thus be written

$$I = I(r)$$

(3.3)

where $I$ is the level of investment and $r$ is the real rate of interest. As the negative slope of the curve II in Figure 3.2 indicates, the derivative of $I(r)$ with respect to $r$ is negative. This is essentially the same II curve that
Consumption

\[ C = a + b Y \]

\[ Y_o \]

Disposable Income

Figure 3.1: The Keynesian Consumption Function

Real Interest Rate

\[ r_m \]

\[ r_o \]

Investment

Figure 3.2: The Investment Function
Figure 3.3: Equality of Income and Expenditure

appeared in Figure 2.4. When the central bank sets the interest rate at $r_0$ the level of domestic investment becomes

$$I_0 = I(r_0)$$  \hspace{1cm} (3.4)

as shown in Figure 3.2.

When this level of investment is added to the exogenous level of government expenditure, which we denote as $G_0$, and to the level of consumption given by equation (3.2) we obtain

$$Y = C(Y - T) + I(r_0) + G_0$$  \hspace{1cm} (3.5)

which can be represented graphically as the line EE in Figure 3.3. This line has a positive intercept with the vertical axis and a slope that is flatter than the $45^o$ line through the origin because the sum of desired consumption, investment, and government expenditure increase as income increases by less than the increase in income—this reflects the fact that the marginal propensity to consume is less than unity. In equilibrium the level of real income will equal the sum of real consumption, investment and government expenditure and will be given by the intersection of the line EE and the $45^o$ line. This yields an output level $Y_e$ on the horizontal axis equal to the sum of
consumption, investment and government expenditure on the vertical one. 

$Y_e$ must satisfy equation (3.5). If we replace the function $C(Y - T)$ in this 
equation with an explicit linear form

$$C = \alpha + \beta(Y - T) \quad (3.6)$$

we obtain

$$Y = \alpha + \beta(Y - T) + I(r_0) + G_0$$

$$= \frac{1}{1 - \beta}[\alpha - \beta T + I(r_0) + G_0]. \quad (3.7)$$

In this equation $[\alpha + I(r_0) + G_0]$ is the intercept of the line EE with the 
vertical axis. The slope of EE is given by $\beta$, the marginal propensity to 
consume. The term $1/(1 - \beta)$ is called the multiplier because $Y$ ultimately 
increases by some multiple of any exogenous shock to the terms in the square 
brackets.

The EE curve will shift upward in response to exogenous increases in con-
sumption, investment and government expenditure. An exogenous increase 
in consumption will occur in response to a shift of the function $C(Y - T)$ (an 
increase in the parameter $\alpha$ in the explicit linear form of that function) or 
in response to a cut in the level of taxes $T$ by the government. An increase 
in the level of investment will occur in response to an increase in business 
confidence that shifts the function $I(r)$, bringing about a rightward shift of II 
in Figure 3.2, or in response to a reduction in the interest rate by the cen-
tral bank and movement down to the right along a given II curve in Figure 
3.2. The early Keynesians viewed monetary policy as operating through the 
direct control of the central bank over interest rates. Tax and government 
expenditure effects on output and income are the cornerstone of traditional 
Keynesian fiscal policy analysis.

Central bank control over the interest rate is directly related to control 
over the money supply. Accordingly, both Keynes himself and his early fol-
lowers expanded the model presented above by introducing the relationship 
between the money supply and interest rates. Implicit in this analysis was 
the fact that the interest rate is the reciprocal of the price of a constant 
perpetual income stream of $1$. Consider a bond having a coupon rate of $1 
per year, or alternatively, a piece of real capital yielding a perpetual income 
stream of that amount. If the interest rate were 10% this income stream 
would be worth $10 because $1 represents 10% interest on an investment of 
$10. So a fall in the interest rate from, say, 10% to 5%, holding the income 
stream constant at $1 would be associated with an increase in the price of 
the asset to $20.
Individual wealth owners have the choice of holding their non-human wealth in either money or bonds, broadly interpreted here to include real capital and intermediate assets of all kinds. Any increase in their demand for bonds must therefore represent an equivalent reduction in their demand for money. The price of bonds, and hence the interest rate, will thus reflect the public’s desire to hold money—an increase in the demand for money will result in an excess supply of bonds causing the price of bonds to fall and the interest rate to rise, and vice versa. Equilibrium in the securities market will therefore occur when the demand for money equals the supply, at which point the demand for bonds will also equal the supply. The supply of money is determined by the central bank. The demand for money is determined by the public’s liquidity preference—that is, by wealthowners’ desire to hold highly liquid money rather than less liquid bonds and other non-monetary assets. Assets are said to be more liquid when they can be converted into money more quickly at lower transactions cost with less prospect of financial loss. A preference for liquidity is therefore a preference for more liquid assets such as money and short-term bonds over less liquid assets such as long-term bonds, stocks, houses, cars, etc.

Keynes and his early followers argued that the demand for money (or liquidity, as they termed it) could be divided into two parts: a transactions demand which is directly related to income, and a speculative demand which is negatively related to the rate of interest. Formally, this can be written

\[ M = L_1(Y) + L_2(r) \]  

where \( L_1(Y) \) is the transactions demand for money and \( L_2(r) \) is the speculative demand. The derivatives of \( L_1(Y) \) and \( L_2(r) \) with respect to \( Y \) and \( r \) are positive and negative respectively. The negative relationship between the speculative demand for money and the rate of interest was the result of a particular assumption about expectations. It was assumed that when interest rates are high the majority of the public will expect them to fall (and bond prices therefore to rise), and when they are low the majority will expect them to rise (and bond prices to fall). High interest rates will thus cause a speculative switch out of money and into bonds in anticipation of the future rise in bond prices and low interest rates will cause a speculative shift out of bonds and into money in anticipation of the future fall in bond prices.

The two equations (3.5) and (3.8) can now be combined to determine the two variables \( Y \) and \( r \). To portray this solution graphically, it is useful to express the two equations as curves in \( (Y, r) \) space as shown in Figure
Figure 3.4: The IS-LM Model

3.4. The curve IS gives the combinations of income and the interest rate that satisfy equation (3.5). These are the combinations of the two variables for which desired expenditures on consumption and investment plus government expenditure equal the real value of output. Alternatively, they are the combinations of $Y$ and $r$ for which savings and investment in the private and government sectors taken together are equal.\footnote{Here we would split government expenditure into its consumption and investment components.} This curve is negatively sloped because a fall in the rate of interest increases the level of desired investment, leading to an increase in the demand for output and the quantity of output produced. The equation of the IS curve is (3.7) in the case where the consumption function is linear. A cut in taxes, an increase in government expenditure or an expectations driven increase in investment expenditure will shift the IS curve to the right.

The curve LM in Figure 3.4 traces out the combinations of the interest rate and income for which the demand for money equals the supply. It is positively sloped because a rise in the rate of interest will reduce the quantity of money demanded, requiring a rise in income to re-equate it with the existing money supply. An increase in the supply of money will require a higher price of bonds and a lower rate of interest to get the public to hold
the new stock of money at the original level of income. The LM curve will thus shift downward to the right. An increase in liquidity preference will have the opposite effect, causing the LM curve to shift to the left—bond prices will have to fall and the interest rate will have to rise to induce the public to be satisfied with the existing stock of money at the original level of income in the face of the increased demand for money. The equation of the LM curve is simply a rearrangement of (3.8) to move the real interest rate to the left-hand side.

In the formulation presented in Figure 3.4, a monetary expansion by the central bank shifts the LM curve to the right, easing credit conditions and lowering the interest rate. Output and income expand as the equilibrium point moves downward to the right along the IS curve. A fiscal expansion, taking the form of either an increase in government expenditures or a decrease in taxes and consequent expansion of consumption expenditure, shifts the IS curve to the right and causes the interest rate and income to both rise as the equilibrium point moves up to the right along the LM curve.

The early Keynesians made much of the fact that there is no apparent mechanism in equations (3.5) and (3.8) and Figure 3.4 to ensure that the equilibrium level of output is the full-employment level. In the late 1930s and early 1940s, this was regarded by a significant fraction of the economics profession as a major analytical breakthrough which destroyed the old classical notion that the economy tended to move automatically to the full-employment level of income. The Keynesian theory was thought to be more general in the sense that it held under all circumstances, whereas the classical theory was only valid in the special case where one assumed the existence of full employment. The Keynesian theory also admitted the possibility that the government could affect output and employment by varying taxes and government expenditure—this avenue was ruled out in the classical theory by the assumption that the quantity of money demanded is independent of the interest rate.
Exercises

1. Suppose that investment expenditure is 10,000 and is under rigid control of the government. Let the consumption function be

\[ C = \alpha + \beta Y \]

where \( \alpha = 20,000 \) and \( \beta = 0.8 \). There is no government expenditure or taxes. Under the crude Keynesian assumption that both money wages and prices are rigid at less than full employment, calculate the level of income \( Y \). Illustrate the result diagrammatically.

2. Suppose that the consumption and investment functions are

\[ C = \alpha + \beta (Y - T) \]

and

\[ I = \delta + \mu r + \gamma Y. \]

Derive the IS curve under the assumption that there is no foreign trade and government expenditure and taxes are exogenously determined. Suppose that income is initially equal to 1000 and that government expenditure and taxes are both initially equal to 100. Show the effects on income of the following changes when \( \beta = 0.5 \), \( \gamma = 0.3 \) and \( \mu = -2.0 \).

   a) An increase in government expenditure from 100 to 110.
   b) An increase in taxes from 100 to 110.
   c) Increases in both government expenditures and taxes from 100 to 110.
   d) An increase in the parameter \( \alpha \) of 10 units.
   e) An increase in the interest rate in the economy from 10% to 15%—i.e., an increase in \( r \) from 0.10 to 0.15.

3. True or False: Explain your answer briefly.

   a) The IS curve gives the combinations of income and the real interest rate for which aggregate demand equals aggregate supply.
   b) An exogenous increase in consumption or investment shifts the IS curve to the right.
c) The IS curve gives the combinations of income and the real interest rate for which savings equals investment.

d) The greater the marginal propensity to consume, the steeper is the IS curve.

4. Suppose that the economy is characterized by the following behavioral relationships and parameters:

\[
\begin{align*}
C &= 150 + 0.8 (Y - T) \quad \text{consumption function} \\
I &= 400 - 200r \quad \text{investment expenditure} \\
G &= 50 \quad \text{government expenditure} \\
T &= 50 \quad \text{taxes} \\
M &= (P)(0.50909 Y - 20000 r) \quad \text{demand function for money} \\
M &= 400 \quad \text{money supply} \\
P &= 1 \quad \text{predetermined price level}
\end{align*}
\]

a) Derive the EE curve for an interest rate of 5% (= 0.05). Draw it on a graph. Calculate the equilibrium level of income and show it on the graph.

b) Derive and draw the IS curve.

c) Derive and draw the LM curve.

d) What are the equilibrium levels of income and the interest rate?

e) The central bank wishes to change equilibrium income to 2770. What change in the money supply, if any, will be required?

f) What would be the change in government spending required to change income to 2770 if the money supply were maintained at 400?

g) Discuss the effects on the interest rate of policies e) and f).
Chapter 4

The Keynesian-Classical Synthesis

In the early days of the Keynesian revolution many economists thought that Keynes had proven that there is no tendency of the modern economy to go to a full-employment equilibrium—the equilibrium position depends on the magnitudes of consumption and investment expenditure generated by savings propensities and business expectations and on the level of government expenditure. This simplistic view was soon discredited on the grounds that it depended almost totally on the underlying assumption that money wages do not adjust in the labour market in response to conditions of excess supply. The second major Keynesian innovation, the notion that the quantity of money demanded depends on interest rates, held firm in subsequent debate and remains a cornerstone of modern macroeconomic theory.¹

4.1 Refinements of the Keynesian Model

The first step in understanding the role of wage rigidity is to note that the money supply term in equation (3.8) should be the real money stock rather than the nominal one. The Keynesians implicitly assumed that the price level was unity so that the nominal money stock in their models was also the real money stock. When we allow for the possibility that the price level

¹Actually, this idea was more of a popularization than innovation since it had been known for at least forty years that the quantity of money held depended on interest rates, although simple working models tended to rely almost exclusively on the assumption that the velocity of circulation is constant.
could differ from unity, the equation must be rewritten as

$$\frac{M}{P} = L_1(Y) + L_2(Y).$$

(4.1)

The real rather than the nominal money stock now becomes the constant underlying the LM curve. It then becomes obvious that if the equilibrium level of employment is below the full-employment level, given by the vertical line $Y_f$ in Figure 4.1, there will be excess supply in the labour market and money wage rates will eventually fall. Monopolistic as well as competitive firms will be induced by profit maximization considerations to pass at least part of these wage reductions through to prices. $P$ will thus fall and the real money stock will increase, shifting LM to the right in Figure 4.1 and increasing output eventually to the full-employment level. Clearly, the Keynesian conclusion that there is no tendency for the economy to go to full employment was the result of an assumption that the money wage rate is inflexible downward in response to the excess supply of labour. When this assumption is relaxed the Keynesian and classical models yield the same conclusion—there is a natural tendency of the economy to go to full-employment equilibrium.

The Keynesians tried to defend the conclusion that full employment would not necessarily be reached by arguing that, as shown in Figure 4.2,
the LM curve could become flat within the relevant range and insensitive in a downward direction to increases in the real money supply resulting from declines in the price level, a situation called a liquidity trap. As a result, it was argued, the IS and LM curves may continue to intersect at an output level below full employment regardless of how low prices fall.\footnote{And how much the authorities might choose to increase the nominal money supply.} This argument loses force when we recognize that as prices continue to fall the increase in real money holdings makes the public wealthier. It is likely that part of the increased wealth will be spent on consumption with the result that the level of consumption will increase at each level of current income—i.e., the consumption function $C(Y - T)$ will shift upward—a result known as the Pigou effect. This will shift IS to the right until it eventually crosses LM at full employment.\footnote{To incorporate the Pigou effect formally into our model we would have to include $M/P$ as an argument in the consumption function. For the classic treatment of this issue, see A. C. Pigou, “The Classical Stationary State,” *Economic Journal*, Vol. 53, 1943, pp. 343–351, and Don Patinkin, “Price Flexibility and Full Employment”, *American Economic Review*, Vol. 38, 1948, 543-564.}

A more sensible formulation of the demand for money also casts doubt on the notion that increases in the stock of real money balances will be ineffective in driving the LM curve downward. The Keynesian rationale for
the negative relationship between the quantity of money demanded and the
interest rate was based on an assumption about the public’s expectations.
The public was assumed to expect interest rates to fall when the current
level of interest rates are high and to rise when current interest rate levels
are low. This is not a useful assumption on which to build a model because
it involves essentially a presumption about how people will react that is not
based on the convexity of indifference curves or some other proposition that
can be demonstrated to be true in a wide variety of circumstances. It leaves
one open to the contrary presumption, which is equally valid because there
is no firm evidence one way or the other, that when interest rates rise the
public will expect them to rise further and when they fall the public will
expect them to fall further. If that were the case, a rise in the interest rate
would lead to portfolio shifts from bonds to money and a fall would lead
to a switch from money to bonds, making the demand for money positively
related to interest rates.

