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Aggregate Supply and Demand Analysis

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with a section on

Social Accounts: Theory and Measurement

by CHARLES L. LEVEN, University of Pittsburgh

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To SIDNEY WEINTRAUB, of course

Contents

Preface

. . . the true law relating the aggregate demand and supply functions. . . is a vitally important chapter of economic theory . . . without which all discussions concerning the volume of aggregate employment are futile.

—J. M. KEYNES, *The General Theory of Employment, Interest, and Money*

What can be the justification for writing a text on macroeconomic theory when, by necessity, a large part of it must be given over to topics adequately covered in existing texts? What this book offers, which other texts do not, is a treatment of Keynesian theory into which price theory has been directly incorporated. We think it is now appropriate to place such an analytical treatment before the well-trained undergraduate and beginning graduate student.

The issues are by no means resolved, but policy makers throughout the free world are acting on the conviction that the price level is related to the money-wage rate. There is ample theoretical support for this belief. Keynes himself, the Cambridge economists close to Keynes, Hicks, and Weintraub, have erected the appropriate theoretical framework, albeit not in terms or places that make it readily comprehensible or available to the beginning student. Thus we have taken it as a fundamental task to promote an interest in and generate an understanding of this body of macroeconomic theory. All of Part III in this book is devoted to this task. The section will appear novel to some readers, since a portion of the analysis is just now appearing in the professional journals, while some ideas appear for the first time in this text.

In Part III, value and distribution theory is linked to Keynesian macroeconomics. Once a bridge between micro- and macroeconomics

is established, it becomes possible to call upon all the theoretical concepts and generalizations of microtheory to increase our understanding of price level and employment phenomena. (After all, it is at the firm level that prices are determined and hiring decisions are made.) The ability to use the "homely but intelligible concepts"[1] of microeconomics in the analysis of macroeconomic phenomena represents an external economy in the development of macroeconomic analysis. The pedagogical advantage of a textbook which forces the student to use his microtheory in developing macroconcepts and solving macroproblems is obvious.

Of course, not everyone will agree with all the implications of this analysis. Our concept of a good textbook, however, is one that brings to the student the excitement of being at the frontier. We think a good text must challenge the student's critical acumen.

Much of this book (all of Part II) is devoted to a careful exposition of that orthodox body of post-Keynesian theory which is formulated in real terms and which normally ignores price level changes before full employment. From both a pedagogical and theoretical point of view, there is much to be gained by laying down the "real" Keynesian functions without the distraction of price level phenomena at the beginning. Even in this section some novel points are made; but, in general, it covers the familar ground treated in many macroeconomic texts. An instructor who has neither the time nor the inclination to get involved in price level problems may consider Parts I, II, and IV adequate for his purposes.

We have asked Charles L. Leven to write the chapter on social accounting in Part IV. Our feeling is that, too often, the discussion of

[1] In comparing neoclassical price theory with neoclassical macroeconomic theory, Keynes noted: "So long as economists are concerned with what is called the Theory of Value, they have been accustomed to teach that prices are governed by the conditions of supply and demand; and, in particular, changes in marginal cost and the elasticity of short-period supply have played a prominent part. But when they pass in volume II, or more often in a separate treatise, to the Theory of Money and Prices, we hear no more of these homely but intelligible concepts and move into a world where prices are governed by the quantity of money, by its income-velocity . . . and little or no attempt is made to relate these vaguer phrases to our former notions of the elasticities of supply and demand." From *J. M. Keynes, The General Theory of Employment, Interest, and Money*, Harcourt, Brace, 1936, p. 292.

the national accounts is presented as an expendable prologue by theorists who have little interest in the sophistry of sectoring and double-entry notation. Professor Leven, however, is an innovator in the theory and practice of social accounting and has a keen appreciation of the dependence of accounting practices on economic theory. We think his treatment of social accounting will be the most rewarding brief statement available to undergraduate or graduate students. Moreover, his rationale for presenting the accounting framework after the theory has been developed, and not before, should prove convincing to all teachers.

The last chapter contains a brief discussion of the empirical and econometric implications of Keynesian theory. The discussion is designed to give the student the flavor of an econometric investigation and raises the many problems which must be overcome in any attempt to test econometrically a macroeconomic model. The emphasis is on econometrics as an art rather than a science.

Since we believe that public policy is an integral part of economic analysis, policy discussions are found throughout the book. Normally they follow immediately after the development of the relevant analysis. The theoretical approach taken here permits a fruitful discussion of wage-, price-, and income-distribution policy, as well as monetary and fiscal policy. The relationships between the balance of payments, international wage and price behavior, and domestic full employment policy are also discussed after the appropriate theory has been developed.

In conclusion, we should like to acknowledge our indebtedness to a few of the many people who have helped us in this undertaking. Our interest in this area began when we were graduate students of Professor Sidney Weintraub. His always provocative and oftimes controversial approach was a continual challenge; and even when we disagreed with him, the result was to generate many ideas which appear in this volume.

Several economists read all or part of the manuscript at various stages and offered constructive suggestions. For their efforts we wish to thank F. Gerard Adams of the University of Pennsylvania, Barbara R. Berman of Brandeis, Kenneth K. Kurihara of Rutgers, and Sidney Weintraub of the University of Pennsylvania. Most especially we owe

thanks for their extraordinary efforts to Miles Fleming of the University of Bristol and Thomas Mayer of the University of California.

No preface would be complete without indicating our families' contributions to this work. Our indebtedness due to the high marginal and average propensities to consume of our wives, Louise and Natalie, was an important motivator in this venture. The natural, rambunctious personalities of our children, Robert, Diane, and Greg Davidson, and Paul and Beth Smolensky drove us back to the peaceful solitude of the manuscript day after day. On the other hand, the ability of our wives and children to tolerate the ebbs and flows of our frustrations as the manuscript progressed was superhuman. Their contribution to this volume can go neither unacknowledged nor unpaid.

PAUL DAVIDSON
EUGENE SMOLENSKY

Philadelphia
June, 1963.

PART I

THE SYSTEM IN BRIEF

CHAPTER I

A simplified equilibrium model

Sometimes, market economies use every available resource to the fullest in a drive to get maximum output. More often, however, market economies use only a part of their available labor and other resources. There were periods in the 1930s, for example, when the United States employed less than 80 percent of the individuals able and willing to work. Why is it that at certain times market economies fail to employ all those who desperately want work, while at other times, grandmothers must be lured into the labor force to meet the demands of industry? It is this fundamental question which we seek to answer in this book.

The basic theory of that which determines the degree to which a market-oriented economy employs its available resources was laid down in 1936 by J. M. Keynes in *The General Theory of Employment, Interest and Money*. In the years since, that theory has been elaborated upon by many others and has become highly sophisticated. In this book only the bare Keynesian essentials, and just those additions which represent fundamental improvements in the model, will be presented in a unified, meaningful form.