While it is obvious that the transactions demand for money will vary di-
rectly with income, there is no reason to expect a rigid relationship between
desired real money holdings and real income. The amount of money desired
at any given level of income will depend on the opportunity cost of holding
money. Since the cost of holding money (instead of bonds and other non-
monetary assets) is the interest earnings forgone, it is reasonable to expect
that the transactions demand for money will be inversely related to the rate
of interest. Of course, the amount of money held to satisfy the transactions
demand will also depend on expectations—if the interest rate is expected to
rise more money will be held and if it is expected to fall less money will be
held. While expectations could operate in either direction in response to an
increase in the interest rate, the substitution effect away from money when
the cost of holding it rises will always operate in one direction. The available
empirical evidence suggests that the real quantity of money demanded is,
in fact, negatively related to the rate of interest as well as positively related
to the level of income. An appropriate form for the demand function for
money is thus

\[
\frac{M}{P} = L(r, Y)
\]  

(4.2)

where the partial derivative of \( L(\ ) \) with respect to \( Y \) is positive and the
partial derivative with respect to \( r \) is negative, with no distinction made
between various motives for holding money. It is generally held that the
negative slope results from the fact that a rise in \( r \) increases the opportunity
cost of holding money.
When the demand function for money is formulated in this way the LM curve always shifts downward to the right when the real money stock increases. Only if money and non-monetary assets are perfect substitutes in portfolios, so that the partial derivative of \( L(\cdot) \) with respect to \( r \) becomes infinite, will the LM curve be unresponsive to changes in the real money stock. In this case the curve would be horizontal throughout its length at the level of interest rates at which the public was indifferent about holding money vs. other assets.\(^4\) There is thus no basis for the liquidity trap argument that the economy will not be driven to full employment by downward wage flexibility.

The early Keynesian models can also be refined by enriching the production specifications. The classical production function and demand function for labour can (and should) be incorporated into the IS-LM model presented above. The full-employment level of output, given by the vertical line \( Y_f \) in Figure 2.2 (which is reproduced here as Figure 4.3) and derived from equations (2.1), (2.2) and (2.3) should be incorporated directly into the Keynesian analysis. When the money wage rate is fixed, the level of employment varies along the demand curve for labour as the price level rises and falls changing the real wage rate. Since it is impossible for employment and output to change without a change in the real wage rate, constant wages cannot imply a constant price level in the face of changing employment as assumed in the simple Keynesian model. Nevertheless, the price level is almost invariably assumed constant in standard classroom analysis. This is an example of an assumption that is wrong but very useful—it simplifies the analysis without having an adverse effect on the qualitative conclusions.

The IS-LM model in Figure 4.1 can be easily modified to incorporate the fact that constancy of money wages does not imply constancy of the price level. Equation (2.2) can be expressed

\[
\frac{W}{P} = w = \frac{dF(N)}{dN} = F'(N) = G(Y)
\]  

\(^4\)It has been suggested in the literature that certain other short-term assets might be such good substitutes for money that it will become impossible for the monetary authority to control interest rates by controlling the money stock. See John G. Gurley and Edward Shaw, “Financial Intermediaries and the Saving-Investment Process”, Journal of Finance, Vol. 11, 1956, pp. 257-276. For an excellent short discussion of this issue, see Abba P. Lerner, “Discussion of Financial Intermediaries and Monetary Policy,” American Economic Review: Papers and Proceedings, 1963, pp. 401-407. The conclusion is that if money and other assets are less than perfect substitutes, as the evidence suggests they are, there will be no loss of monetary control. Although induced changes in money substitutes will occur, these will be only partially offsetting—some fall in the rate of interest will always be required to induce the public to hold additional money balances.
where the term \([F^{-1}(Y)]\) in \(N = F'[F^{-1}(Y)]\) is simply a rearrangement of the production function \(Y = F(N)\) to make \(N\) a function of \(Y\), and \(dG(Y)/dY\) is negative because the marginal product of labour declines as employment increases and \(Y\) varies positively with \(N\) in the production function. Equation (4.3) can be rewritten as an equation determining the price level as follows

\[
P = \frac{W}{G(Y)} \tag{4.4}
\]

Since \(G(Y)\) falls as \(Y\) increases, the price level rises as output increases holding the money wage rate constant. Also, \(P\) increases proportionally with an increase in the money wage rate holding output constant. Substitution of (4.3) into (4.2) yields

\[
\frac{M}{W} = \frac{L(r,Y)}{G(Y)} = \tilde{L}(r,Y) \tag{4.5}
\]

where \(\tilde{L}(r,Y)\) is the demand function for real money balances measured in units of labour (as compared to \(L(r,Y)\) which is the demand function for real money balances measured in units of output). For example, if \(W\) is $10
4.1. REFINEMENTS OF THE KEYNESIAN MODEL

per hour, a nominal money stock of $100 would represent a real money stock of 10 labour-hours. The LM curve would remain the same except that the constant underlying it is now $M/W$ instead of $M/P$ and its slope would be steeper. None of the conclusions reached earlier change.

A final refinement of the Keynesian model is the modification of the consumption and investment functions to let consumption be a function of the interest rate as well as the level of income and investment be a function of the level of income as well as the interest rate. In the case of investment, it will be recalled that the II curve in Figure 3.2 represented a ranking of projects by the interest rate at which their present values would become positive and at which they would therefore be undertaken. Since the production function $Y = F(N)$ has a constant capital stock embedded in it, the marginal product of capital will increase when the quantity of labour employed increases relative to the quantity of capital. This increase in the marginal product of capital as employment and output increase results in higher earnings on all investment projects in the economy. An increase in the level of income will thus cause the II curve to shift upward in Figure 4.4 and the investment function must be rewritten

$$I = I(r, Y)$$

where the partial derivative of $I(\ )$ with respect to $r$ is negative and the partial derivative with respect to $Y$ is positive.

The consumption function must be modified to take into account the fact that the fraction of income consumed may change as a result of a change in the interest rate. There are two influences of the interest rate on consumption. On the one hand, an increase in the interest rate increases the relative cost of consuming now rather than in the future, which will cause current consumption to fall. On the other hand, the increase in the interest rate increases wealth because it increases the amount of future consumption that will be obtained from the current level of saving. To the extent that current consumption and future consumption are both normal goods, we would expect consumers to transfer some of this increase in future consumption resulting from the rise in the interest rate to the present, increasing consumption today. The net effect of the interest rate on consumption will depend upon which of these effects dominates.

This argument can be presented more rigorously with reference to Figure 4.5. The individual consumer’s income and consumption in year 0 are shown along the horizontal axis while her income and consumption in year 1 are shown along the vertical axis. Suppose that she receives the incomes $Y_0$ and
Figure 4.4: The Investment Function Responding to and Increase in Income

$Y_1$ in the two years. The maximum that could be consumed in year 0 (leaving nothing for consumption in year 1) is given by $m_0$ and the maximum that can be consumed in year 1 if nothing is consumed in year 0 is $m_1$. These quantities are given by

$$m_0 = Y_0 + \frac{Y_1}{1 + r}$$  \hspace{1cm} (4.7)$$

and

$$m_1 = (1 + r)Y_0 + Y_1$$  \hspace{1cm} (4.8)$$

Given the rate of interest, the consumer can allocate her consumption intertemporally along the straight line joining the points $m_1$ and $m_0$. The slope of this line can be obtained by dividing (4.8) by (4.7) to yield $-(1+r)$. The negative sign is added because the slope is obviously negative. Given the budget constraint, the consumer will choose that allocation of her income to consumption in the two years that maximizes her utility, putting her on the highest possible indifference curve. This occurs at point $a$ in Figure 4.5.

Now suppose that the rate of interest rises. This will increase the slope of the budget constraint, rotating it around its position at point $b$. At point
Figure 4.5: The Consumption-Saving Decision in Response to Interest Rate Changes.

$b$ the consumer would be consuming each year’s income as it is received so that neither borrowing nor lending would be taking place. That point on the budget constraint is thus unaffected by changes in the rate of interest. It can be immediately seen from the diagram that the consumer’s new equilibrium will be a some point such as $d$ where an indifference curve is tangent to the new budget constraint. The movement from point $a$ to point $d$ can be broken down into two parts. First, there is the movement from $a$ to $c$ that would occur if the consumer were held on her original indifference curve in the face of the rise in the interest rate. This movement is the substitution effect that results from the shift in the relative ‘price’ of future consumption in terms of current consumption with wealth held constant. Second there is the movement from point $c$ to point $d$ that occurs as a result of the fact that the rise in the interest rate puts the consumer on a higher indifference curve, increasing her wealth. This wealth effect leads the consumer to consume more in year 0 as long as present consumption is not an inferior good. The diagram is drawn so that the net effect of the wealth and substitution effect is to increase both current and future consumption—the point $d$ is slightly to the right of point $a$. A bit of experimentation will make it obvious, however, that this condition depends on the particular assumption made about the
position and convexity of the new indifference curve the consumer ends up being on. Since we can say little about the shape of the indifference curves, we cannot rule out either an increase or decrease in current consumption in response to a rise in the interest rate.

In any event, equation (3.2) must be written as

\[ C = C(Y - T, r) \] (4.9)

where the partial derivative of \( C(\ldots) \) with respect to \( Y - T = Y_d \) is positive and the partial derivative with respect to \( r \) is either positive or negative.

With these modifications, the equation of the IS curve becomes

\[ Y = C(Y - T, r) + I(r, Y) + G_0. \] (4.10)

The slope of this curve

\[ \frac{1 - \partial C/\partial Y_d - \partial I/\partial Y}{\partial C/\partial r + \partial I/\partial r} \]

is negative. The IS curve remains negatively sloped and shifts to the right with increases in government expenditure and cuts in taxes.

These refinements leave the policy implications of the model unchanged. While the early radical conclusion that there is no natural tendency of the economy to gravitate to full employment is unjustified, the Keynesian analysis contributed in an important way to our knowledge of macroeconomics. First, to the extent that wages are inflexible downward (and upward as well) in the short run, the model provides us with a vehicle for analyzing the effects on output, employment, and interest rates of a variety of exogenous influences including the policies of the government.

Second, the Keynesian analysis brought out implications of government tax and expenditure policies for output and price level determination that

\[ dY = \frac{1}{1 - \partial C/\partial Y_d - \partial I/\partial Y} \left[ (\frac{\partial C}{\partial r} + \frac{\partial I}{\partial r}) \frac{dr}{dr} - \frac{\partial C}{\partial Y_d} dT + dG_0 \right] \]

The slope is the ratio \( dr/dY \). Stability of the model requires that \((1 - \partial C/\partial Y_d - \partial I/\partial Y)\) be positive. The combined terms \((\partial C/\partial Y_d + \partial I/\partial Y)\) are defined as the marginal propensity to spend, the sum of the marginal propensity to consume and the marginal propensity to invest. \( \partial I/\partial r \) is clearly negative, but there is ambiguity about the sign of \( \partial C/\partial r \). Nevertheless, economists usually assume that \( \partial C/\partial r \) will never be large enough if it is positive to offset \( \partial I/\partial r \) so the overall expression \((\partial C/\partial r + \partial I/\partial r)\) is always negative.

\[ 5 \text{The slope is obtained from the total derivative of (4.10) which can be expressed} \]

\[ dY = \frac{1}{1 - \partial C/\partial Y_d - \partial I/\partial Y} \left[ (\frac{\partial C}{\partial r} + \frac{\partial I}{\partial r}) \frac{dr}{dr} - \frac{\partial C}{\partial Y_d} dT + dG_0 \right] \]
were not present in the simplistic classical formulation. In the crude classical model, the composition of aggregate expenditure—i.e., its division between consumption, investment and government demand—had no effect on the level of aggregate demand and prices. Exogenous shifts in consumption and investment resulted in changes in the interest rate but the interest rate had no effect on the quantity of money demanded. As a result, the aggregate demand curve of Figure 2.3 remained unchanged. If one were to impose on the crude Keynesian model the classical assumption that desired money holdings are a rigid proportion of current income—i.e., that the income velocity of money is constant—the LM curve becomes vertical as shown in Figure 4.6. Since changes in the interest rate have no effect on desired money holdings, a specific real income is necessary to get the public to hold each particular real stock of money. The partial derivatives of the real money stock with respect to the interest rate become zero in equations (4.2) and (4.5) and the partial derivatives with respect to output become equal to $k$ or $1/V$. We can replace equation (4.2) with

$$\frac{M}{P} = kY \quad (4.11)$$

or, if we wish to express the money stock in labour rather than output units, with

$$\frac{M}{W} = \frac{kY}{G(Y)}. \quad (4.12)$$

When the Keynesian model is modified in this fashion, monetary policy continues to work in the same way—an increase in the nominal money stock shifts the LM curve to the right, lowering the interest rate and increasing the level of income and employment. But an upward shift of the IS curve resulting from a cut in taxes or an increase in the level of government expenditure only raises the interest rate—the intersection of IS and LM can not move to the right because LM is vertical. Since a fall in the money wage rate increases the real money stock and shifts LM to the right, the economy has a natural tendency to go to full employment as long as wage rates respond to excess supply in the labour market. One can thus view the second Keynesian assumption as the introduction of demand for money postulates that made the LM curve positively sloped.
4.2 Modification of the Classical Model

Without modification to allow for wage and price rigidity, the classical model is represented by the money market equilibrium equation (4.11) together with the full-employment aggregate supply equation

\[ Y = Y_f, \]  

(4.13)

The former, which can alternatively be expressed as

\[ P = \frac{M}{kY}, \]  

(4.14)

appears as the aggregate demand curve AD in Figure 2.3, while the latter appears as the vertical aggregate supply curve AS. These curves are also shown in Figure 4.7. The aggregate demand curve is negatively sloped because a rise in the level of real income, holding the nominal money supply and \( k \) constant, will reduce the price level at which the public will hold the existing money stock, and at which there will consequently be no excess demand or supply of domestic output. The curve AD shifts upward to the right in response to an increase in the stock of money or a reduction in \( k \).

At increased levels of \( M \) or reduced levels of \( k \) the public will try to use its
excess money holdings to purchase goods. A rise in the price level will be required to induce them not to do this.

Figure 4.7: Aggregate Demand and Keynesian and Full-Employment Aggregate Supply Curves

Responsiveness of desired money holdings to interest rates can be introduced into the classical theory simply by expressing $k$, the desired ratio of money to income, as a function of the rate of interest. Since classical models admit the possibility of inflation, an appropriate synthetic model must recognize that it is the nominal and not the real interest rate that represents the cost of holding money. In addition, there is no reason to assume that $k$ is constant with respect to $Y$. Expressing $k$ as a function of both $Y$ and the nominal interest rate we obtain, using equation (1.3), the following demand function for money.

$$\frac{M}{P} = k(r + E_p, Y) Y = L(r + E_p, Y). \quad (4.15)$$

A rise in the rate of interest arising from, say, a shift in the investment function, a cut in taxes, an increase in government expenditure or an increase in the expected rate of inflation, will now reduce desired money holdings and shift the AD curve upward to the right.
As was noted in Chapter 2, the classical model can also be easily modified to introduce money wage rigidity. Equation (4.4) is derived from the classical production relationships. If we fix $W$ in that equation, it gives a positive relationship between $Y$ and $P$. As $P$ rises, the real wage rate falls, inducing firms to hire more labour and leading to an increase in employment. When the money wage is fixed, therefore, equation (4.4) becomes the aggregate supply curve instead of (4.13). Shifts in the AD curve arising from changes in the nominal money stock, in the demand for money, or in taxes or government expenditure (in the case where the aggregate demand curve is represented by (4.15)) now lead to changes in the level of employment just as in the Keynesian model.

This refined version of the classical model is portrayed in Figure 4.7. The curve KAS, representing equation (4.4) can be referred to as the Keynesian aggregate supply curve since it gives the relationship between the price level and the level of output produced under the Keynesian assumption that the money wage rate is fixed. Shifts in the aggregate demand curve arising from monetary or fiscal policy or other exogenous forces now lead to changes in output and employment as the intersection of AD and KAS moves along the curve KAS. In the classical case where money wages are flexible, $W$ adjusts so that the Keynesian aggregate supply curve always intersects AS at the point where AD intersects AS.

### 4.3 The Synthesized Model

It is obvious that the crude Keynesian and classical models are two special cases of a more general model. The issue is not whether a person is Keynesian or classical, but what one believes about the structure of the economy. The synthesized model contains equations (4.10), (4.2), and (4.4) which are relisted here for convenience.

$$\begin{align*}
Y &= C(Y - T, r) + I(r, Y) + G_0 \\
\frac{M}{P} &= L(r + E_p, Y) \\
P &= \frac{W}{G(Y)}
\end{align*}$$

Equation (4.13), also repeated below, must be added as a long-run condition to incorporate eventual wage flexibility in response to market forces.

$$Y = Y_f$$

(4.13)
4.3. **THE SYNTHESIZED MODEL**

When wages are fixed, the top three equations solve for \( r \), \( Y \), and \( P \). In classroom analysis, equation (4.4) is often replaced with the simple price level constraint

\[
P = \bar{P}.
\]

Equation (4.10) is the IS curve. It gives the combinations of the interest rate and income for which the quantity of output produced in the economy equals the quantity demanded. It is negatively sloped because a fall in the rate of interest increases the sum of consumption and investment, leading to an increase in both the demand for output and the level of output that will satisfy that demand. An increase in the government budget deficit or in the level of real government expenditure increases the equilibrium level of output at each interest rate, shifting the IS curve to the right.

Equation (4.2) is the demand function for money which in combination with either equation (4.4) or equation (4.16) gives the equation of the LM curve. When (4.16) is substituted, and the price level is thereby treated as rigidly fixed, we obtain a version of the LM curve that has the real money stock, measured in output units, as an exogenous determinant. This curve gives the combinations of income and the interest rate for which the demand for real money balances equals the supply. It is positively sloped because a rise in income increases the demand for real balances, requiring an increase in the interest rate to choke off that increase in demand and leave the community satisfied with the existing real money stock. An increase in the nominal money supply or a decline in the price level increases the real money supply, requiring either an increase in the level of income or a decrease in the interest rate to get the public to absorb the additional real money holdings—the LM curve thus shifts to the right. Similarly, an increase in the demand for real money balances requires a rise in the interest rate or a fall income to limit the public’s quantity demanded to the existing stock in the face of the shift in preferences—LM shifts to the left.

When equation (4.4) is substituted into the demand function for money we obtain an LM curve that has the real money stock, measured in labour units as the underlying shift variable. Equation (4.4) gives the effects of output and the money wage rate on the price level. An increase in the level of output, holding the money wage rate constant, involves an increase in the employment of labour on the fixed capital stock and leads to diminishing returns to labour and an increase in the costs to firms of producing output. These increased costs are passed on in the form of an increase in product prices and, hence, in the price level. An increase in the money wage rate,
CHAPTER 4. THE KEYNESIAN-CLASSICAL SYNTHESIS

holding output constant, is directly and proportionally passed on in the form of an increase in the price level. When this equation is substituted into (4.2) the variable $P$ is eliminated and replaced by $W/G(Y)$. The ratio $L(r, Y)/G(Y)$ can then be expressed as a consolidated function of $r$ and $Y$, and the demand for money in labour units expressed as a function of the interest rate and the level of income. This gives a version of the LM curve with the same properties as the previous version except that it is steeper.

Under less-than-full-employment conditions, downward wage flexibility in the long-run and the associated downward flexibility of prices will shift the LM curve to the right until it intersects the IS curve at the point where the latter crosses the vertical full-employment line at $Y_f$. When wages are too high and do not fall in response to market forces, prices will also be too high and the LM curve will cross the IS curve at a level of output below full-employment.

It has already been noted that the Keynesian model yields the standard classical conclusions when we replace the demand function for money with the classical version that has individuals desiring to hold a constant ratio of money to income and we assume that wages and prices are flexible. This converts the LM curve into a vertical line which shifts in response to adjustments of wages and prices until it lies on top of the full-employment line projected upwards at $Y_f$. Under these extreme classical assumptions the IS-LM graphical approach is of little use because the main variable that is solved for—the level of prices—does not appear on either axis, and the real income variable on the horizontal axis takes a fixed value. When the more plausible demand function form money (4.2) is used, and the LM curve is therefore upward sloping, the IS-LM graphing is useful, even under full employment conditions, because it is the best way of visualizing the effects of fiscal policy on interest rates.

The aggregate demand and supply graphing, illustrated by Figure 4.7, is the most useful way of visualizing price level determination under extreme classical assumptions. The exogenous forces driving the model are changes in the nominal money supply, shifts in the demand for money and changes in the full-employment level of output and income as a result of shifts in the public’s choice between work and leisure. Changes in the level of prices can be read off the vertical axis.\(^6\)

---

\(^6\)One has to be careful using the IS-LM graphing to analyze the effects of technological change. The reason is that most changes in technology affect the IS curve as well as shift the full-employment level of output to the right—there is no reason to believe that the interest rate will fall. The conclusion that would result from the AD-AS graphing, that a technological improvement will increase output and cause the price level to fall, assuming
4.3. THE SYNTHESIZED MODEL

The implications of wage rigidity can also be neatly visualized on an AD-AS graph. The level of aggregate output is positively related to the price level in equation (4.4) as portrayed by the KAS curve. Less-than-full-employment results whenever the AD curve crosses the fixed-wage aggregate supply curve KAS curve at a level of output below \( Y_f \). An increase in the demand for money or a reduction in the money supply will shift the AD curve to the left, reducing both the price level and the level of employment. An exactly equal fall in output will occur on the corresponding IS-LM graph as a result of the leftward shift of LM.

The increase in the demand for money or reduction in the money supply just noted leads to a rise in the rate of interest in the IS-LM graph but this interest rate change does not appear on the corresponding AD-AS graph. At the same time, the fall in the price level is behind the scenes in the IS-LM graph (where the demand for money is expressed in labour units) but can be read directly off the equivalent AD-AS graph.

Each of the two graphical representations gives a different perspective on what is happening. Which framework to use depends on whether one is analyzing the price level or interest rate effects of exogenous changes. In the IS-LM presentation, the two equations (4.10) and (4.2) appear on the graph with equation (4.4) buried from sight by substitution into (4.2). In the AD-AS representation, equations (4.2) and (4.4) appear on the graph as the curves AD and KAS, respectively, with equation (4.10) buried by substitution into equation (4.4). In making that substitution, we note that equation (4.10) can be rearranged to yield an equivalent equation of the form

\[
r = E(Y - T, G)
\]

(4.17)

which, when substituted into equation (4.10) yields

\[
P = \frac{M}{L(E(Y - T, G) + E_p, Y)}
\]

(4.18)

which is the equation of the AD curve. Since this equation is the solution of the IS and LM equations, the AD curve traces out all the alternative combinations of \( P \) and \( Y \) for which the IS and LM curves intersect, holding the nominal money supply, the expected inflation rate, government expenditure that the nominal money supply remains constant, is generally correct but we have to recognize that technological improvements may also shift the demand function for money. For these reasons, the entire analysis in this book assumes that the level technology is constant—to analyze economic growth problems we need different tools.
and taxes constant. The equilibrium $P$ and $Y$ occur at the intersection of AD with the fixed wage aggregate supply curve KAS.

It is clear that a fiscal expansion will require an increase in the interest rate to preserve the equality of the two sides of equation (4.10) at each level of income—a rise in government expenditure or a cut in taxes increases the right side of the equation, making it necessary for $r$ to rise to choke off an equivalent amount of consumption and investment. This means that $\partial E/\partial G$ and $\partial E/\partial (Y-T)$ are both positive. Since the rise in the interest rate reduces the quantity of money demanded—i.e., $\partial L/\partial E$ is negative—the denominator of equation (4.18) will fall as $G$ rises and $T$ falls, and the AD curve will shift upward. Fiscal expansion thus leads to an increase in output and prices. The same output expansion can be seen on the corresponding IS-LM graph where increases in $G$ and reductions in $T$ shift the IS curve to the right. The rise in the interest rate is clearly evident in this graphical presentation whereas the rise in the price level is buried in the slope of the LM curve. In the AD-AS graphing, the rise in the price level is clearly shown with the increase in the interest rate buried in the slope of the AD curve.

When wages are flexible in response to labour market forces, the fixed wage or Keynesian aggregate supply curve KAS shifts up and down with increases and decreases in the money wage rate so as to always intersect the aggregate demand curve AD along the full-employment aggregate supply curve AS. Thus, for example, if the level of output is $Y_0$ in Figure 4.7, so that unemployment exists, the excess supply in the labour market will result in a fall in the money wage rate, causing KAS to shift downward to pass through the point $a$. 
4.3. THE SYNTHESIZED MODEL

Exercises

1. A school teacher earns $1000 per month, each month of the year. As soon as her income is received each month she goes to the bank and cashes her paycheck, pays her rent of $350 and puts $50 into an RRSP. The remainder she keeps on hand as cash, spending it evenly over the month.

   a) How much money (i.e., cash) does she hold on the first day of the month after paying her rent and purchasing her RRSP but before making any expenditures? On the last day of the month after making that day’s expenditures? On average during the month? What would be a reasonable estimate of her demand for money? Of her propensity to hold money (i.e., her level of $k$)?

   b) Now suppose that the teacher has the opportunity of putting money into an non-chequable savings account at the beginning of the month and then making an extra trip to the bank at the middle of the month to draw it out in anticipation of her daily expenditures during the latter half of the month. Suppose that she earns 1% per month (12% per year) on her savings account. Suppose further that it costs her 24 cents to make the extra trip to the bank. How much does she gain by doing this? What will be her demand for money and propensity to hold money now?

   c) If we now assume that the teacher can make as many trips to the bank as she wants, at a cost of 24 cents per trip, what will be the optimum number of trips? The optimum demand for money? The optimum propensity to hold money?

   d) Suppose now that the interest rate falls to $\frac{1}{2}$% per month. What will be the optimum number of trips to the bank now? Her demand for money? Her propensity to hold money?

   e) What does this example suggest about the relationship between the quantity of money demanded and the rate of interest, holding the level of income constant? Why does this relationship arise?

   f) Now suppose that the teacher gets promoted to Head of Department and receives a pay raise to $1500 per month. Suppose now that she decides to put $150 per month into an RRSP and gets a better apartment costing $450 per month. What now will be her demand for money when the interest rate is 1% per month? When it is $\frac{1}{2}$% per month? What does this suggest about the effect of a change in income on the demand for money, holding the interest rate constant? Why does this effect occur?
2. Suppose that the economy is characterized by the following behavioral relationships and parameters:

\[ C = .1 + .8(Y - T) \quad \text{consumption function} \]

\[ I = .8 - .04r \quad \text{investment function} \]

\[ M = P (.3Y + .04r) \quad \text{demand function for money} \]

\[ Y = \sqrt{N} \quad \text{short-run aggregate production function} \]

\[ N = 128W/P \quad \text{labour supply function} \]

Output is measured in billions of dollars, the money supply in tens of millions of dollars, the interest rate in percent, the quantity of labour in billions of hours, wages in dollars per hour and prices in dollars per unit of output. (These units of measurement have no bearing on the calculations required below—they merely make the resulting numbers look ‘realistic’.)

a) Derive the equations for and graph appropriately the following:

1) The IS curve.

2) The Keynesian fixed wage aggregate supply curve.

3) The full employment aggregate supply curve.

4) The LM curve when the real money supply is measured in output units.

5) The LM curve when the real money supply is measured in labour units.

6) The aggregate demand curve.

b) How does the LM curve derived in 5) above compare with the one derived in 4)?

c) Assume the following values for the exogenous variables:

\[ T = .5 \quad \text{taxes} \]

\[ G = .5 \quad \text{government spending} \]

\[ M = 1 \quad \text{money supply} \]
Calculate the following:

1) The full-employment equilibrium values of the endogenous variables.

2) The values of the endogenous variables when \( M \) is decreased to .9 and \( W \) remains fixed at its level in 1).

3) The values of the endogenous variables when \( T \) is increased to .55 and \( W \) remains fixed at its level in 1) above.

4) The values of the endogenous variables when \( M \) is decreased to .9 and \( W \) is determined by forces in the labour market.

5) The values of the endogenous variables when \( T \) is increased to .55 and \( W \) is determined by forces in the labour market.

3. True or False: Explain your answer briefly.

a) The labour market must be in equilibrium if aggregate demand is to equal aggregate supply.

b) Minimum wages are good because they raise the average level of wages in the economy.

c) Trade unions create unemployment in the economy by imposing minimum wages.

d) The Keynesian aggregate supply curve slopes upward because labour and capital are not perfect substitutes in production and the real rental rates on capital are perfectly responsive to market forces.

e) Investment is positively affected by income because the marginal product of capital declines as the economy expands.

f) the LM curve gives the combinations of income and the rate of interest for which the asset markets are in equilibrium.

g) If the demand and supply of money are equal, the markets for securities are also in equilibrium.

h) Under full-employment conditions, one does not need the LM curve to determine the real rate of interest.

i) An increase in the money supply causes the real interest rate to fall under less-than-full-employment conditions while an expansion of government expenditure or a cut in taxes causes it to increase.
4. Using the standard IS-LM framework, analyze step by step the effects on output and employment and prices of
a) an increase in the money supply.
b) an increase in the demand for money.
c) a cut in taxes.
d) an increase in government expenditure.
e) an economy-wide increase in the money wage rate brought about by union activity.

Use, alternatively, both Keynesian and classical assumptions about the functioning of the labour market—assume that the former apply to the short run and the latter to the long-run.

5. Set up the two graphical representations of the synthesized model of the economy developed in this chapter.

A: The aggregate demand and supply representation, portrayed with output on the horizontal axis and the price level on the vertical one.

B: The IS-LM representation, portrayed with output on the horizontal axis and the real interest rate on the vertical one.

Show with a graphic demonstration, accompanied by appropriate explanation, that the two representations give exactly the same answers with regard to the effects of the following exogenous stimuli:

1) A shift in the demand function for money.

2) A legally imposed increase in the level of real wages in the whole economy.

3) An increase in government expenditure.
Chapter 5

Some Early Monetary Policy Controversies

Because the traditional classical model assumed continuous full employment, the only role for monetary policy was to determine the price level. Sophisticated classical economists, however, such as Ralph Hawtrey and Keynes himself in his pre-general theory days,\(^1\) were well aware of the existence of unemployment and strikingly perceptive by modern standards in their analysis of it. With the publication of the *General Theory* and the subsequent Keynesian revolution, monetary policy took a back seat to fiscal policy. Until the mid-1950s it was generally believed that monetary policy had been expansionary but ineffective in the depression of the 1930s. The reasoning behind this was that interest rates were kept close to zero but the Great Depression continued unabated.

5.0.1 Interest Rate vs. Money Supply Targeting

The first post-war challenge to the Keynesian orthodoxy was the debate, initiated largely by Milton Friedman, as to whether interest rates should be used to determine if monetary policy is expansionary or contractionary, and whether the widely held view that monetary policy was expansionary but unsuccessful in the Great Depression was correct.\(^2\) This debate was limited

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\(^2\)Discussion of these issues was intertwined with controversy over the relative merits of monetary as compared to fiscal policy. A good discussion of the details of Friedman’s position and the flavour of these controversies during the period over the conduct of monetary policy and the effectiveness of monetary as compared to fiscal policy can be found in

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to the effects of unanticipated movements in the nominal money supply. No distinction was made between nominal and real interest rates, as was appropriate in so far as actual and expected inflation was extremely low in the 1950s and 1960s.