THE MODEL

The entrepreneur plays the key causal role in the system. The formidable task facing the entrepreneur is to determine simultaneously what will be produced, the quantities he will produce, the techniques he will employ, and the input mix that will be least costly. These decisions must, in a market economy, be made in advance of actual

sales. Consequently, entrepreneurs must incur considerable costs in anticipation of future sales in making rational production decisions.

There will be some quantity of workers that each entrepreneur will seek to hire for each level of expected sales. In the aggregate, therefore, there will be a systematic relationship between the number of workers (N) that employers will want to hire and the total sales (Z) which entrepreneurs expect. This relationship is called the *aggregate supply function*, and is drawn as the Z-curve in Fig. 1.1. The exact

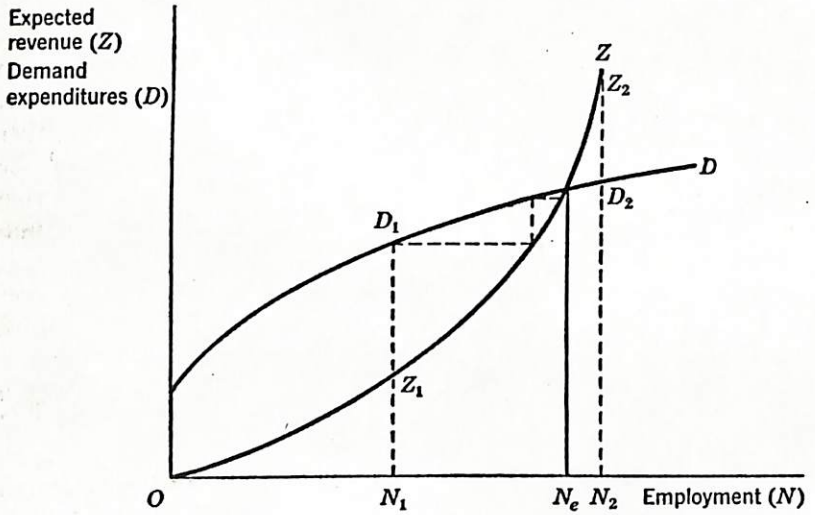

FIG. 1.1. Aggregate Supply and Aggregate Demand.

form of this function will depend upon a number of strategic variables (discussed in Chapter 9). In general, the more entrepreneurs expect to sell, the larger the number of workers entrepreneurs will want to hire, so that the aggregate supply function (in Fig. 1.1) is upward sloping.

Entrepreneurial expectations of sales revenue determine hiring decisions, which, in turn, give direction to the production of goods and services, and set off a flow of money payments to the owners of productive inputs. There will, for example, be a flow of money-wage payments to workers to compensate them for their efforts. Rentiers,

who have previously contracted with business firms to receive a fixed sum of money will be paid, whatever the level of economic activity. Furthermore, managers of enterprises will distribute some of the profits of the firms to the owners. These money income flows to workers, rentiers, and profit recipients provide the funds with which consumers can purchase the goods and services that are produced by industry. Based on a variety of considerations (discussed in Chapters 3 and 10), the recipients of these money income flows will determine how much of their receipts they will spend on consumption goods. In general, the greater the level of employment, the greater the flow of money income payments, and therefore the greater the total spending on consumption goods by the community.

Consumers represent only one (although quantitatively the most important) class of buyers of the output of industry. Governments, foreigners, and businessmen themselves are also purchasers of the products of industry. The decisions as to how much will be spent by these buyers in any period will be based on factors that differ from group to group. Businessmen buy the products of industry mainly to obtain additional production facilities. Government spending is based on a host of considerations including the desire of the community for public services, threats of war, etc. Foreigners will buy domestically produced goods when they cannot purchase the same goods elsewhere at a lower delivered price. At any level of employment, the sum of expenditures by consumers, businessmen, governments, and foreigners *on domestically produced* goods is called aggregate demand. As employment varies, this sum of expenditures will vary. The relationship between the total sum of spending by the four groups and the level of employment is called the *aggregate demand function.* Since as employment increases, the money flow to consumers grows, we may assume that, in general, total spending increases as employment rises. Thus the aggregate demand function will slope upward as indicated by the D-curve in Fig. 1.1.

Given the aggregate supply function which shows how much entrepreneurs would expect to sell at any level of employment,[1] and the

[1] Some economists prefer to say that the aggregate supply function is the amount of actual receipts which would induce the hiring of every specified level of employment. Our formulation, however, is intended to emphasize the fact that, as a rule, hiring decisions precede sales and, therefore, it is the *expectations* of sales revenue which determines the level of employment.

aggregate demand function which indicates how much buyers would want to buy at any level of employment, it is now possible, with the help of Fig. 1.1, to explain what determines the level of employment and sales. For example, suppose entrepreneurs expected sales of Z_1 (in Fig. 1:1). They would hire N_1 workers. When N_1 workers were hired, however, the total sum that all buyers would want to spend would be D_1, which would exceed entrepreneurial expectations. If entrepreneurs hire N_1 workers, they will be pleasantly surprised to find that when they offer the output produced by N_1 workers on the market, demand will exceed supply at the going price. Thus, as Keynes noted,

> there will be an incentive to entrepreneurs to increase employment... and if necessary, to raise costs by competing with one another for the factors of production, up to the value of N for which Z has become equal to D. Thus the volume of employment is given by the point of intersection between the aggregate demand function and the aggregate supply function .... *this is the substance of the General Theory of Employment....*[2]

If we started from a level of employment to the right of the intersection of the aggregate demand and supply functions (such as N_2 in Fig. 1.1), then, at that level of employment, entrepreneurs would be disappointed as they found that buyers wanted to spend only D_2 which is less than entrepreneurial sales expectations which are Z_2. This disappointment would induce entrepreneurs to reduce employment. As long as entrepreneurs hired more than N_e workers, however, buyers' spending would continue to be less than sales expectations. At the employment level N_e, desired purchases will just equal expected sales.

The value of total spending as given by the aggregate demand function where it is intersected by the aggregate supply function, will be called *effective demand.* It represents an equilibrium level of spending, where entrepreneurial expectations are just being realized, so that there is no inducement to change hiring policy. Obviously, the shape and position of the aggregate demand function and the aggregate supply function are essential to the determination of effective demand

[2] J. M. Keynes, *The General Theory of Employment, Interest and Money,* Harcourt, Brace, 1936, p. 25. Italics added.

and, therefore, employment. The various factors upon which these two functions depend are examined in detail in the remainder of this book.