![Figure 5.1: Interest Rate vs. Money Supply Targeting](image)

Friedman argued that the appropriate measure of whether money is tight or easy is the nominal money supply and not interest rates. The basis for his argument can be seen with reference to Figure 5.1. Suppose that expectations about the future profitability of investment turn sour. Investment will decline exogenously and the IS curve will shift leftward to IS'. The real interest rate will decline to \( r_1 \) and output will fall below its full-employment level. When the expected rate of inflation is zero, market interest rates will fall in line with the real interest rate. If the monetary authority is using interest rates to judge whether monetary policy is tight or easy, it will be tempted to conclude that its policy is expansionary—after all, the interest rate has fallen! The interest rate \( r_1 \) is too high, however, and monetary policy is too tight. To achieve full employment, the money supply must be

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expanded sufficiently to shift the LM curve to $LM'$ and drive the interest rate all the way down to $r_2$. Had the authorities looked at the money supply instead of the interest rate, they would have realized that no increase in the money supply had occurred as the interest rate fell to $r_1$. Easy money implies an increase in the money supply—a fall in the interest rate does not necessarily imply that the money supply has increased.

But interest rates would be a better indicator of monetary tightness or ease than the nominal money supply if the exogenous shock to the economy was a shift of the demand function for money rather than a shift in the investment function. Suppose in Figure 5 that the initial equilibrium is at $r_2$ and $Y_f$ and that the demand for money increases, shifting the LM curve from $LM'$ to $LM$. The interest rate rises to $r_1$, reducing the levels of output and employment. If the authorities conclude from the high level of interest rates that money is too tight, they will be correct. If they look at the money supply they will conclude that monetary policy has not changed. In this case, stabilization of the interest rate will stabilize employment while stabilization of the money supply will not. It can be argued, however, that even in this case the authorities can usefully focus on the money supply—whenever there is less than full employment the money supply is too low and whenever there is inflation the money supply is too high. The money supply should be increased or reduced accordingly, regardless of what is happening to interest rates. Unfortunately, this argument is weakened by the fact that, in the real world, money supply changes (and interest changes as well) affect employment and output with a lag. By the time unemployment is observed, money will have been too tight for several months, and it will take several more months for an easing of monetary policy to have its effect on the unemployment rate.

The case for using the money supply rather than market interest rates as an indicator of monetary tightness or ease is strengthened when the expected inflation rate is not zero. The observed market interest rate is the nominal interest rate, which equals the real rate plus the expected rate of inflation. Higher nominal interest rates need not signify higher real rates because the expected inflation rate may have risen. And it is the real interest rate that affects consumption and investment. Thus in the midst of continuing inflation the authorities could be led to conclude from increasingly higher market interest rates that monetary policy is becoming increasingly tight, when the higher interest rates in fact indicate that the public is expecting greater and greater inflation on account of increasingly high rates of nominal money growth. Correct monetary policy in this case requires keeping careful track of the rate of expansion of the nominal money supply.
To bolster his views about the importance of controlling the nominal money supply and not becoming distracted by changes in market interest rates, Friedman examined money growth in the 1930s and found that the nominal money supply in the United States fell by around one-third between 1929 and 1933. Since the price level was also falling, and it is therefore reasonable to assume that expected inflation rates during the period were negative, nominal interest rates of nearly zero were consistent with substantially higher real rates. Monetary policy was tight, not easy, in the Great Depression. In fact, Friedman argued, and his argument is now widely accepted, that the main reason for the severity of the Great Depression in the U.S. was the enormous decline in the U.S. money supply resulting from bank failures, with the latter exacerbated by a failure of the Federal Reserve System to act appropriately as a lender of last resort.

As can be seen from Figure 5.1, the question of whether the money supply or interest rates give a better indication of whether money is tight or easy hinges on how stable the demand for money is in relation to other factors affecting interest rates. Friedman and his followers argued that the demand for money is a stable function of a limited number of variables—specifically, nominal interest rates, real income and possibly some measure of wealth. Friedman’s detractors argued that the demand function for money is highly unstable. In the highly stable monetary environment of the 1950s and early 1960s, when actual and expected inflation rates varied within a narrow range, it may have been arguable that the demand function for money was more variable than the factors determining full-employment real interest rates. From the late 1960s until the late 1980s, however, the inflation rate became high in some years and variable, with nominal interest rates following suit. The expected inflation component of observed market interest rates, and the underlying contracted real interest rates, became increasingly difficult to estimate. It was perhaps this march of events, rather than the force of Friedman’s argument, that convinced the economics profession that Friedman was right.

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4This is not to suggest that bank failures caused the Great Depression. It is agreed that in their absence a major recession would still have occurred. Opinions differ as to the cause of that recession.
5.0.2 Rules vs. Discretion

While the controversy about whether the nominal money supply or interest rates are the best indicator of the stance of monetary policy was in full swing, a second debate about how monetary policy should be conducted began, also primarily at the instigation of Milton Friedman. This came to be known as the rules vs. discretion debate.

The Keynesians and early neo-Keynesians advocated a continual adjustment of the money supply and interest rates to maintain the economy continuously at full employment. In terms of Figure 5.1, this implied that forecasts of the real interest rate at which the IS curve crosses the full-employment line were to be made and the nominal money supply adjusted continuously to drive the LM curve to where it crosses the IS curve at this full-employment point. There is a tradition in monetary policy going back many decades according to which the full-employment real interest rate, where the IS curve crosses the full-employment line, is called the natural rate of interest, while the actual real rate of interest is called the market rate of interest. The traditional goal of monetary policy has been to continually drive the market rate of interest into equality with the natural rate of interest while at the same time maintaining a stable price level. If the authorities are doing a good job of accomplishing this, the nominal money supply will tend to expand in recessions and contract in boom periods.

In contrast, Friedman’s empirical work led him to conclude that the money supply tended to move pro-cyclically, increasing relative to its trend in booms and declining relative to its trend in recessions. This suggests that the actions of the authorities might have been accentuating the cyclical movements in economic activity rather than moderating them. In addition, Friedman uncovered evidence suggesting that money growth affects economic activity with a long and variable lag.

The problem is the inability of the authorities to forecast economic activity far enough ahead to be able to implement monetary policy appropriately. As Allan Metzler pointed out, “neither the Federal Reserve staff nor private forecasters, using the techniques currently available, has been able to forecast, on average, whether the economy will be in boom or recession one or four quarters ahead. In fact, since currently observed data are often three months old, because it took three months to collect them, forecasters have a difficult time determining whether or not the economy is currently in recession or boom! Thus the economy is into the next recession or boom before

CHAPTER 5. MONETARY POLICY CONTROVERSIES

the authorities know it. Given the lag between an increase in the nominal money supply and its effect on economic activity, it is virtually impossible to produce a countercyclical pattern of monetary growth.

Friedman argued that the role of the monetary authority should be to create a stable rate of monetary growth. Attempts to exercise discretion—that is, to adjust money growth to offset current movements in economic activity—are doomed to failure because by the time a specific policy action to cure a recession takes effect the economy is moving out of the recession and into the next expansion. As a result, the authorities tend to increase rather than reduce the cyclical variability of the economy.

There are two problems with the constant money growth rule argument. First, the money supply can be defined in different ways as follows:

- \( H \) — base money (currency held by the public and reserves held by banks)
- \( M_1 \) — currency held by the public plus demand deposits
- \( M_2 \) — \( M_1 \) plus time deposits

The ratios of \( M_1 \) and \( M_2 \) to \( H \), known as the money multipliers, can be obtained by taking the ratio of the monetary aggregate to base money, with each aggregate broken into its components

\[
\frac{M_1}{H} = \frac{CP + DD}{CP + BR} = \frac{c + d}{c + f} \tag{5.1}
\]
\[
\frac{M_2}{H} = \frac{CP + DD + TD}{CP + BR} = \frac{c + 1}{c + f} \tag{5.2}
\]

where \( CP \) is currency in the hands of the public, \( DD \) is demand deposits, \( TD \) is time deposits, \( BR \) is bank reserves, and

\[
c = \frac{CP}{DD + TD}
\]
\[
d = \frac{DD}{DD + TD}
\]
\[
f = \frac{BR}{DD + TD}.
\]

These different monetary aggregates often behave differently through time, the growth rates of some increasing while the growth rates of others are decreasing. It is not clear which aggregate the authorities should stabilize.

The second problem is the difficulty of dealing with changes in the rates of growth of the ratio of desired money holdings to income. An upward
trend in desired money holdings relative to real income (downward trend in income velocity) for a number of periods will impose a deflationary price-level trend, while a downward trend in the desired money to income ratio will lead to an inflationary trend. Should the authorities change the money growth rule when trends in velocity change? How long must a downward or upward movement in velocity persist before it should be viewed as a trend? Frequent adjustments to accommodate short-term changes in velocity involve discretionary policy little different from the activist policies Friedman was criticizing, and suffer from the same forecasting problems.

The inflationary experiences of the 1970s led the Federal Reserve Bank, and the central banks of other countries as well, to adopt stable though not rigidly constant rates of monetary growth as an objective of policy. While announced monetary targets exhibited stability, however, the actual realized money growth rates were, as Meltzer notes, no more stable than they had been previously.\(^6\)

The inability or unwillingness of monetary authorities to stabilize money growth while at the same time paying homage to monetary rules has led some to argue that the right to exercise discretion should be taken away from them and a particular money growth rate enshrined in the constitution. A monetary aggregate would be chosen and the authorities legally bound to increase it at a constitutionally specified rate. Critics argue that this will subject the economy to future swings in prices resulting from the effects of technological change on real interest rates and on the transactions returns from holding money as well as from shifts in the desired mix of various short-term and long-term assets in portfolios. Proponents argue that market forces, working in a stable environment, will adapt to these exogenous changes in such a way that the risks to individuals from holding various assets will be appropriately incorporated in market interest rates and unemployment will be minimized by full use of all available information by wage and price setters. Since the authorities have no information beyond what is available to the private sector, and should they acquire such information they can make it available at no charge, there is nothing the authorities can do to improve things—discretionary intervention merely increases the variance of aggregate demand. A negative rate of inflation, should one occur, is claimed to present no problem as long as everyone knows that irreversible market forces rather than temporary and potentially reversible errors in monetary policy are causing it—wages and prices will simply be adjusted to take it into account.

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\(^6\)See Meltzer, *op. cit.*
Since a constant money growth rule has never been adopted in the past, there is no historical evidence to bring to bear in settling this debate. Both sides are forced to argue on the basis of predictions about how the economy will function under a set of institutions and forces that have never been experienced.
Exercises

1. True or false: Explain your answer briefly.

   a) Monetary policy was expansionary but unsuccessful in the Great Depression.

   b) Neither the level of market interest rates nor the observed level of the nominal money supply give a clear indication of whether monetary policy is tight or easy.

   c) If the quantity of money demanded depends on income, market interest rates, and nothing else, and never shifts in response to changes in preferences, information, etc., then one can determine whether monetary policy is tight or easy by looking only at the nominal money stock.

   d) The basic goal of monetary policy is to keep the market rate of interest equal to the natural rate of interest—that is, to keep the LM curve stable through time.

2. Outline briefly the case for using rules rather than discretion in the exercise of monetary policy. Then outline the case for using discretion instead of rules. What information do we need to make it worthwhile to use discretion?
Chapter 6

Fiscal Policy Controversies

The Keynesian notion that the government could keep the economy at full employment by judicious manipulation of taxes and expenditure ushered in a radical change in the focus of policy discussion. That simplistic view of the government’s policy options was challenged, however, and has since been considerably eroded in debate. The major focus of the attack was on the effects of tax cuts, although the Keynesian conclusions regarding the effects of shifts in government expenditure are equally, if not more, open to dispute.

6.1 Permanent and Transitory Wealth Effects of Tax Cuts

The traditional Keynesian view of the effects of tax cuts—that a cut in taxes increases the public’s disposable income and, as a result, its consumption—must first be modified to take into account modern ideas about the nature of the consumption function. Because individuals plan ahead, and decide on their projected levels of consumption in all future years simultaneously with their consumption in the current year, consumption will depend on the entire time path of current and anticipated future income—that is on the level of wealth. We can define permanent income as the maximum constant level of consumption the individual could enjoy in perpetuity. Permanent income could thus be defined as the present value of current and future income receipts multiplied by the rate of interest. The present value of

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current and future income is a measure of the level of wealth,

\[ W = Y_0 + \frac{Y_1}{1+r} + \frac{Y_2}{(1+r)^2} + \frac{Y_3}{(1+r)^3} + \frac{Y_4}{(1+r)^4} + \ldots \quad (6.1) \]

and permanent income can be defined as the interest rate times that level of wealth

\[ Y_p = rW. \quad (6.2) \]

Since individuals will, at least at some stages of their lives, want to increase their permanent income through time, consumption will be some fraction, less than unity, of permanent income. Accordingly, an increase in current disposable income will lead to an increase in consumption only if it represents an increase in wealth and permanent income.

In this respect, one can think of three kinds of increases (or decreases) in current income. First there could be an increase in current income accompanied by the anticipation of an equally higher income level in all future years. This increase in current income reflects an equivalent increase in permanent income, and consumption in the current and all future periods will increase. Second, there could be an increase in current income that the consumer views as a random fluctuation to be offset next year or in some subsequent year by a decline current income of equal present value. In this case wealth has not increased—the increase in current income was transitory. Third, there could be an increase in current income with no anticipation that income in the next or subsequent periods will be higher or lower than if the current income change had not occurred. This can be referred to as a windfall—a one-time receipt. Current income and wealth will increase by an amount equal to the windfall but future income will remain unchanged. Permanent income will increase by the interest rate times the windfall increase in wealth—i.e., by the interest rate times the increase in current income. Of course, a windfall need not be restricted to just the current period. There may be an anticipation of higher income for the current period, next year and the year after, with income returning to its initial level in all subsequent years. In this case wealth will increase by the present value of the windfall receipts and permanent income will increase by the interest rate times that increase in wealth.

This has important implications with respect to the effects of a tax cut on current consumption. If the cut in taxes is a permanent one, expected to last forever, then disposable income will rise permanently as a result of the tax cut. If disposable income equals consumers’ actual income (which
implies that anything produced with the taxes the government is levying is worthless!) the effect will be an increase in consumption by some fraction of the tax cut, that fraction being the proportion of permanent income being consumed. A permanent tax cut of, say, $100 would increase permanent income by $100 and consumption would rise permanently by $80 where the fraction of permanent income being consumed—or the marginal propensity to consume out of permanent income—is 0.8. On the other hand, suppose that the tax reduction applies to this year only, with taxes returning to their previous level in subsequent years. In this case wealth will rise by the $100 and, given an interest rate of, say, 5% the increase in permanent income will be only $5. In this case, the resulting increase in consumption would be only $4.

The first question that must be asked when analyzing the effects on aggregate demand of a given tax cut is: For what period will taxes be lowered? It is inappropriate to routinely assume that any cut in taxes will be a permanent one.

### 6.2 Financing a Tax Cut by Printing Money

The major criticisms of Keynesian fiscal policy involve the implications of government financing of tax cuts. Since government expenditure is by assumption constant at some level, the loss of government revenues resulting from a cut in taxes must be made up in some way. There are only two ways, apart from reducing government expenditure, that the deficiency of revenues can be made up—by printing money or by borrowing from the private sector through a sale of government bonds. The government’s budget constraint can be written

\[
G = T + \frac{dM}{dt} + \frac{dB}{dT} = T + \Omega
\]  

(6.3)

where \(\Omega\), the sum of monetary and bond finance, is defined as the government’s budget deficit—the deficit of tax revenues in relation to expenditure. It follows that when taxes are reduced the government must either borrow an equivalent amount of funds from the public or print an equivalent amount of money.

Assume for the moment that the government finances the tax cut by printing money and that the public is fully aware of what is happening. Everyone knows that prices will rise in the future in proportion to the increase in the money supply so that the real value of existing money holdings
are going to be eroded by precisely the amount of the cut in taxes. Suppose, for example, that current real output is 100 units, real government expenditure is 50 units and real taxes are 50 units. Suppose further that the price level—the price of a unit of current output—is $1 and that the nominal money stock is $50. It follows that the real money stock, measured in units of output, is 50. Assume now that the government cuts taxes from 50 units to 45 units, financing its budget deficit of $5 by increasing the nominal money stock to $55. When the economy is at full employment, the price level must rise proportionally with the increase in the money stock to $1.1 per unit of output and the real money stock must remain at 50. The public has received a tax reduction of $5 from the government but is forced to spend the entire amount to acquire sufficient additional nominal money balances to maintain its real money holdings at the desired level (which has not changed because there has been no prior change in wealth or in the rate of interest). Since after reestablishing its equilibrium real money stock the public has no more funds, in real terms, than it had before the tax cut, consumption cannot increase. The government gave the public a reduction in taxes but forced it to accumulate $5 of money balances to hold its real money stock intact. These additional $5 of money holdings were given to the public in return for the same goods the government would have purchased with the revenue lost by reducing taxes. There are no effects on any real variables in the economy. In fact, the government has not really cut taxes at all. It gave the public a reduction of $5 of, say, income taxes, while at the same time reducing the real value of the nominal money stock it held before the tax cut by exactly the same amount—the public has, in effect, paid a $5 tax on its money holdings. The government has replaced a tax on income with a tax on money.

How will this change if there is less-than-full employment? Suppose for the sake of argument that the public expects the lower taxes and the resulting addition to nominal money holdings to continue every year. Suppose further that there is less-than-full employment and the price level is expected to remain constant. In continuation of the previous example, the public is now expecting to receive a cash payment of $5 in every period from now to infinity. This case payment will be treated in the same way as a $5 increase in income receipts in the current and all future years from any source. Permanent income will increase by $5 and consumption in all periods will rise accordingly.

But the increased flow of money transfers from the government cannot possibly be regarded as permanent because as the money supply expands full employment will be reached. We have already shown that tax cuts fi-
nanced by printing money have no effect under full-employment conditions. The situation can be portrayed in Figure 6.1. The economy is initially at the less-than-full-employment output $Y_0$. A cut in taxes accompanied by an increase in nominal money holdings will, we can suppose, have some immediate positive effect on permanent income—an increased real income flow will be received until full-employment is reached and wealth will therefore rise. To the extent that it does, consumption will increase at each level of the interest rate and income. So the IS curve will shift to the right to IS'. The LM curve will also shift to the right, to LM', because the stock of money has increased—this shift in the LM curve will augment the effect of the tax cut on the equilibrium level of output. Next period’s consumption will be roughly the same as this period’s because the wealth effect of the tax cut was a one-shot increase. As long as wealth remains higher by a given amount, permanent income will remain higher by a given amount. The IS curve will thus remain at IS' during next period. The LM curve, on the other hand, will shift further to the right next period because the money stock is now higher than originally by $10. In every future period until full employment is reached the LM curve will shift further to the right as the money stock grows by an additional $5. Ultimately the LM curve will arrive at the position LM'' and the economy will reach full employment.

What happens to the IS curve as full employment is reached? Recall that
IS' is to the right of IS because the public is consuming a higher fraction of its measured income as a result of the wealth effect of the temporary additions to its real money holdings. Its real money stock is increasing because nominal money holdings are increasing faster than the price level is. Once income rises close to $Y_f$ the price level will have risen to wipe out the real value of these additional money holdings and thereafter the price level will rise at the rate at which the nominal money stock is being increased. The temporary wealth effect will be fully contained in the increase in wealth that occurs as a result of the movement of the economy to full employment and the increase in output to $Y_f$. The IS curve will return to its original position. The ultimate full-employment equilibrium will thus be at point $a$.

We must conclude that even when there is less-than-full-employment, a tax cut financed by printing money will have a smaller effect on consumption than would be implied by the crude Keynesian analysis. Permanent income will clearly not increase by anything near the amount of the tax cut because any wealth effects of increases in the nominal money stock beyond those involved in the shift of measured income towards full employment must necessarily be temporary.

### 6.3 Bond Finance: Ricardian Equivalence

Alternatively, the government can cover a budget deficit by selling bonds to the private sector. In this case, it is giving the private sector both an interest earning asset and a stream of future tax liabilities required to finance the interest on it. The public is accepting government bonds in return for the funds it would otherwise have paid in taxes but is, at the same time, acquiring the obligation to pay future taxes equal to the interest it will receive on these bonds plus their eventual amortization. The present value of the current and future payment of funds to the government is the same under bond finance as under tax finance.

To see the effects of this policy more clearly, suppose that the taxpaying public is evenly divided between two types of people, A-people and B-people, both of which receive a $100 tax reduction per person. The B-people, it will be assumed, take advantage of the government’s offer of new bonds by purchasing $200 worth per person, while the A-people purchase no bonds. Suppose that the bonds pay interest at 10% percent per annum. Then in all future years the government will have to levy an additional tax of $10 per person on both the A- and B-people to cover the interest on the bonds. The B-people will receive this interest, amounting to $20 per person. The
government has, in effect, arranged $100 loans from the B-people to the A-people. The community as a whole has paid the government $100 per capita for bonds in lieu of paying the $100 in taxes. Every year it receives $10 interest per capita on the bonds and pays $10 per capita in additional taxes to cover that interest. Clearly, people are on average no better off than if they had paid the taxes in the first place. All that has happened is that the A-people have been allowed to defer $100 in taxes in return for paying $10 interest per year to the B-people.

This is as one might expect—as long as government expenditure is the same, the government is taking the same amount of real resources from the private sector whether the funds are acquired by taxes or bond sales. To the extent that consumers’ wealth is unaffected, it is realistic to assume that their current and future consumption will be unaffected. There thus appears to be no basis for assuming that a tax cut will cause consumption to increase.

The notion that it makes no difference whether government expenditure is financed by bonds or taxes is known as Ricardian equivalence. If it holds, and if the inflationary effects of monetary finance are fully anticipated, $T$ does not belong in the consumption function—a cut in taxes will not shift the IS curve to the right, and Keynesian tax policy will be impotent.\(^2\)

### 6.4 Intergenerational Transfers

A number of arguments have been raised to show that Ricardian Equivalence does not in fact hold. First, it has been argued that future taxes will in considerable part be paid by future generations, while the tax cut increases the spending power of the current generation. To the extent that the current generation does not regard future generations’ wealth as highly as its own, a tax cut financed by issuing bonds gives the present generation an opportunity to increase its consumption at the expense of future generations. Current consumption thus rises and the IS curve shifts to the right.

Suppose, for example, that the A-people were to borrow $100 per person from the B-people in the private market. In order to be able to do this they each must guarantee that there will be funds to pay off the loan in the event of their death. If a borrower does not have a prospective estate sufficient to

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\(^2\)Actually, the term Ricardian equivalence is frequently used to mean an invariance of aggregate demand to shifts between monetary and tax finance as well as between bond and tax finance, and the definition is sometimes further broadened to include complete crowding out of the aggregate demand effects of changes in government expenditure. The latter issue will be considered later in this chapter.
discharge the additional liability, he will not be allowed to borrow. In the case where a person borrows through the mechanism of a bond financed tax cut, however, the liability continues past his death. The payment of interest occurs not through a private contract, but through the ongoing payment of taxes to the government imposed on all members of the community. If borrowers have no children, or do not care about their children’s welfare, they are wealthier because of the fact that they can borrow during their lifetime and leave the debt for someone else to pay off when they die. Consumption will increase in response to the increase in private wealth. Savings and investment will be lower, and the capital stock passed on to the next generation will be smaller. The present generation increases its consumption at the expense of the consumption of its children.

But the crucial assumption here is that people either have no children or do not care about the welfare of their children. Suppose that each A-person has a single heir, to whom he plans to leave $10,000 upon his death. Suppose further that all government bonds are consols—bonds which pay interest at a fixed rate in perpetuity and are never amortized. If, upon the A-person’s death, his heir faces a net tax liability of $10 per year as a result of the $100 worth of bonds per capita issued to finance the tax cut, the inheritance will be reduced to $9,900, or $10,000 minus the present value of $10 per year in perpetuity. This will lower the A-person’s utility because the bequest to his heir is an argument in his utility function along with his own present and future consumption. To reestablish equilibrium, the A-person will increase the bequest to $10,100 so that, net of future tax liabilities, his heir will still receive $10,000. He will do this by saving an additional amount in his lifetime, currently equal in present value to $100.

Now consider the situation from the point of view of B-people, each of which we assume to also have a single heir. Each B-person has purchased $200 of government bonds which, when he dies will pass to his heir. Each B-heir will earn $20 per year on these bonds. Of this, $10 will be paid to the government in taxes and $10 will be a net increase income, paid in taxes by the heirs of the A-people. If we suppose that each B-person is also arranging to leave $10,000 to his single heir, the actual bequest will increase to $10,100 as a result of the tax cut. To maintain equilibrium, therefore, B-people will reduce their bequests by $100 by selling during their lifetime bonds equal in present value to $100 and correspondingly increasing consumption over their lifetimes. This sale of bonds by B-people to maintain their level of bequests will exactly equal the purchase of bonds undertaken by the A-people to maintain their level of bequests. The heirs of both A-people and B-people will thus find themselves each holding $100 of government bonds on which
they will earn $10 interest, while at the same time paying $10 annually in
taxes to finance these interest payments. The wealth of neither the A-heirs
nor the B-heirs will be affected by the tax cut. During their lifetimes, A-
people will shift consumption from their old age to their youth as a result of
having borrowed from B-people, while B-people will shift consumption from
their youth to their old age as a result of having lent to the A-people. At the
ends of their lives, however, they will leave the same bequests to their heirs
as originally planned. The heirs will start with a clean slate, their interest
earnings on government bonds exactly covered by additional taxes. The net
effect of the shift from tax to bond finance will be zero.

Suppose that in the face of the tax cut and bond issue, the A-people
do not want to borrow from the B-people. Nothing says that they have to.
They can themselves buy $100 of the new bonds, an amount equal to their
tax cut, leaving the B-people to do the same. If the B-people remain anxious
to buy more than $100 worth of bonds per capita they will bid down the
interest rate the government will have to offer on the bonds until this excess
demand for bonds has been eliminated.

As long as the current owners of wealth are voluntarily leaving bequests
to their children, they choose the magnitude of these bequests on the basis of
utility maximization. If the government cuts taxes on the current generation
and raises taxes on future generations, the public will simply adjust the level
of bequests to re-establish the utility maximizing intergenerational transfer.
Indeed, if the public wishes to consume now at the expense of future gen-
erations, it can do so without the fiscal machinations of the government by

The intergenerational argument makes clear, however, that if some mem-
bers of the community have no heirs or do not care about the welfare of their
heirs, a tax cut financed by selling bonds can have an effect on the perceived
wealth of the current generation and on its consumption. But there is no
reason to assume that the impact effect on consumption of this intergenera-
tional transfer will equal the marginal propensity to consume times the tax
cut, as crude Keynesian models assert. Most people have heirs and most
leaves bequests to them. The intergenerational transfer effect may thus be small—the question of how small is an empirical one.

6.5 Debt Illusion

One argument in favour of the Keynesian view that tax cuts increase consumption does not dispute Ricardian equivalence. It assumes that tax cuts financed by either bond issues or monetary expansion have no effect on the public’s wealth. But it notes that in the short-run the public is likely to be unaware of the extent to which taxes will have to increase in the future to finance newly issued debt, and unaware of the future price increases what will occur when a tax cut is financed by monetary expansion. Thus, perceived wealth increases even though actual wealth remains unchanged. If this is true a tax cut, however financed, will lead to an increase in consumption until the public catches on to what is really happening. It is hard to believe that this ignorance could last indefinitely—if it did, the government could increase perceived wealth indefinitely by printing up paper and distributing it to the public. But it is easy to believe that for a short period following a tax cut, say a year or so, the full wealth implications may go unappreciated.4

While this short-run illusory wealth effect of bond and monetary finance permits the government to shift the IS curve to the right by running a budget deficit, there is a day of reckoning in the longer run. The rightward shift of the IS curve will be reversed when the public learns of the offsetting effect of the bond and monetary finance on wealth. A government utilizing Keynesian tax policy can, to the extent the policy is effective, expect an exogenous leftward shift of the IS curve at some unknown date in the future when the public realizes what has happened.

Another problem with this argument is that to the extent that the public is unaware that future taxes will increase it is also unlikely to regard the tax cut as permanent. If it regards it as permanent, on the other hand, the full future tax implications will also likely be understood. As demonstrated above, when the tax cut is regarded as transitory the effect on consumption will be small.

6.6 Human Capital Market Efficiency

Another argument against Ricardian equivalence relates to the effect of bond finance on the functioning of the human capital market. As noted above, a cut in taxes financed by a new issue of government bonds creates, in effect, a loan from those who choose to purchase the newly issued bonds to those who do not. A person who purchases sufficient bonds to provide interest earnings equal to her share of the future taxes that will be levied to service the debt will be in exactly the same position as before the tax cut. A person who buys fewer bonds than this will be borrowing from the rest of the community, while a person who buys more bonds will be lending to the rest of the community. The important characteristic of these loans is that they are made at substantially lower interest rates than would exist were the loans arranged in the private market.

Human capital provides poor collateral for a loan because its earnings are tied to the behaviour of the person in whom it is embodied. If the borrower chooses to not work or moves to some other legal jurisdiction, it may be impossible for the lender to recover the interest and principal. This contrasts with the case where physical capital assets—land, buildings, machinery, inventories, etc.—are used as collateral. In this case the lender acquires legal ownership of the collateral if the terms of the loan are not honoured by the borrower. A lender cannot foreclose on a borrower’s human capital because slavery is illegal.\(^5\)

When borrowing occurs through the mechanism of a tax cut financed by new issues of government bonds, the borrower needs no collateral because the payment of interest on the loan and its amortization are guaranteed by the taxing power of the state. For this reason, the borrowing can take place at much lower interest rates than those prevailing on consumer loans. Since the social opportunity cost of borrowing is the interest rate on government bonds rather than the private rate (the government bond rate reflects the cost to society of guaranteeing the loans), one can argue that the use of bond rather than tax finance of government expenditure improves the efficiency of the human capital market.

It could thus be argued that a tax cut increases wealth by making the human capital market more efficient and that this increase in wealth (and,\(^5\) Slavery is probably also uneconomic. Apart from breaking rock, digging holes in the ground, and picking cotton, it is difficult to imagine tasks in which the purpose and intention of the slave can be monitored—did the slave who, being trained in the law, takes care of his master’s legal matters really try to win the case? Or was he undermining his master?)
as a result, permanent income) leads to an increase in consumption and a shift of the IS curve to the right.

Again it should be noted that this failure of Ricardian equivalence does not guarantee that consumption will increase by the marginal propensity to consume times the tax cut. Furthermore, there is an additional problem. If bond finance is so good, why have taxes at all? Why not finance all government expenditure by floating bonds? Individuals could then borrow optimally against their human capital!

There is good reason why we do not observe this. If the government were to finance all of its expenditure by issuing bonds, the stock of government debt would increase until the tax liabilities of some individuals in the community exceed their incomes. While the community owes the public debt to itself in the aggregate, some individuals in the community end up net debtors and others net creditors. The debtors' tax payments cannot become too high or they will sink into slavery to the government. In a democratic political system, these debtors could eventually form a majority that would vote for abrogation of the debt. Since this would be politically unacceptable, the ability of the government to honour and service the public debt would come into question if that debt got too large. The interest rate at which the government could borrow would rise until it eventually became higher than the interest rate on unsecured loans.