ORGANIZATION OF THIS BOOK

This book is divided into four parts. Part I is devoted to a general statement of goals and procedures and to the development of the specialized vocabulary which is necessary for the precise exposition of the theory. Part II presents the orthodox body of Keynesian theory as it has been developed since 1936. In Part II only demand aspects of the system are emphasized in explaining variations in the total output of the economy. In Part III, on the other hand, aggregate supply and demand receive equal attention in explaining variations in employment and prices. In Part IV, empirical implementation of the theory is discussed. The social accounting framework is presented in such a way as to show how the theory has guided the formulation of generally used social accounting conventions. In the last chapter of the book, a discussion of some econometric applications, which provide a measure of the quantitative implications of the theory, is presented.

A DIGRESSION ON EXPECTATIONS IN A WORLD OF UNCERTAINTY

Economists often construct models that assume away uncertainty. These models are usually justified on the grounds that (1) they eliminate subjective factors, and (2) they ease the mathematical analysis and verbal exposition. Uncertainty, it is implied, merely "muddies the water" without changing the results.

In the real world, however, uncertainty is important and affects all economic activity. Many of the institutions of our modern economy would have no function in a world of certainty. There would be no need for stock market speculation, forward commodity and foreign exchange markets, or pecuniary contracts in a certain world; there

would be less reason for holding money and there would be no profits.[3] These factors, however, play a vital role in the determination of employment only in a world—our world—where the future is uncertain.

The importance of uncertainty has been explicitly introduced into the expectational aspects of the aggregate supply function, as well as in many other relationships in the Keynesian system. Some investigators, however, in attempting to provide an objective, empirically testable formulation of the subjective Keynesian relationships, have given uncertainty elements little or no consideration. In fact, even in the following chapters, there is a tendency to slur the difference between the uncertainties of the real world and the surety of the economic model. We would not be playing fair with the student, however, if we failed to alert him to our own negligence and to the carelessness of others.

Since production decisions depend on future sales, the hiring of workers is clearly based on expectations. These anticipations have been categorized into short- and long-term expectations. Short-term expectations are concerned with the cost of output from existing facilities and anticipations as to the sales revenue obtainable from this output, while long-term expectations are concerned with what the entrepreneur can hope to earn in the future if he makes an addition to his capital equipment. The aggregate supply function is usually thought to be based on short-term expectations, while the demand for investment goods is based on long-term expectations. These two categories are not completely independent. (Entrepreneurs in the capital goods industries, for example, base their short-term expectations on their estimates of the long-term expectations of other entrepreneurs.) Both long- and short-term expectations are relevant for the hiring decision. Actual sales are irrelevant except to the extent that they modify present or future expectations. Similarly, past expectations which may have lead to the accumulation of the present stock of capital goods are not pertinent. Each decision that is made will take into account the present stock of capital, but will reflect current expectations of prospective costs and sales revenue and not prior expectations.

[3] See S. Weintraub, *An Approach to the Theory of Income Distribution*, Chilton, 1958, Chap. 10. See also J. F. Weston, "The Profit Concept and Theory: A Restatement," *Journal of Political Economy*, 62, 1954.

Any change in short-term expectations will alter the employment level desired by entrepreneurs. Time must elapse, however, before changes in hiring decisions can take effect and, therefore, the path of employment from, say, N_1 (in Fig. 1.1) to equilibrium is likely to be more complex than outlined above. Nevertheless, since there is a "large overlap between the . . . realised sale-proceeds of recent output and . . . the sale-proceeds expected from current input,"[4] normally it will be assumed that the economy takes a smooth, direct path to equilibrium.

CONCLUSION

At any point in time the level of effective demand may, or may not, be one which guarantees full employment or any of the other goals usually set for a market system. After just one more preliminary chapter we can turn to the determinants of the level of effective demand and start on the direct but long path towards an understanding of just why it is that the level of effective demand may not be the one which society would choose in the happiest of circumstances.

[4] J. M. Keynes, *op. cit.*, p. 51. Those readers who wish to explore possible subtleties involved in the adjustment path are referred to Keynes' classic treatment of expectations in *op. cit.*, pp. 47–51, 147–164.

CHAPTER 2

The rationale of a forecasting model

DISTINGUISHING BETWEEN FORECASTING AND EQUILIBRIUM MODELS

Those analytical systems which view the economy as being driven by two innately countervailing motives—maximization of profits by entrepreneurs and maximization of utility by consumers—and which examine the circumstances under which these motives result in a situation where neither entrepreneurs nor consumers act to change their economic environment, are termed *equilibrium models*. A model which fails to take into account one or the other of these driving forces will be called, for lack of a more appropriate name, a *forecasting model*, for it attempts to predict the actions of one group without analyzing the actions of the other group.

Typically, the conclusion that can be drawn from an equilibrium model is a statement about those effects which will follow from the eventual equilibrating of the profit maximizing and utility maximizing motives. The conclusion that market price equates supply and demand, for example, is the best known result of an equilibrium model. The components of this model are (1) a demand equation based on utility maximizing assumptions, (2) a supply equation based on profit maximizing suppositions, and (3) the equilibrium condition that the quantity supplied will eventually come to equal the quantity demanded. For example, if the demand and supply curves are linear,

this model can be expressed algebraically as:

$$Q_d = a_1 - b_1P \tag{2.1}$$
$$Q_s = a_2 + b_2P \tag{2.2}$$
$$Q_d = Q_s, \tag{2.3}$$

where Q_d is the quantity demanded of a commodity, say rum, P is the market price of rum, Q_s is the quantity of rum supplied, and the a's and b's are constants. Since the quantity of rum demanded depends upon the market price as shown by (2.1), while the quantity supplied depends upon the market price as shown in (2.2), the value of the market price which is obtained by simultaneously solving (2.1), (2.2), and (2.3) is

$$P = (a_1 - a_2)/(b_1 + b_2). \tag{2.4}$$

This system can also be presented graphically, as in Fig. 2.1. The demand relationship (2.1) is drawn as the line D, while the supply relation (2.2) is the line S. The equilibrium price where the quantity

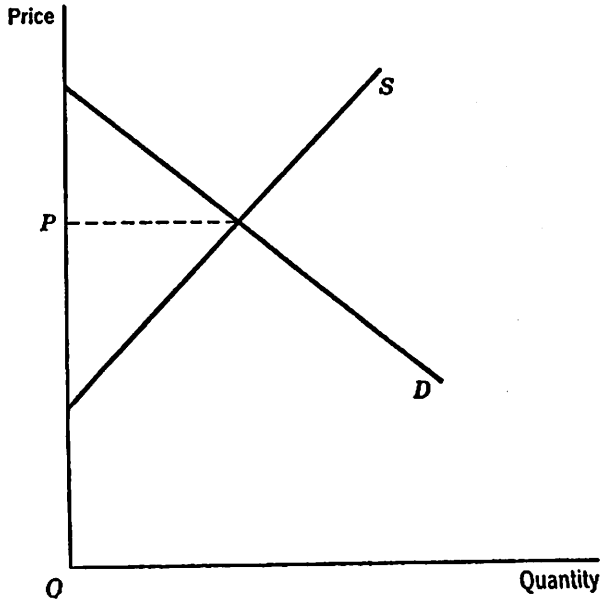

FIG. 2.1. Demand and Supply of Rum.

supplied equals the quantity demanded is given by the intersection of the two curves and is equivalent to (2.4). The price obtained in (2.4) would always be the price for rum if the demand and supply relations never changed, and if the rum market was one in which no transactions occurred until the price arrived at was such that the quantity demanded at that price equaled the quantity supplied at that price. Most markets, of course, are not such auction markets and therefore transactions occur at different prices through time, even when the underlying supply and demand determinants do not change. Consequently, not all prices observed in a market are expected to be equilibrium prices; rather, it is expected that the demand and supply equations represent basic determinants which are stable and which will persist long enough for the price of rum, as it fluctuates through time, to eventually approach the value $(a_1 - a_2)/(b_1 + b_2)$.

Not all economic models are equilibrium models. For some problems, either supply or demand relations may be assumed to have little direct relevance. When this is the case, analysis will be made easier by dropping the equilibrium framework. When the gains from such a simplification exceed the costs of laying aside a part of the underlying determinants, the equilibrium frame is usually dropped. There are many examples in the history of economic thought of instances in which the equilibrium framework was fruitfully abandoned for a forecasting approach. The Ricardian system, for example, in its treatment of the long-run growth problem, tended to skirt the question of demand and concentrated on supply phenomena instead. The Ricardian system was based on Say's Law of Markets, which is often paraphrased as "Supply creates its own demand." Ricardo felt, therefore, that he did not have to give separate consideration to demand conditions, and concentrated his attention solely upon the supply side.

Keynes, rejecting Say's Law, set out an equilibrium model in which both aggregate supply and aggregate demand for output and employment were analyzed.[1] Nevertheless, many of the followers of Keynes have treated his system as if it were a forecasting model. Two basic changes in Keynes' original model were required to effect the conversion. First, it was necessary to orient the analysis towards fluctuations in real income rather than fluctuations in employment. Second,

[1] J. M. Keynes, "The General Theory," S. E. Harris, ed., *The New Economics*, Dobson Ltd., 1949, pp. 190–193.

it was necessary to separate the wage rate from the price level. Once these two adjustments had been made, it became possible to invert Say's Law and to say that demand creates its own supply. Consequently, it was feasible to ignore the supply side.

The forecasting version of the Keynesian system assumes that prices are constant while employment varies directly with real income. This system is able to ignore supply phenomena by relying upon the concept of the *full-employment ceiling*. This concept allows economies to be categorized as either (1) underemployed economies in which changes in output and employment occur without any changes in prices or money wages, or (2) fully-employed economies in which prices and money wages change while output and employment remains fixed. Until the economy reaches some very high level of economic activity which is called full employment, the economy operates under the principles governing underemployed economies. At full employment, a ceiling on output is reached, so that any further increases in demand can affect wages and prices but can not influence employment or output. Making use of the concept of a full-employment ceiling is tantamount to assuming that until full employment is reached, aggregate supply merely accommodates changes in aggregate demand without any changes in prices, while, at the ceiling, output will not expand when demand increases. Thus, investigators believed that they could ignore supply phenomena and merely try to forecast demand in order to understand economies that were not at full employment. The weakness of this view will become apparent in Part III of this book; but in Part II, we shall hold to this simple view since it remains the dominant one among economists and because this model does have considerable value.

FUNCTIONS OF A FORECASTING MODEL

The Keynesian forecasting model concerns itself with the level and composition of aggregate demand in attempting to explain changes in real output. The real output (which is of the same magnitude as real income) of an economy consists of a bewildering array of goods and services which vary from nuclear reactors to tongue depressors. Some

classification scheme must be imposed upon output, if the analysis is not to be swamped by a mass of detail. Many schemes are possible. Experience has shown that the classification scheme which views the economy in terms of the motives of those who choose to acquire the output produced by the economy is the most fruitful. This approach permits aggregate demand to be subdivided neatly into only four relatively homogeneous components: consumption, investment, government, and foreign purchases.

In what sense are these components homogeneous? They are homogeneous in that all buyers in any one of these categories are activated to acquire goods by a common set of motives, but motives vary drastically from category to category. Consumption goods are bought because the buyers want the goods for the utility they expect to obtain from using them. Investment goods, on the other hand, are purchased not because the buyers will derive direct satisfaction from them, but because the buyers want them to facilitate further production and sales. Thus, whether a good is classified as investment or consumption depends not on the physical attributes of the good, but on the motive of the purchaser. A can of peas, for example, that is bought by a grocer for his shelves is an investment good. A can of peas bought by the grocer's wife for her kitchen is a consumption good. The conceptual distinction is clear enough, though the national income accountant may often find measurement difficult.

Government and foreign purchases could each be decomposed, depending upon the motives of the buyer, into either consumption or investment. For many purposes it would be useful to do just that. For the purpose of understanding changes in the total level of economic activity, however, it is expedient to give government and foreign purchases special treatment. It is also consistent to treat these purchases as belonging to separate categories since the conditions which induce purchases in these cases differ greatly from those which dominate domestic consumption and investment spending. Government spending will depend on a number of considerations including the desire of the community for public services, threats of war, the ability of governments to tax or obtain credit, and the willingness of legislators to increase government activity. Foreigners, on the other hand, will purchase domestically-produced goods when they cannot purchase the same goods elsewhere at a lower delivered price.

In conclusion, a Keynesian forecasting model attempts to predict the magnitude of the four components of aggregate demand (consumption, investment, government and foreign purchases). The sum of these four components, in this model, is the level of real effective demand and national output.

EXOGENOUS AND ENDOGENOUS VARIABLES

All theoretical systems or models consist of sets of relationships among variables. These relationships or functions attempt to explain how one variable will change when another one varies. For example, the statement that, as price rises, the quantity demanded decreases, is a simple qualitative relationship between the variables, price and quantity demanded. As stated here, price is the *independent variable* while quantity demanded is the *dependent variable*. Quantity is the dependent variable since it changes only in response to changes in the independent variable, price.