Obviously, there is an optimum stock of public debt. Wealth will increase with an expansion of government debt toward this optimum and will decrease if the public debt expands beyond the optimum point. If the stock is above the optimum, a tax cut financed by the creation of additional debt will lower wealth and permanent income.

How do we know in any given circumstances that the stock of government debt is below the optimum? The answer is that we do not know, although it has been argued that in recessions the optimal stock of government debt will be higher because potential borrowers against human capital face more stringent constraints than they face in periods of boom. The argument is that when employment is uncertain the interest rate premium required to compensate lenders for the risk of default by borrowers without collateral will be higher. This implies that social wealth will be maximized by cutting taxes and expanding the public debt in periods of recession and raising taxes and cutting the public debt in periods of boom. Note again, however, that this does not imply that the effects of such tax changes on consumption will equal the marginal propensity to consume times the magnitude of the tax change as the simple Keynesian model implies.
6.7 Credit Constraints

Since individuals are forward looking they decide how much to consume today based on today’s income plus the incomes expected in all future periods. When today’s income is above their permanent income, they save the difference in the expectation of drawing down those savings in periods in which their current income is below their permanent income. Individuals with relatively low permanent incomes may achieve consumption smoothing by borrowing in periods when their current income is below their permanent income with the expectation of paying back the loan in future periods when current income is above permanent income. People who take this latter route end up paying very high interest rates on their borrowings during bad times because, as we have noted, human capital cannot be used as security for loans.

Individuals who choose to save during good times and draw down their savings in periods when current income is below permanent income have limited choices as to where they put these savings. They can hold time deposits that pay little interest or government bonds that pay relatively low interest compared to equities but can be liquidated quickly without loss. And there is a big gap between the interest that can be earned on government bonds and the interest rate that will have to be paid on personal loans made in bad times to be paid back in good times.

It is reasonable for people to compare these interest rates with the rate of return that can be earned by lending to and borrowing from oneself—that is, by letting personally held real capital goods such as clothes, household appliances, and automobiles depreciate in bad times, reducing one’s real capital stock, and then replacing and repairing these items in good times, rebuilding that capital stock. This approach will be useful if the return to personal capital stock is above the return on government bonds but below the interest rate paid on loans to credit card and finance companies.

A person who chooses to inter-temporally smooth consumption relative to income by this latter route will find that a tax cut—i.e., borrowing from other tax payers—in bad years and a tax increase that permits the government to repay that public debt in good times will reduce the amount of depreciation of consumer durables that has to be allowed in bad times and the amount of such durables that have to be replaced in good times. This means that, as a result of the tax cut, investment in consumer durables will be greater than otherwise in recessions and smaller than otherwise in booms. Although they are really investment expenditures, purchases of durables by consumers are treated in national accounts as consumption. This means
that tax cuts in recessions will have a positive effect on what we measure as consumption and tax increases in booms will tend to cause measured consumption to be lower than otherwise. These effects of tax changes are in the directions postulated by Keynesian theory. And it might be reasonable to expect that the full amount of these tax changes will feed into consumption because the consumption changes involved are really transitory changes in savings that directly involve changes in durable investment. Depending upon the proportion of consumers who find it useful to vary their purchases of durables rather than borrow in the credit market in bad times and pay back in good times, the effects of tax changes on measured consumption through this avenue could be quite large.

Individuals who borrow and lend from themselves by varying their purchases of consumer durables can be thought of as credit constrained in the sense that they cannot borrow and lend freely at rates of interest equivalent to the returns they earn on personally held durable goods. The returns on durable goods are the value of the services received from using these goods as a proportion of their cost. Their cost has two components—the interest foregone on other assets that could be held instead of the durables, and depreciation per period.

6.8 Changes in Government Expenditure

A number of important objections can also be raised to the simplistic Keynesian notion that an increase in government expenditure has a one-for-one effect on aggregate demand at the initial level of output. These center around the question of whether the increased government provision of goods and services will crowd out private consumption and investment. When government expenditure is decomposed into its consumption and investment components, equation (3.1) can be rewritten as

\[ Y = C + I + G = C_p + C_g + I_p + I_g \] (6.4)

where \( C_g + I_g = G \). If the recipients of government provided consumption goods regard them as perfect substitutes for private consumption, the aggregate Keynesian consumption function becomes

\[ C = C_p + C_g = C(Y - T, r) \] (6.5)

which upon substitution into (6.4) becomes

\[ Y = C(Y - T, r) + I_p + I_g. \] (6.6)
An increase in government expenditure that takes the form of a provision of consumer goods will have no effect on aggregate expenditure—private consumption expenditure will decline by the amount government expenditure increases. If the government provided consumer good is not identical with some private good, the increase in government expenditure will still be offset by an equal reduction in private consumption unless it increases the public’s overall desire to consume now rather than in the future. That is, the government policy must induce the community to substitute current for future (private plus public) consumption at the existing levels of interest rates and wealth. While this is plausible, it is unlikely that government provision of consumption goods would always have this effect. For example, law enforcement services provided by the government could be viewed as a consumer good that makes private individuals more secure and makes it unnecessary for them to set aside as large a fraction of current income to cover future contingencies. On the other hand, government provision of school lunches would undoubtedly result in an equivalent reduction in private food expenditures.

A similar problem arises with respect to government expenditure on investment goods. We could think of the curve II in Figure 6.2 as a ranking
of all potential investment projects, whether undertaken by the government or the private sector. Any government investment project that has a capturable rate of return above the market interest rate will be one that the private sector would otherwise have undertaken, so the increase in government expenditure will lead to a dollar-for-dollar reduction in private investment expenditure. If the government undertakes projects whose return is below the market interest rate, there will be a movement down II to the new investment level $I_1$. At the market interest rate, the level of aggregate investment increases, so the II curve shifts rightward to $I'I$. It is as if the private sector were to expand its investment beyond the profitable level. In this case, however, there will be some offset on the consumption side since the project has a negative, albeit small, effect on wealth because the returns on these government projects do not justify their cost.

Government can undertake, of course, projects on which the returns cannot be capturable by private sector investors. But it should go forward with these projects whether or not there is a recession or boom. Moreover, a particular government investment project may increase the return to other investment projects in the economy. For example, the purchase of armaments may reduce the possibility that the country will be overrun by a foreign power and thereby raise the expected rate of return to domestic residents from the existing stock of capital. This would shift the II curve to the right in Figure 6.2, say to $I'I'$. In this case, the increased government investment would shift aggregate (public plus private) investment to $I_1$ at the initial market real interest rate $r_0$.

In both the above cases the market interest rate would ultimately have to rise as a result of a rightward shift of the IS curve brought about by the increase in private plus public investment to keep output from rising above the full-employment level.

6.9 Required Modifications of the Model

Although professional opinions differ on the effects of tax cuts on consumption and aggregate demand, it is clear that the Keynesian formulation is much too simplistic. It would seem appropriate to rewrite the consumption function as

$$C = C(Y, r, \Omega) \quad (6.7)$$

and to modify the IS curve equation accordingly. The partial derivative $\partial C/\partial \Omega$ would be greater than or equal to zero depending on how the change
in the deficit is financed and the circumstances regarding the public’s interpretation of that change in the deficit. Indeed, the fact that consumption will decline when the public realizes that wealth effects of past deficits were illusory suggests that, for many problems, past deficits should also be included as arguments in the function $C(\ldots)$.

It is also clear that increases in government expenditure can not be routinely viewed as having the standard Keynesian multiplier effects on output. The most sensible way to handle crowding out complications would be to treat the level of government expenditure as an argument in the investment function, with investment now incorporating both private and public capital formation, rather than as a separate component of aggregate demand. And, since government investment may have a negative or positive wealth effect and government consumption may under some circumstances cause total consumption, of both private and government supplied goods, to increase, government expenditure should appear as an argument in the consumption function as well. Accordingly, equation (6.6) would become

$$Y = C(Y, r, \Omega, G) + I(r, Y, G)$$

(6.8)

where the functions $C(\ldots)$ and $I(\ldots)$ now refer to all consumption and investment expenditure, public and private, and the derivatives $\partial C/\partial G$ and $\partial I/\partial G$ will be positive, negative, or zero, depending on the nature of the particular increase in government expenditure, its wealth effects, and its division between consumption and investment goods.

The conclusion is that Keynesian tax and expenditure policies will in many cases shift the IS curve to the right as the traditional analysis postulates, but in some circumstances the effects may be non-existent or even perverse.
Exercises

1. True or false: Explain your answer briefly.
   a) The present value of income plus bequests received from the previous generation must equal the present value of consumption plus bequests to one’s heirs.
   b) The size of the public debt is of no consequence because we owe it to ourselves.
   c) A switch from bond to tax finance will lower consumption and aggregate demand because it makes the market for human capital less efficient.
   d) The public’s marginal propensity to consume out of a windfall increase in income is the same as its marginal propensity to consume out of any other increase in current income.
   e) The public’s marginal propensity to consume out of a windfall increase in income is zero because, by definition, windfalls are transitory and transitory changes in income have no effect on consumption.
   f) A one year income tax rebate of $200 will increase current consumption by the marginal propensity to consume multiplied by $200.

2. Suppose that the government gives the public an income tax rebate of $100 million in the aggregate, and finances the deficit by printing $100 million of nominal money balances. Assume that the nominal money stock is originally $1 billion and nominal income is originally $3 billion.
   a) Demonstrate that when the economy is at full employment the government has really not cut taxes at all, but has simply substituted a tax on money holdings for a reduced tax on income.
   b) Does your argument in a) also hold if there is less than full employment? Why or why not?
   c) What would have been the effect on the IS curve had the government, instead of cutting taxes by $100 million, printed up $100 million and used it to purchase bonds from the private sector? Assume that any interest earned on these newly purchased bonds will be used to reduce taxes in the future.

3. Suppose that the government establishes an airline and purchases a number of jet aircraft from a domestic manufacturer for that purpose. Outline
the effects of this policy on the level of investment, the IS curve, the LM curve, and the level of output and employment when the economy is initially at less-than-full-employment. How would your analysis change if there is full employment?

4. Suppose that, instead of investing in an airline in the question above, the government invests an equivalent amount of resources in a dam on the Itchiwabee River. Several careful studies of the dam indicate that while it will help the local native people maintain their way of life, the present value of the its returns, according to all calculations, fall far short of its cost. Outline the effects of this policy on the IS curve, the LM curve, the level of output and employment and the price level. Does permanent income increase?

5. Suppose that there are two types of people, A-people and B-people. The two groups are equal in number and each person has a life expectancy of two years. Assume that the A-people are childless but the B-people each have two heirs whose consumption they value as highly as their own. In particular, suppose that each multi-generational B-family—that is, each B-person, his/her heirs, and his/her heirs’ heirs, etc.—acts like a single infinitely lived consumer who consumes each year a constant fraction, equal to 0.8, of permanent income. Suppose that the A-people, on the other hand, choose to distribute their consumption equally in the two remaining years of their life, regardless of the rate of interest. Assume that the government cuts everyone’s taxes in the first of the two remaining years of this generation’s lifetime by $1000 and floats $1000 worth of debt per capita in that period. Taxes then revert to their old level plus an amount necessary to finance the interest on the new debt in all subsequent years. Assume that the equilibrium market interest rate on government bonds is constant and equal to the real return to investing in real capital in the economy, namely 10% per year. Suppose further that all individuals are fully informed of all the consequences of the government’s policy.

a) Which people, the A-people or the B-people will buy the government bonds?

b) What will be the change in each A-person’s consumption during the remaining two years of his/her life as a result of the government policy?

c) What will be the change in the consumption of each B-person during the final two years of his/her life as a result of the government policy?
d) What will be the change in the annual consumption of each B-heir as a result of the government’s policy.

e) What is the effect of the government’s policy on the intergenerational time path of consumption?

f) How would your answer change if it happened that the A-people were the same as the B-people with the exception that all members of both groups have a single heir?
Chapter 7

Price Level Adjustment and Rational Expectations

While the traditional classical model assumed that wages adjust instantaneously to excess demand and supply, everyone knew that unemployment is a characteristic of depressed periods. Various loosely formulated arguments, most of them familiar today, emerged over the years to explain this phenomenon. Keynes, spurred by the need to explain the massive unemployment of the Great Depression, adopted the extreme assumption that money wages are rigidly fixed when aggregate demand falls below the full employment level. This view that for institutional and other reasons money wages do not respond to excess supply in the labour market dominated professional thinking for two or three decades. Yet everyone knew that this was an extreme assumption—money wages frequently fall during recessions.

7.1 The Phillips Curve

In 1958, A.W. Phillips drew attention to a phenomena that had been observed from time to time for generations, namely, that when the rate of increase in money wages is high the unemployment rate tends to be low, and vice versa.1 This observed negative relation between inflation (of prices as well as wages) and unemployment became known as the Phillips curve.

Chart 7.1 plots the inflation and unemployment rates for the United States for the period 1956–69. This scatter indicates a negative relationship of the sort suggested by Phillips. This type of evidence led many

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Chart 7.1:

Economists to believe that policy makers face a tradeoff between inflation and unemployment—that by tolerating a higher inflation rate, they can achieve a reduction in the unemployment rate. Since most people agreed that unemployment was more odious than inflation, the implication was that an inflationary monetary policy would be socially beneficial.

At this point it should be noted that the Phillips curve concept does not fit rigorously within the theoretical framework we have developed in the preceding chapters. The Keynesian aggregate supply curve, given by equation (4.4), postulates a positive relationship between the deviations of the price level below its full-employment equilibrium level and deviations of the level of output below full employment. This suggests a negative relationship between changes in prices and changes in the unemployment rate. It does not directly imply a negative relationship between price-level changes and the level of the unemployment rate. The Keynesian and classical models, as we have developed them, admit of only two states of the world—full employment with upward money wage flexibility, and less-than-full-employment with money wage rigidity and some price level flexibility. In the light of those traditional theories, the Phillips curve can only be interpreted as a loose empirical generalization—an observed association of periods of low unemployment with periods of high inflation. Evidently, as employment presses towards the full-employment ceiling, higher than normal price-level increases tend to occur.

It turns out on further examination of the data that the case for a Phillips
7.1. THE PHILLIPS CURVE

THE PHILLIPS CURVE: UNITED STATES, 1954-1989

Chart 7.2:

THE PHILLIPS CURVE: UNITED STATES, 1974-1989

Chart 7.3:
curve extending over long periods is extremely shaky. Chart 7.2 plots the scatter diagram of inflation and unemployment for the whole period 1956–1989. No clear negative relationship between the two variables is present. Nevertheless, for the sub-period 1974–89, plotted in Chart 7.3, a negative Phillips relationship, albeit rather weak, is again observable. Since the average inflation rate in the 1974-79 period is substantially higher than that in the 1956–69 period, as can be seen from the scales of the respective charts, the evidence is consistent with a Phillips curve that shifted upward between the two periods.

7.2 Theories of Price Adjustment

The problem in interpreting this evidence is that neither the classical nor the Keynesian models incorporate a useful theory of how wages and prices change. Wages and prices change, if at all, in the Keynesian theory as a result of institutional circumstances beyond the scope of conventional economic theory. The classical model, on the other hand, incorporates a theory of price adjustment that has wages and prices responding instantaneously to excess demand and supply in perfectly competitive markets. Not only does this latter theory fail to explain observed unemployment, it implies that labour and commodity markets are auction markets. In the absence of an auctioneer calling out prices and taking bids, there is no mechanism by which prices can change—the traditional perfect competition assumption that every buyer or seller is too insignificant to influence price, and therefore take it as given, eliminates any role for individual suppliers and demanders in the price adjustment process. Of course, this fiction that prices change as a result of some implicit auction process is useful for many standard price theory problems that concern the economic forces determining relative prices. It is not useful in the present situation, however, where the key issue is the process by which prices change.