If this single relationship constituted the complete model, then price would also be called an *exogenous variable* since the model would *not* explain why price changes. The model would explain why the quantity demanded changes, and, therefore, the quantity demanded would be the *endogenous variable*. Dependent variables are always endogenous. A variable which is independent in a single relationship may be a dependent variable in another function which is part of the same model. In that case, the variable would be an endogenous variable in the system. Exogenous variables are any variables in a model which are independent in every relationship in which they appear. For example, in most models of consumer behavior, consumer tastes are assumed to be exogenous, that is, no attempt is made to explain changes in consumer tastes.

An analytical model, therefore, consists of a set of endogenous variables expressed in terms of exogenous variables, and model building consists of making an increasingly larger number of relevant variables endogenous. That is how we will proceed in Part II. Real national output is taken as endogenous from the outset. We will always want to explain changes in this strategic variable. As Part II progresses, consumption, investment, and the rate of interest are added as endoge-

nous variables, while government and foreign purchases, and the quantity of money are introduced as exogenous variables. The ultimate outcome is a set of simultaneous equations in which the number of endogenous variables is equal to the number of equations. Presumably, then, this system can be solved for the values of the endogenous variables, if the numerical values of the remaining exogenous variables and a set of statistically determined constants are known. The set of equations obtained in Part II form the basis of orthodox macroeconomic theory. More sophisticated macroanalytic models can and have been built, and these will be discussed in Parts III and IV.

A DIGRESSION: THE CONCEPT OF A SCHEDULE

All economic decisions involve making a choice among alternatives. Economic relationships typically are statements about alternative situations, and are usually expressed as functions. A function is a generalized expression in which all possible values of the dependent variable are related to all possible values of the independent variable. For example, the demand function, $Q = 10 - 2P$, is a simple statement about all possible alternative relationships between the price of a good, P, and the quantity demanded, Q. It is essential to realize that this function describes a schedule of alternative prices and demand quantities. If, for example, the price is \$1.00, then eight units will be demanded. Alternatively, if the price is \$4.00, then two units will be demanded. The number of possible alternative combinations of price and quantity is literally infinite. In the market, however, only one price and one quantity demanded can exist at a point of time, that is, only one alternative of all the possible combinations will occur under a given set of circumstances.

The ability of the reader to distinguish between a movement along the schedule and a change in the entire schedule is basic to an understanding of all economic models. If the price were to change from \$1.00 to \$4.00, then, according to our demand schedule we would expect the quantity demanded to change from eight units to two units. This change in the quantity demanded is induced by a change in the price. *It is not a change in demand.* A change in demand implies that the underlying determinants of the demand function have changed so

that the whole schedule of alternatives has been altered, i.e., at any given price, the quantity demanded will be different than before. For example, a change in demand would imply that the demand function might now be $Q = 25 - 4P$.

Once the reader is able to distinguish between movements from one alternative situation to another on the schedule from a shift in the entire schedule, he will have made considerable progress toward understanding economics.

To distinguish movements along a schedule from shifts in a schedule, i.e., from changes in the entire schedule, phrases such as "at any given level of . . . ," "at each . . . ," or "in the schedule sense . . . ," will be used to indicate changes in the entire schedule. If, for example, there is an upward shift in the demand function for rum, we will state, "*at any given price*, the quantity of rum demanded increases"; or an increase in the aggregate supply function will be indicated by "*at any given level of employment*, entrepreneurial expectations of sales have risen."[2]

On the other hand, if we are discussing a movement from one equilibrium position on the demand schedule for rum to another (induced by an outward shift of the supply function for rum), we will say "as the price declined, the quantity demanded increased." Similarly, a movement along the aggregate supply function from one equilibrium position to another (due to an upward shift in the aggregate demand function) will be indicated by "as total spending increases, employment rises."

[2] The "Swedish School" of economists have distinguished between the concept of the entire schedule and the equilibrium point by using the term *ex ante* for the former and *ex post* for the latter. (See B. Ohlin, "Alternative Theories of the Rate of Interest," *Economic Journal*, 47, 1937, p. 423.) Unfortunately, this terminology has created further confusion. For this reason we prefer our longer but more precise phrases "at any level of . . . ," or "in the schedule sense . . . ," to fix in the readers mind the concept of a schedule change.

find ourselves in a circular trap in which a prerequisite for the operation of the accelerator is that the economy must be at capacity; but if the economy is at full capacity then there can be no increases in output which is a necessary condition for an increase in net investment. Thus it would appear that the accelerator and the ceiling become relevant at the same time.

One way of breaking out of this trap is to define efficient utilization (capacity) of the capital stock as those instances when business firms produce at the minimum point on their average variable cost curves rather than at the physical limits of output. Thus output can be expanded in the short run, by operating the existing stock of capital more intensively; but because of diminishing returns, the increasing cost of producing additional output from existing facilities will encourage entrepreneurs to enlarge their stocks of capital. Until the minimum point on the average variable cost curve is reached, there is no incentive to increase plant and equipment, while the incentive to expand the stock of capital increases if production occurs at a point beyond the minimum cost level.[7]

Although defining optimum utilization of the capital stock in terms of the minimum average cost position removes the theory from the circular trap indicated above, it reduces its usefulness in that the timing of net investment is now less predictable. The problem facing each entrepreneur now is how far beyond the minimum cost level can he afford to operate before it pays to increase the stock of capital. Also, how long a period can he operate his facilities intensively before adding to capacity? This will depend, in part, upon the entrepreneur's expectations about the durability of the increase in demand; for if the higher level of demand is expected to be short-lived then it will not pay to add to capacity. Once the investment problem has been posed in this manner, it is clear that the entrepreneur must base his investment decision on all factors affecting the future rate of return over the full life of the capital good. In short, he must calculate the marginal efficiency of capital and the accelerator is no substitute for this computation. The accelerator may be a way of introducing the current situation into the investment decision making process, but long-run expectations must also be considered.

[7] Of course, even if the incentive to invest is present, entrepreneurs may be unable to acquire the funds necessary to finance new investment.

CHAPTER 6

Simultaneous determination of output and the rate of interest

The dynamic analysis of Chapter 5 can be extended in a number of directions, but these extensions must be reserved for a text dealing specifically with business cycles or with growth models. For us, there remains at this point the important task of completing the static Keynesian system.

We can summarize what has thus far been said about the Keynesian model with the following set of equations[1]:

The output identity,

$$Y \equiv C + I + G + X, \tag{6.1}$$

where Y is output, C is consumption, I is gross investment, G is government spending, and X is net foreign spending.

The consumption function,

$$C = a_1 + b_1 Y. \tag{6.2}$$

The marginal efficiency of capital schedule,

$$I = a_2 - b_2 r, \tag{6.3}$$

where r is the marginal efficiency of capital, and the a's and b's are

[1] Linear equational forms are used merely to simplify the algebra; this does not imply that the actual relationships need be linear.

constants, and the condition that the marginal efficiency of capital equals the rate of interest (i), i.e.,

$$r = i. \tag{6.4}$$

In our simplest case (where $G = X = 0$) we have a linear system of four equations in five unknowns (Y, C, I, r, i), and four statistically determined constants (a_1, b_1, a_2, b_2).

As it stands, the system could not be solved for there would be more unknowns than independent equations. One way out of this is to assume, as in Chapter 4, that the rate of interest is exogenously determined. This would reduce the number of unknowns to four, which is the same as the number of independent equations, and once the magnitudes of the a's and b's were determined a solution would be possible.

The interest rate is, however, a strategic economic variable. It is a determinant of the level of investment and it affects the distribution of income, and consequently, as we shall see in Part III, it indirectly affects the level of employment and prices. Its existence gives rise to a host of financial institutions including the central bank. It continues to be the center of a controversy between Marxist and non-Marxist economists. For these reasons, and many others, it is not satisfactory to treat the rate of interest[2] as exogenously determined. We turn, therefore, to the determinants of the rate of interest by first answering the question, "Why is interest paid?"

To understand the investment decision it was necessary to concentrate attention on those factors which lead some entrepreneurs to choose new investment goods in preference to placements or other secondhand assets. Understanding the process by which the rate of interest is determined turns on a very similar distinction. The key point now is to isolate those factors which lead households and firms to prefer holding some portion of their assets in the form of money rather than in some other form which would generate a future flow of income. (Money is defined as currency plus demand deposits.)

The Keynesian model envisages two separate and distinct decisions that must be made by households and entrepreneurs. The first decision is: what proportion of current income is to be spent? For households, the decision will be based on their propensities to consume and for entrepreneurs it will depend upon the relationship between the marginal efficiency of capital schedule and the going rate of interest. For that proportion of current income which remains unspent, a second decision must be made: in what form is the unspent income to be kept? Will this unspent margin be kept in the form of money, or will it be converted into some financial asset (placement) from which there is an expected future return? Why would anyone wish to keep his unspent income in the form of money and thereby forego the opportunity to earn a future return? The answer to these questions will explain both the existence and the level of the rate of interest.

[2] Remember, although we are using the simplification of a single rate of interest, in reality there is a complex structure of interest rates which vary in different degrees from the riskless rate of interest on a perpetual bond.

LIQUIDITY PREFERENCE: THE MOTIVES FOR HOLDING MONEY

A lusty checking account is obviously an asset calculated to delight households and firms alike. A safe deposit box full of stocks and bonds is also a gratifying possession. Indeed, the safe deposit box is not only gratifying, it is rewarding. Stocks and bonds usually imply that there will be a flow of money payments in the form of dividends and interest. Deposits in a checking account, on the other hand, earn no return. Since every dollar in a checking account, or held as cash, represents a lost earnings opportunity, why would rational income-maximizing households and firms want to hold any money? One possible reason is that cash holdings are temporary—that individuals just cannot unload their money instantaneously. This clearly is not the whole or even a major part of the explanation of cash in pocket and deposits in checking accounts. If it were, then the speed with which money changes hands would be very much more rapid than it is.

In fact, there are excellent reasons for holding money and for foregoing the income which could be earned by giving up money to obtain financial assets. These reasons are conveniently grouped into three categories: the demands for (1) transactions, (2) precautionary, and (3) speculative, cash balances.[3]

[3] These three catagories are mainly for analytical convenience, since "money held for each of the three purposes forms, nevertheless, a single pool, which the holder is under no necessity to segregate into three water-tight compartments . . . ." J. M. Keynes, *The General Theory of Employment, Interest and Money*, Harcourt, Brace, 1936, p. 195.

1. Transactions balances

People and firms receive money payments at discrete points in time, but they incur obligations which must be paid more or less continuously. To meet these obligations when they come due, without more than conventional delay, requires having cash balances or money. You can not even buy a bus ride with a coupon from an A. T. & T. bond; you must have cash. Of course, you could try to sell financial assets, as the cash is needed, but managing assets in this way would be costly since brokers' fees must be paid and, in addition, you might pay dearly for having to convert placements into cash if market prices were unfavorable.

The term to remember is *liquidity*. All assets have varying degrees of liquidity, i.e., varying degrees of loss of value involved in converting assets to money, and varying degrees of time lapse before the conversion can be effected. Only demand deposits and currency are perfectly liquid.[4] To minimize the cost of meeting obligations as they come due, it is cheapest to keep some perfectly liquid assets. It is conventional to call the desire to hold money to meet day-to-day obligations the *transaction demand for money*.

The amount of money held for transactions purposes depends primarily on two factors: (1) the length of time between payments periods (e.g., whether wages are paid weekly, bimonthly, or monthly), and (2) the volume of transactions engaged in between payments periods.

The greater the duration of time between payments periods, all other things being equal, the larger the average cash balance the individual must maintain over the period to meet a given level of obligations as they come due. Nevertheless, since payments practices are largely a matter of custom and only change slowly over time,[5] the duration of the payments period is not likely to induce changes

[4] Even the liquidity of money is a matter of degree, and sometimes even cash will not do, as anyone who has ever tried to buy a bus ride with a fifty dollar bill will testify.

[5] The growth of the use of the credit card may have a significant effect on transactions balances over time. If everything could be purchased by merely showing a credit card, and if the bill for purchases could be timed to coincide with income receipts, then the individual need hold transactions balances only momentarily before turning them over to his creditors.

in the level of demand for transactions balances in the short run, although it may be significant over a long time span.

The amount of money held as transactions balances depends, therefore, primarily upon the level of expenditures since, as the pace of business activity grows, the larger will be the volume of transactions, in any period, and the larger the amount of cash balances needed for foreseeable expenses. In the forecasting model, however, prices are assumed constant; consequently, only changes in physical output can induce changes in the quantity of money demanded for transactions balances. Assuming that there is desired ratio between the quantity of money held for transactions purposes and the level of output, this relationship can then be expressed as the upward sloping line L_t in Fig. 6.1a. Thus, if the level of output is Y_1, then the quantity of money held for transactions purposes will be m_t^1.

2. Precautionary balances

Liquidity is required not only to match up inflows and outflows of money which are reasonably predictable, but to match up inflows of funds and unexpected demands for cash. The transactions motive is meant to cover the need to meet the normal expenses of running a household or firm. In addition, one can count on the fact that certain transactions will arise from time to time that are totally unexpected. There is no way of knowing when your child will fall into an open manhole, or your wife will mash the car fender, or the chef's best tie will fall into the vichyssoise. You do know, however, that demands will be made upon your money which you do not now foresee. Holding cash to meet these requirements which are unexpected in the specifics, but thoroughly foreseeable in general, is termed the *precautionary demand for money*.