Obviously, if individual buyers and sellers are to make decisions about when and how much to change prices, most markets must be assumed to be imperfectly competitive to some degree. Since most products are differentiated in some way from their competitors and the labour services provided by each worker are to some extent unique, this assumption is easy to swallow. Only the very few markets with auction-type price-setting processes are perfectly competitive.

\[2\] For a thorough analysis and discussion, see Robert Barro, *op. cit.*, 443–447.
7.2. THEORIES OF PRICE ADJUSTMENT

What, then, is the process by which wages and prices change in imperfectly competitive markets? Is it possible in such markets for rational workers and firms to set wages that will result in less labour being employed than would, in retrospect, be optimal? The conclusion that emerges from the analysis of these questions over the past forty years is that there is no one single process by which prices are set. Three different types of wage and price setting mechanisms which can result in observed ‘unemployment’ have been identified.\(^3\)

7.2.1 The Auction Model

The first of these is an extension of the perfectly competitive auction model.\(^4\) The analysis supposes that markets are sufficiently competitive for prices to adjust to supply and demand changes almost immediately. Any worker wanting employment can find it at the prevailing wage rate or slightly less. It is then argued that because of poor information, misperceptions about the true equilibrium levels of wages and prices in relation to current levels cause workers to work harder in boom periods when wages and prices are relatively high and use the extra funds to finance leisure in slack periods when wages and prices are low. In the simplest version of this theory, the level of the upward sloping supply curve of labour, with the money wage rate on the vertical axis, is assumed to depend on the expected price level while the level of the negatively sloped demand curve for labour by firms is assumed to depend on current prices. An unexpected expansion of aggregate demand causes firms to demand more labour, raising money wages and current prices relative to workers’ price-level expectations. This happens because workers mistakenly view the expansion of their own industry as a local rather than an economy-wide event. Faced with what is perceived as a temporary increase in their real wage rate—temporary because the entry of workers will eventually drive the wage rate down to the level existing else-

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\(^3\)For a fuller discussion of these three different approaches, see J. E. Floyd, “Auction, Search and Contract Theories of Unemployment”, University of Toronto, 2000, available from the author’s web-site.

where in the economy—workers substitute future leisure for current leisure and work more. In general, therefore, the observed unemployment rate will be below normal when prices are abnormally high and above normal when prices are abnormally low.

While this theory might be useful in explaining work-leisure tradeoffs of females with children and other part-time workers, it is inconsistent with the fact that quit rates—the fraction of workers quitting their jobs—decline in recession periods and increase during booms. The theory predicts falling nominal wages during recession periods with workers quitting—i.e., taking leisure—as a result. It also fails to explain the fact that in recession periods firms refuse to hire workers who would be willing to work at the going wage rate or less.

### 7.2.2 The Search Theory

The second theory of wage adjustment is what has become known as the search theory.\(^5\) The search theory starts with the proposition that unemployed workers are seeking employment and focuses on the length of time that it takes them on average to find work. The typical unemployed worker’s skills and work habits are similar to but not identical with those of competing workers. A wide range of possible employment situations are feasible to him, but both he and the firm that might potentially hire him are not fully informed of each other’s relevant characteristics. Acquisition of this information requires a search process of some sort. One such process would have firms advertising vacancies and workers shopping around for jobs. Less frequently, perhaps, one might find workers advertising their availability and firms shopping for employees.

Asking wages exist for which a worker will find employment almost immediately, but these wages will be low in comparison to what many firms would be willing to pay for his services. On the other hand, at a very high asking wage a firm could potentially be found that would offer employment, but such firms are few and far between and the worker can expect to wait a long time on average before encountering one of them. So the typical unemployed worker faces a choice—the higher his asking or reservation wage, the longer the length of time it will take him on average to find employment. Because the time it will take to find employment at each reservation wage is random, the actual waiting time will almost always differ from the average.

or expected waiting time.

Standard economic theory tells us that the worker will choose the asking wage that will maximize his expected utility and will expect to wait some period of time on average before finding employment at that wage. Associated with the equilibrium expected waiting times of the set of unemployed workers in the economy will be what might be called the natural or equilibrium rate of unemployment—representing the normal or equilibrium proportion of workers that happen to be between jobs. Of this set of unemployed workers, some will find jobs quicker than average and some will take longer than the average time to find jobs. The average waiting time will determine the natural rate of unemployment. If everyone knows the market conditions then the difference between the waiting times experienced by individual workers or small groups of workers and the average for all workers is simply one of the vagaries of life. Nothing can or should be done about it.

Suppose, on the other hand, that market conditions have deteriorated unbeknownst to market participants. Asking wages that would be expected to result in the equilibrium expected waiting time will now result in larger waiting times. And any individual worker or small groups of workers who experience higher than expected waiting times have no way of knowing that this is the result of a deterioration of market conditions and not just the luck of the draw. When deviations of actual waiting times above expected waiting times persist over a large group of workers over a longer and longer time, there develops a stronger and stronger basis for concluding that market conditions have changed and the asking wages that will produce the equilibrium expected waiting times have fallen. Conversely, of course, actual waiting times will fall below expected waiting times if market conditions have unexpectedly improved, and persistence of unexpectedly low waiting times in the economy will eventually inform workers that the asking wages that will produce equilibrium expected waiting times have risen.

Thus, the condition for normal unemployment rates—loosely referred to as full employment—to occur is that workers have good information about the state of aggregate demand, and hence the demand for labour, in the economy. When the information possessed by workers about market conditions is correct, the level of unemployment will gravitate to the natural rate. When workers overestimate demand conditions, failing to realize that they have deteriorated, they inadvertently price themselves out of the market, causing the time taken to find jobs and the pool of workers between jobs to be unusually large. When they underestimate aggregate demand conditions and under-price themselves, jobs are found much more quickly than
expected and the pool of unemployed workers shrinks below its natural size.

Once workers realize that the state of aggregate demand has shifted reservation wages will adjust and the unemployment rate will return to its natural level. Indeed, deviations of employment from the natural rate can be viewed as an integral part of the process by which workers acquire information about changes in aggregate demand and labour market conditions.

This story applies equally well whether firms set offering wages and workers search for employment or workers set asking wages and firms search for workers. A crucial ingredient of the search process, however, must be a degree of non-homogeneity of both workers and jobs. Workers are slightly different and are thus worth slightly different amounts to firms that know about them. Jobs and employers are also slightly different and yield different amounts of non-pecuniary utility to workers. Negotiation between buyer and seller is therefore a necessary ingredient of labour market equilibrium.

The search theory goes part of the way in explaining both normal frictional unemployment and the positive correlation of the unemployment rate with the business cycle. And it is more realistic and the auction theory in that it allows for the fact that workers are actively searching for jobs rather than simply making employment decisions at existing market wage rates. Like the auction theory, however, it implies that quit rates should increase in recessions and decrease in booms, as workers will tend to regard their current employment situations as firm specific. When firms lower wages in a recession, some workers will quit and begin a search for employment elsewhere at wages that have not fallen. In fact, quit rates decrease during recessions and increase during booms, the opposite of what the search theory predicts. The search theory also fails to explain another very important fact—that firms actually lay workers off during recessions and refuse to hire workers who are clearly willing to work for them at the wages they currently are paying. Firms do not cut wages and maintain employment during periods of slack demand—instead, they tend to maintain wages and reduce the number of workers employed.

7.2.3 The Contract Theory

The third theory of wage and price adjustment attempts to explain why quit rates decline and firms choose to lay off workers rather than reduce wages in recessions. It begins by noting that individuals cannot diversify their human capital as easily as their non-human assets. Non-human wealth can be spread widely among bonds, equities, real estate, etc., while many individuals’ human skills have only one avenue of employment. Thus, if
workers are risk averse they will seek ways of insuring themselves against fluctuations in their incomes arising from variations in the demand for the narrow range of labour services they provide. The owners of firms, on the other hand, can diversify easily by owning little pieces of a large number of firms together with a variety of other assets. To the extent that the individual firm assumes some of the risk associated with fluctuations in the demand for its workers' human capital, it can diversify that risk away. It is profitable, therefore, for the firm to assume some of that risk in return for the acceptance by workers of a lower than average level of wages. And it is profitable for workers to accept lower wages if the stability of their incomes can be increased. Firms and workers thus make a contract according to which workers accept a lower wage in return for a guarantee of long-term income stability. This theory of price adjustment is thus referred to as the contract theory.\(^6\)

The contract between the firm and its workers may be an explicit one, hammered out in union-management negotiations, or it may be implicit, guaranteed solely by the fact that the firm must maintain its reputation as a 'good employer' if it is to be able to successfully hire workers at reasonable wages over the long run. The essence of these contracts, whether explicit or implicit, is that the firm guarantees employment for a large fraction of its employees at real wage rates that reflect their mean or average marginal productivities over periods that may extend as long as a lifetime. In the most extreme cases the current wage paid could be viewed as one of many instalment payments in a lifetime contract. As a result of these considerations, the wage paid at any particular point in time may be above or below the workers' marginal products at that point in time. The losses to firms from paying wages that differ from workers' marginal products is compensated for by the gain in profits by paying lower wages, on average, than would otherwise be the case.

The firm can be thought of as having several classes of employees, ranked by seniority. The lowest class gets laid off first when the demand for the firm's output declines, the next lowest class gets laid off next, and so forth, with the very senior employees getting laid off only if demand declines to the point where the survival of the firm is in jeopardy. Wages are maintained in the face of these layoffs and employment is kept at a point where the

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marginal product of labour is substantially below the wage rate the firm is paying to its employed workers. Similarly, employment will expand in times when demand is high but the marginal product of labour will remain above the wage rate being paid, the latter being equal to the average of labour’s marginal productivity over the business cycle.

The contract theory thus explains why quit rates are low in recessions and high in boom periods. And it also explains why firms lay off workers in slack periods, refusing to hire individuals willing to work at wage rates currently being paid.\(^7\)

While wages are set under explicit or implicit contractual arrangements with a time horizon that may be several years long, they nevertheless are affected by current market conditions. Wages will be routinely increased each year by the expected rate of inflation, and adjusted in response to information about the level of aggregate demand to maintain real wages at the contractually agreed upon level. When, due to misinformation about market conditions, wages are set too high in relation to product demand, firms will end up hiring too few workers and producing too little output. When workers and firms eventually realize that they are pricing labour too high and firms are unable to product average output levels at a cost consistent with market demand, the rates of increase of wages and perhaps even the level of wages will be lowered. And when wages are set too low in relation to product demand, firms will find themselves using too many workers on average and producing in excess of the normal full-employment output level. Steps will be taken to bring wages up to a level consistent with the productivity of labour at normal average output levels. It follows that when aggregate demand unexpectedly increases as a result either of changes in monetary and fiscal policy or exogenous shocks arising from factors beyond anyone’s control, firms will employ too many workers and the unemployment rate will fall below its normal or natural level. And when aggregate demand unexpectedly declines, firms will lay workers off and unemployment will rise above the natural rate.

\(^7\)Another argument that can explain why firms keep workers on the payroll at value marginal products below the wage rate being paid under conditions of slack demand relates to past investment of firm-specific capital by the firm in its workers. During their employment, workers acquire specific knowledge and skills that will be lost to the firm if they go to another firm after a layoff. It pays the firm to keep these workers around because otherwise resources would have to be used to train someone new. Also, the firm knows about the work habits and capabilities of its current workers, having fired at great cost those hires who did not possess the necessary qualities. Since the firm does not initially know the capability of new hires, another costly process of hiring and firing will be required to acquire replacements for workers lost.
7.2.4 Some Implications

All three of the theories of price adjustment have a role to play in explaining why money wages do not adjust immediately to shifts in aggregate demand so as to maintain employment at its long-run equilibrium level. And since the situation differs from industry to industry, a variety of stories based on the theoretical insights of the three approaches can be used to ‘rationalize’ particular events. Nevertheless, all of the theories have one important thing in common. They predict that the unemployment rate will be at its natural level when price setters—be they workers or firms or both in any particular instance—are well informed about the current state of aggregate demand and future changes in it. And they all predict that unanticipated increases in aggregate demand will lead to deviations of the unemployment rate below the natural rate and unanticipated decreases in aggregate demand will lead to greater than normal unemployment.

When the government expands the money supply the equilibrium money wage rate will rise. If workers and firms are not aware of this shift in nominal aggregate demand, however, they will continue to set wages at the old level. Firms will find it desirable to increase their labour force beyond the level originally planned and workers will find jobs a lot quicker than they had anticipated. The unemployment rate will fall below the natural level. Similarly, an unanticipated cutback in the money supply will cause firms to employ less workers than they had originally planned and workers will find themselves taking longer to find jobs than they had anticipated. The unemployment rate will rise above the natural level.

These deviations of the unemployment rate from the normal or natural level arise from an optimal response of price setters, both workers and firms, in the light of the information available to them. Non-optimality arises from the point of view of the economy as a whole only to the extent that price setters do not have the correct information about the state of the economy and this information could be costlessly distributed to them by the government. Changes in aggregate demand that are unanticipated by both government and the private sector will lead to deviations of the level of employment from the natural rate that will be the result of optimal decision making on the basis of available information in the economy. Such deviations can hardly be regarded as resulting from non-optimal behaviour, since no one could have predicted the changes in aggregate demand that bring them about.\(^8\)

\(^8\)A question that arises in popular discussion is whether the unemployment described above is ‘voluntary’, as distinguished from the Keynesian notion of ‘involuntary’ unemp-
Where the government does not completely or convincingly inform the private sector about its policy plans, deviations of employment from the natural rate become a mechanism by which price setters learn that changes in government policy have taken place. When the government announces that it is fighting inflation by reducing the rate of monetary growth, and the private sector believes it, wages and prices will adjust immediately to the new aggregate demand conditions and no deviations of unemployment from the natural rate will occur. But such announcements are rarely believable. Politicians, to obtain political favour or votes, often make announcements that leave the impression that a particular policy will be followed but which can be interpreted in a variety of ways should the policy not be forthcoming as planned. Moreover, to the extent that a tightening of the money supply produces some unemployment and stress, the policy makers may lose their nerve and rescind the policy before it has any substantial effect on the inflation rate. Price setters who act on the basis of the government’s announcement of intentions will be worse off than had they ignored it. Thus, where policy makers cannot believably inform the private sector of their plans, or where exogenous changes unrelated to government policy occur, a deviation of unemployment from its natural rate is necessary to inform wage and price setters that things have changed. High unemployment rates in recessions perform the function of informing wage setters that aggregate demand is growing less rapidly than they thought, and low unemployment rates in booms transmit to wage setters the information that aggregate demand is expanding at a more rapid rate than they had anticipated.

This analysis leads to a number of conclusions about the process of price

employment. The issue is particularly important in reference to Lucas’s analysis where, confronted with a decline in the demand for their services that is perceived as temporary, workers ‘take a holiday’. It turns out that the term ‘involuntary’ is not a scientifically useful one. Workers voluntary make decisions of the basis of the (albeit inadequate) information they possess at the time the decisions are made. Sometimes these decisions lead to job loss and hardship as a result of the random draw of events. If it were possible to turn the clock back the worker would, in retrospect, have made different decisions. Confronted with the same information now as was available when the original decisions were made, however, the worker would make the same decisions now as he did then, provided that his attitude towards risk remained unchanged. And since the random process of life has by construction remained unchanged, the probability of an adverse result is the same now as it was then. Moreover, if the information available to economic agents is obtained optimally—i.e., at marginal cost equal to its marginal return—and the government has no information that could be made available free of charge, the unemployment and over-employment that results in the random course of events is socially optimal. Distortions may arise, however, with respect to the provision of unemployment insurance in that markets for contingent claims may not exist or function adequately.
level adjustment. First, the natural rate of unemployment is not a ‘full-employment ceiling’ but rather a level that will be achieved under conditions where price setters are well informed about the state of aggregate demand. Deviations below the natural rate are every bit as important as deviations above it.

Second, when we speak of wage rigidity or stickiness we should be referring to rigidity of the rate of growth of wages rather than their level. If prices have been inflating at 10 percent per year for the past five years, and everyone expects inflation to continue at the same rate, money wages will be ‘rigid’ or ‘sticky’ around a 10 percent growth path. A shift of the monetary regime to result in a 5 percent inflation rate will result in a higher than normal unemployment rate until price setters catch on to what is happening. For a while, wages will be growing at 10 percent while aggregate demand growth calls for wage increases of 5 percent per year, and labour will be inadvertently pricing itself out of the market. Eventually, as price setters learn about the new equilibrium inflation rate, wage increases will eventually flatten out and eventually stabilize at a growth rate of 5 percent. As this happens, unemployment will fall back to its natural level.

Third, the simultaneous existence of both inflation and unemployment is now quite consistent with our model. The IS, LM, aggregate demand and aggregate supply curves can be interpreted as overlaying any rate of anticipated inflation—exogenous shifts in these curves and resulting changes in the equilibrium levels of the variables represent movements relative to what the curves and variables would otherwise have been.

Fourth, since unanticipated variations in aggregate demand result in price changes in the same direction and changes in unemployment rates in the opposite direction, we can expect to observe a negative relationship between the rate of inflation and the unemployment rate as long as the aggregate demand variations remain unanticipated. In other words, there is a good reason to expect a Phillips curve to appear when unanticipated shifts in aggregate demand are taking place. Nevertheless, this Phillips curve is conditional upon a given expected rate of inflation. When a fully anticipated shift in aggregate demand occurs, the inflation rate will change without a change in the unemployment rate and the Phillips curve will shift vertically. This is what appears to have happened in the U.S. between the periods 1956–69 and 1974–89 in Charts 7.1, 7.2 and 7.3. Changes in the inflation rate were associated with opposite changes in the unemployment rate along one Phillips curve during the early period, and along a different

\footnote{For simplicity, we ignore wage increases resulting from productivity growth.}
higher Phillips curve during the later period. The Phillips curve shifted upward because the higher average inflation rates experienced in the 1970s became anticipated by wage and price setters.

Thus, policy makers do not face a tradeoff between inflation and unemployment in the long run. A tradeoff appears in the short-run only if wage and price setters are uninformed about what is happening.

### 7.3 Rational Expectations

To incorporate the above analysis of the process of wage and price adjustment into our model it is necessary to reexamine the fixed wage aggregate supply equation (4.4) which is reproduced below for convenience.

\[
P = \frac{W}{G(Y)}
\] (7.1)

This curve, portrayed as the curve KAS in Figure 4.7, was derived in Chapter 4.

If we hold the money wage rate fixed in Figure 7.1, which is a reproduction of Figures 2.2 and 4.3 with the added convenience assumption that the
supply curve of labour in the economy is vertical, a rise in the price level will cause the level of employment to increase as the real wage rate falls from, say, \( w_1 \) to \( w_0 \) and we move downward to the right along the demand curve for labour DD. The increase in employment results in an increase in output and income, so the rise in the price level is associated with a rise in income. It is this relationship between the price level and output that we called the fixed (nominal) wage aggregate supply curve and portrayed as the curve KAS in Figure 4.7 and we now rename EAS for reasons that will be made clear shortly.

We can interpret the fixed wage as the wage rate chosen by price setters on the basis of available information about the state of the economy. This will be the wage rate, call it \( W_e \), that they expect will lead to the normal level of output and employment, which we continue to represent by \( Y_f \). When employment is at the natural rate, the price level will be equal to

\[
P_e = \frac{W_e}{G(Y_f)}
\]  

(7.2)

Let us call \( P_e \) the expected price level and \( W_e \) the expected full-employment equilibrium nominal wage rate. The actual level of \( P \) will exceed \( P_e \) when
output is above normal and will be below $P_e$ when output is below normal. This relationship between $P$ and $Y$ is the curve EAS in Figure 7.2. If the expected full-employment nominal wage rate rises as a result of an expected economy-wide increase in aggregate demand, the expected level of prices will also rise, say to $P'_e$, and EAS will shift upward to EAS'. Because the level of the EAS curve depends on the level at which the wage rate is set, which depends in turn on price setters’ expectations about the state of the economy, we call this curve the expectations augmented aggregate supply curve.

The slope of the expectations augmented aggregate supply curve in the neighbourhood of the price-output combination represented by $P_e$ and $Y_f$ can be expressed as

$$\lambda = \frac{P - P_e}{Y - Y_f}$$

which can be expressed alternatively as

$$P - P_e = \lambda (Y - Y_f).$$

(7.3)

This latter equation is often referred to as the Lucas supply curve.\(^\text{10}\)

If expectations are rational—that is, if market participants set $W_e$ on the basis of all information available to them about the state of aggregate demand—$P_e$ will be the price level at which expected aggregate demand will equal the full-employment aggregate supply.\(^\text{11}\) We denote the expected level of aggregate demand by the curve AD\(_e\) in Figures 7.2 and 7.3.

The price $P_e$ in these figures thus equals the rational expectation of the price level. Wage and price setters do not know for sure what the price level will be when they set wages and prices. But $P_e$ is the price level that they consider most probable or most likely. Their uncertainty about the level of prices that will be consistent with full employment is, of course, the result of their uncertainty about what the level of aggregate demand will be. Accordingly, AD\(_e\) in Figure 7.3 is what they expect the level of aggregate demand to be, corresponding to the expected price level $P_e$, but the level of


aggregate demand actually realized may be AD₁ or AD₂ and the associated full-employment equilibrium prices $P₁$ or $P₂$.

Only by chance will aggregate demand equal the level expected by price setters. If it is above the expected level, the price level and level of output will be above $P_e$ and $Y_f$; if it is below the expected level, the price and output levels will be below $P_e$ and $Y_f$. Note that if aggregate demand happens to be AD₂ the price level that actually occurs will be below the full-employment price level $P₃$—this is because the level of employment will increase above $Y_f$. Similarly, if aggregate demand is AD₁ the price level will be above the full-employment level $P₁$ because the level of employment will fall below $Y_f$. If the actions of the authorities or other unforeseen forces unexpectedly reduce aggregate demand to AD₃, the full-employment price level will be $P₃$ and the level of output will fall to $Y₃$ and the realized price level to somewhat above $P₁$.

Nothing here implies that market participants’ expectations are not rational—they based their judgments on all the information available. This highlights a very important point about rational expectations. To be rational, wage and price setters do not have to be right in their expectations—they merely have to use all information available in forming them. If their information about the future course of government policy and the structure
of the economy is not biased, the rationally expected full-employment price level is just as likely to be too high as too low. Thus, even though wage and price setters’ expectations about the course of aggregate demand and the resulting full-employment equilibrium may be way off the mark in any given year, we would expect that over a large number of years they will be right on average—that the downside and upside errors will average out to zero.

A number of important implications of the above analysis must be emphasized. First, levels of employment above or below the natural rate arise because market participants are wrong in their predictions about the course of aggregate demand. When aggregate demand is greater than expected, output rises above the full-employment level and unemployment falls below the natural rate. And when aggregate demand is less than expected, output falls below the full-employment level and unemployment rises above the natural rate. Second, an increase in the stock of money or expansionary fiscal policy will result in an increase in the level of employment only if market participants are either unaware of what the government is doing or misunderstand the effects of government actions on the economy. If the private sector is fully informed about the policies being implemented and the resulting increase in aggregate demand is therefore fully anticipated, wages will be set at a level which will take this increase into account, subject of course to errors in estimating the effects of the ‘known’ policy on the economy. Apart from the effects of these errors, which are equally likely to be in either direction, the level of employment will be no different than it would have been had the government done nothing. Less-than-full employment or over-full employment may also occur because wage and price setters may incorrectly estimate the non-governmental forces affecting aggregate demand. But these expectational errors would have occurred regardless of the government’s monetary and fiscal policy. Finally, it is clear that policy makers face a tradeoff between higher inflation and lower unemployment rates only to the extent that they can fool wage and price setters into believing that they are not going to attempt to move the economy up to the left along the Phillips curve associated with currently held wage and price expectations. As soon as the private sector realizes that the authorities are increasing the rate of inflation, wages and prices will begin inflating at the new full-employment equilibrium level. The Phillips curve will shift up by the increase in the rate of inflation, and unemployment will return to its natural level.

The conclusion that only unexpected government policy actions affect the levels of output and employment is an important and controversial one. An important argument on the dissenting side has been raised by John
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Taylor.\(^{12}\) If workers and firms have formed explicit contracts with respect to the future course of wages, they may not be able to reduce or increase them even if they know they should. In this case the EAS curve is too high and cannot be reduced. A solution would be for the government to conduct expansionary policy to compensate, thereby shifting AD to the right to achieve full-employment equilibrium. In this case expansionary policy has a beneficial result even though private wage and price setters fully understand what the government is doing.

If market participants form their expectations using all information available to them, and are free to readjust wages and prices accordingly, any fully anticipated increase in aggregate demand resulting from fiscal expansion will also result in an increase in wages and prices sufficient to offset its effects on the level of employment. Since most tax and government expenditure changes are either announced in advance or result from known effects of changes in the level of economic activity on tax revenues and public expenditure obligations, it would seem more likely that they will be fully anticipated than would future changes in the rate of money growth.

One type of fiscal policy for which this is particularly true is built-in stabilization. It has been frequently argued over the years that the government should adopt tax policies that make tax revenues positively related to the level of income and expenditure policies that lead to increases in expenditures on unemployment insurance, make-work projects, welfare payments, and so forth, in hard times. As a result, a government deficit will emerge to exert an expansionary effect on the economy in bad times and a budgetary surplus will occur in good times to act as a brake on aggregate demand. Such policies have been adopted by most industrial countries since the Second World War.

Rational expectations considerations suggest that these built-in stabilizers will have little effect on the level of employment. Everyone in the economy who is affected by these policies is likely to have a clear idea of the effects on his or her wealth position over the business cycle. It is thus almost certain that wages and prices will be set with a view to these effects, with the result that aggregate demand changes that result from built-in stabilizers will be fully reflected in current wage and price levels.

Rational expectations considerations also suggest that government budget deficits and surpluses may contain information about future monetary changes that market participants will take into account when setting wages.

and prices. If the government is running a budget deficit, then it must either raise future taxes to pay off the public debt that is being accumulated as a result of that deficit or monetize that debt by exchanging it for newly printed money. In either case the present value of all taxes, present and future, including the tax on money resulting from the inflationary consequences of monetizing the debt, must be the same whether or not there is a budget deficit. If the debt resulting from budget deficits has been frequently monetized in the past, current changes in the government deficit may affect the public’s expectations about the degree of future monetary expansion and inflation. The extent of these effects will depend on market participants’ assessment of the likelihood that the government, in response to political pressure, will try to ‘hide’ future taxes from some members of the public by levying them on money holdings via inflation rather than on incomes or on the consumption of particular commodities such as alcohol, tobacco and gasoline. If monetization of the deficit is expected to occur not too far in the future, it will affect the desired level of current money holdings and the current level of wages and prices.
Exercises

1. Short answer questions.
   a) Explain what is meant by rational expectations.
   b) Derive and explain the expectations augmented supply curve.
   c) What effects do wage contracts have on the expectations augmented supply curve?
   d) Show on an appropriate diagram the effects of an increase in the money supply when the expected price level is constant.
   e) Show on an appropriate diagram the effects of a fully anticipated increase in the nominal money stock.
   f) Show on an appropriate diagram the effects of an expected increase in the nominal money stock that does not materialize.
   g) How can one explain the simultaneous existence of inflation and unemployment?

2. True or false: Explain your answer briefly.
   a) Fully anticipated inflation shifts the demand and supply curves for labour upward in proportion.
   b) The demand for labour depends on the actual price level while the supply of labour depends on the expected price level.
   c) A fully anticipated increase in aggregate demand has no effect on the level of employment while an unanticipated increase in aggregate demand increases both employment and prices.
   d) An anticipated increase in aggregate demand that does not occur will raise the level of employment and prices.
   e) An increase in the expected rate of inflation causes both nominal and real interest rates to increase.
   f) An increase in the expected rate of inflation is impossible when there is less-than-full employment.
g) It is possible to lower the unemployment rate in both the short and long runs by increasing the rate of inflation.

h) It is possible to reduce the inflation rate as well as the level of unemployment by persuading firms and unions to hold the line on wage and price increases.

3. Which of the statements below are true according to a correct interpretation of the meaning of rational expectations?

a) A rational expectation of the price level is the price level agents expect on the basis of all information available to them.

b) A rational expectation of the price level is the price level at which expected aggregate demand equals the full-employment level of aggregate supply.

c) A rational expectation of the price level is that price level that will occur if all currently available information turns out to be correct.

d) A rational expectation of the price level is the price level expected to be consistent with full-employment.

4. Using the standard aggregate demand and supply graphing, with the price level on the vertical axis and the level of output on the horizontal one, show the effects of

a) a fully anticipated increase in aggregate demand.

b) an unanticipated increase in aggregate demand.

c) an anticipated increase in aggregate demand that does not materialize.

Then show the effects of these shocks on a standard IS-LM graph.

5. Consider an economy with aggregate demand and expectations augmented aggregate supply equations of the form

\[ y_d(t) = a(t) + b [m(t) - p(t)] \]

and

\[ y_s(t) = Y_f + z [p(t) - p_e(t)], \]
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where \( b > 0, \ z > 0, \) and the characters \( y, \ m \) and \( p \) refer to the logarithms of \( Y, \ M \) and \( P \) respectively, and the functional forms \( a(t), \ m(t), \ p(t), \) etc., indicate that the variables \( a, \ m, \) and \( p \) are functions of time.

Assume that expectations are rational and demonstrate that output at any point in time will equal its full-employment level plus a component, positive or negative, equal to the effects of unanticipated changes in \( a(t) \) and \( m(t) \). Demonstrate from this that a fully anticipated increase in the money supply will increase prices but have no effect on output, while an unanticipated increase in the money supply will raise both output and the price level.

7. Suppose that the economy is characterized by the following behavioral relationships and parameters:

\[
\begin{align*}
y &= 1 + .5 n + .04 t & \text{production function} \\
y &= .8 c + .2 k & \text{income identity} \\
c &= .5 + .75 y & \text{consumption function} \\
k &= .3 - .025 r & \text{investment function} \\
m - p &= -.95833 + y - .5 i & \text{demand function for money} \\
y - y_f &= .2 [p - p_e] & \text{Lucas supply curve}
\end{align*}
\]

where \( t \) is time and \( y, \ n, \ c, \ k, \ m \) and \( p \) are the logarithms of indexes of output, employment, consumption (private plus government), investment (private plus government), nominal money holdings and the price level, all normalized at 1.0 in the initial year \( t = 0 \). The variables \( i \) and \( r \) are the nominal and real interest rates in percent per year. The economy is initially at its natural level of output and employment and the actual and expected inflation rate is zero.

Calculate the effects on output and the price level of

a) A 10% increase in the nominal money supply that is fully anticipated by wage and price setters.

b) A 10% increase in the nominal money supply that is not anticipated by wage and price setters.

c) An anticipated 10% increase in the nominal money supply that does not materialize.

d) A fully increase in the inflation rate from 5% to 10% per year.

e) A fully anticipated increase in consumption of 10% resulting from fiscal policy that takes the form either of a tax cut or an increase in government expenditure.
f) An unanticipated increase in investment of 10% resulting from a shift in firms’ expectations as to the future profitability of investment.