As with transactions balances, the amount of money held as precautionary balances will be directly related to the level of output, since as the pace of economic activity quickens, the volume of contingency expenses tends to increase. In Fig. 6.1b, therefore, the relationship between the quantity of money held for precautionary purposes and the level of output is expressed as the upward sloping line L_p. Thus, if the level of output is Y_1, the quantity of money held for precautionary purposes is m_p^1.

3. Speculative balances

There is further motive for holding money apart form the mere avoidance of the cost of converting placements to cash. The rate of return on a placement varies with its price which in turn may vary through time. Timing in the acquisition of placements, therefore, can affect the rate of return earned from financial assets. In particular, once money has been converted to a financial asset, the opportunity to buy that asset sometime in the future at a lower price has been foregone.

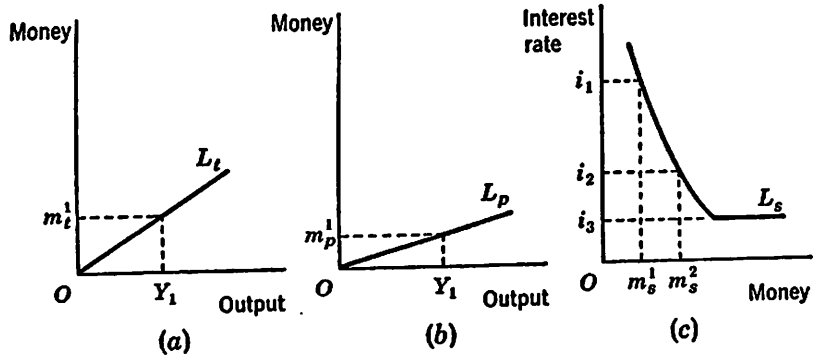

FIGURE 6.1.

For any negotiable bond, there is a direct relationship between its price and the effective interest rate. For example, a United States Treasury bond which will mature in forty years may have a coupon rate of interest of 3 percent and a face value of $1,000. Once the coupon rate of interest is printed on the bond it cannot change. The Treasury will pay the bondholder, whoever he is, $30.00 per year until the bond matures, no matter what price the current bondholder has paid for the bond. At maturity, the Treasury will redeem the bond from the bondholder at its face value of $1,000. As long as the bond is outstanding it can be resold in the market at any price that buyers and sellers can agree upon. It is because the price of the bond can fluctuate, that the effective interest rate to future bondholders can change.

Some bonds have no maturity date. For example, British Consols are perpetual debt obligations of the British government. For such

bonds it is simple arithmetic to illustrate the relationship between the coupon rate of interest, the effective rate, and the price of the bond. Suppose a previously issued perpetual bond with a $1,000 face value has a coupon rate of interest of 3 percent. If the current rate of interest on newly issued perpetuities is 3 percent, then the previously issued bond would be as desirable as the new bonds. Consequently, holders of the old bonds can sell them for $1,000 each in the market.

If, however, the interest rate rose to 6 percent, then a newly issued bond of $1,000 face value would pay the bond holder $60.00 per year. Holders of the old bond, which still pays $30.00 per year, could induce buyers to purchase them, only if they were willing to sell at a market price of $500 (since $30.00 per annum on $500 is a 6 percent return).[6]

In the liquidity preference theory of interest rate determination, it is usually assumed, for purposes of simplifying the exposition, that perpetual, riskless bonds are the only alternative form of financial assets other than money in which unspent income may be held. (This convention will be adhered to until Chapter 13.) For a potential bond buyer who expects a rise in the rate of interest in the coming year, therefore, holding cash at present may be the most profitable course of action. If the interest earned during the interim between the time the bond is bought and the time the rate of interest is expected to rise is less than the fall in the market price of the asset, it is profitable to postpone purchase of the bond until its price falls. In other words, if an individual expects the rate of interest to rise at an annual rate which is greater than the current rate of interest, then it pays to hold cash in order to buy bonds at a lower price in the future. Holding money in anticipation of a rise in the rate of interest (i.e., an expected drop in future bond prices) is called the *speculative motive for holding money*.

The amount of money held as speculative balances will depend on the relationship between expectations as to the future rate of interest relative to the present rate. When interest rates are high the interest income foregone as a consequence of holding cash will be substantial.

[6] The arithmetic is considerably more complicated when the old bond has a maturity date, for then the present value of the bond must take into account not only the value of the future interest payments, but also the redemption payment (properly discounted) at maturity. The market price for this bond can be computed via equation (4.1).

Moreover, when bond yields are high the loss resulting from a possible further decline in bond prices is reduced in two ways. First, the higher the interest income the greater must be the future decline in the bond price in order for the loss in capital value to exceed the earnings. Secondly, and more importantly, if the rate of interest is thought to be high relative to what future rates are expected to be individuals will feel it unlikely that bond prices will fall. In Fig. 6.1c, the relationship between the rate of interest and the quantity of money held for speculative balances is represented by the curve L_s. Our analysis thus far has suggested that if the current rate of interest, say i_1, is high relative to the expected future rate, then the quantity of money held for speculative balances will be small, say m_s^1.

At very low rates of interest, on the other hand, the foregone income from holding cash instead of bonds is very small. Moreover, the potential cost of capital loss from holding a bond is very high. For example, if \$1,000 is invested in a perpetual bond paying one percent per annum, then the interest earned is only \$10.00 per year. However, if the going interest rate should rise to 1.1 percent the next week, the bond price would decline to \$900, implying a capital loss of \$100 if the bond must be sold. In addition, if it is believed that interest rates are low, then individuals will believe it is likely that bond prices will fall. Consequently, with any given set of expectations, the lower the rate of interest the more individuals will desire to hold speculative cash balances instead of holding bonds. Thus, if the interest rate is low, say i_2, then the quantity of money demanded for speculative purposes will be m_s^2 (in Fig. 6.1c).

It is usually agreed that at some low, but positive, rate of interest, say i_3, in Fig. 6.1c, the risk of capital loss is so high, while the opportunity cost of holding cash is so low, that demand for cash balances for speculative reasons becomes perfectly elastic, i.e., individuals will be totally unwilling to give up cash to obtain a bond paying such a low rate. When the interest rate is so low that the demand for speculative balances becomes infinite, then the economy is said to be in a *liquidity trap*. The highly suggestive term "trap" is used to connote that the rate of interest cannot be driven any lower, and that further stimuli to investment and employment via reductions in interest, are no longer possible.

In essence, the speculative motive indicates that an individual attempting to manage his assets in the most efficient way is subject to two types of risk: (1) income risk, and (2) capital risk. If an individual holds money he loses income but keeps his wealth intact. If he holds bonds he gains income but risks loss of capital. In an uncertain world both risks are vexatious and an individual will divide his wealth into money and bonds depending upon his disposition at the margin to bear income risks and capital risks. At each rate of interest, an individual will appraise the magnitude of each of these risks differently. Also, as the rate of interest varies, different individuals will appraise the magnitude of each of these risks differently. At each rate of interest, therefore, the public will disagree about the future course of the rate of interest. This disagreement will divide wealth holders into two groups—those who rush to buy bonds (the "bulls") and those who rush to sell bonds (the "bears"). The price of bonds will ultimately equate the demand for bonds by the bulls with the supply of bonds offered by the bears.

The total demand for money will be viewed as the sum of the transactions, precautionary, and speculative demands for money.

THE SUPPLY OF MONEY

For the society as a whole, the amount of money depends primarily upon the actions of the commercial banks and the monetary authority. The monetary authority can manipulate commercial bank reserves. Commercial banks may use their reserves for several purposes. Some portion (the actual fraction depending upon either law or custom) of these reserves will be held to back the banks' liabilities. (These reserves are the banks' equivalent of transactions and precautionary balances.) The remainder, i.e., excess reserves, are used to maximize bank profits. A bank with excess reserves is faced with the same speculative liquidity decision that confronts individuals. To hold reserves is to forego possible earnings based on the current rate of interest. As with individuals, if the rate of interest is expected to rise sufficiently in the future, the banks will hold their excess reserves rather than purchase debt securities. Alternatively, if bankers believe

interest rates are high, they will want to use these reserves to make loans. Unlike individuals, however, when banks make loans they create additional demand deposits which increase the money supply. Thus, the actions of the monetary authority in creating commercial bank reserves in tandem with the actions of the commercial banks in creating demand deposits determines the supply of money.[7] At any point in time, we will assume that the supply of money has been exogenously determined by the banking system.[8]

THE DETERMINATION OF THE RATE OF INTEREST AND THE LEVEL OF OUTPUT

The banking system determines the supply of money, while the motives for holding cash balances determines the demand for money. The rate of interest brings the demand for money into equality with the supply of money. The interest rate will also affect the level of investment and therefore the level of output which, in turn, will feed back on the demand for transactions and precautionary balances. All these adjustments will be taking place simultaneously in the economy; but for expositional purposes it is necessary to break into this process at some point and to speak as if decisions which are really being made simultaneously occur in some sequence.

Let us start with a given quantity of money which exists in the system due to the decisions of the commercial banks and the monetary authority. Holders of this quantity of money must decide whether or not to keep their cash or acquire bonds. Given the level of output, they determine their transaction and their precautionary needs for cash. Now, what of the remaining quantity of money? Those individuals who hold money in excess of their transactions and precautionary needs and who feel that the rate of interest is sufficient to compensate them for their loss of liquidity, will seek to purchase bonds. Others who presently hold cash and some who hold bonds may expect bond prices to fall and prefer to hold cash. The public will form into two groups—the "bulls" and the "bears." The bulls will wish to buy bonds and the bears will want to sell bonds. If the bulls predominate, then prices of bonds will rise (interest rates will fall). With a fall in the rate of interest, given the marginal efficiency of capital schedule, entrepreneurs will increase real investment. Output will rise by some multiple of the increase in investment which, in turn, will generate an increase in the demand for transactions and precautionary balances. The increased demand for these balances, with a constant money supply, will bring upward pressure to bear on the rate of interest. This process will proceed until the economy eventually reaches a level of output and a rate of interest which will persist as long as the underlying determinants hold fast.

[7] Of course, there are additional factors which may affect the size of bank reserves, e.g., the public's desire to hold its money in the form of currency rather than demand deposits.

[8] The usual procedure of treating the liquidity motives of the nonbank public as the basis for the demand function for money, while treating the liquidity motives of commercial banks as the foundation for the supply function of money, attributes essentially the same motives to demand in the one case and to supply in the other. An alternative formulation would to be include commercial bank liquidity motives in the total demand for balances by including the commercial banks' holdings of excess reserves multiplied by the deposit-expansion coefficient in the speculative demand. For consistency, the supply of money would then have to be defined as the total money potential, i.e., the sum of currency existing plus demand deposits plus the maximum demand-deposits that the banking system could create if it were fully "loaned-up." See S. Weintraub, *An Approach to the Theory of Income Distribution*, Chilton, 1958, p. 163.

Algebraic solution

The simultaneity of the system is brought out by restating the model algebraically. We have the following system of equations:

The output identity,

$$Y \equiv C + I. \tag{6.5}$$

The consumption function,

$$C = a_1 + b_1 Y. \tag{6.6}$$

The marginal efficiency of capital schedule,

$$I = a_2 - b_2 r. \tag{6.7}$$

The demand for money schedule which is the sum of the demand functions for transactions, precautionary, and speculative balances,

which, *outside of the liquidity trap*, may be written as[9]

$$m = \alpha_3 + (\beta_1 + \beta_2)Y - \beta_3 i. \tag{6.8a}$$

This equation implies that the demand for money is an increasing function of the level of employment and a decreasing function of the rate of interest. In other words, if output rises then the demand for money for transactions and precautionary purposes will increase, while if the rate of interest increases (with a given set of expectations) the demand for speculative balances will decrease. The total demand for money will depend on both of these factors. Equation (6.8a) is applicable at any time except when the economy is in the liquidity trap. When the economy is in the liquidity trap, the demand for speculative balances becomes infinite, so that the demand for money can be expressed algebraically as

$$i = \alpha_2, \tag{6.8b}$$

where α_2 is a constant.

Equations (6.6) to (6.8) are the behavioral determinants of the system. Several further equations are required to complete the system. Firstly, there is the condition that the rate of interest equals the rate of return of the marginal investment (r):

$$i = r. \tag{6.9}$$

Secondly, the quantity of money is assumed to be exogenously determined:

$$m = \overline{m}, \tag{6.10}$$

where $\overline{m}$ is the exogenously determined quantity of money.

Once $\overline{m}$ is set, the system can be solved for all the remaining unknowns (output, consumption, investment, the rate of interest, and the marginal efficiency of capital).

Economists have, however, found their comprehension of the system is improved by reducing the system to two equations in two unknowns.

[9] The transactions demand function is $m_t = \beta_1 Y$, the precautionary function is $m_p = \beta_2 Y$, and the speculative function is $m_s = \alpha_3 - \beta_3 i$. Combining these functions we obtain $m_t + m_p + m_s = m = (\beta_1 + \beta_2)Y + \alpha_3 - \beta_3 i$.

Equation (6.11) is formed by combining the output identity, the consumption function and marginal efficiency schedule:

$$Y = \left(\frac{1}{1 - b_1}\right)(a_1 + a_2 - b_2 r). \tag{6.11}$$

Since from (6.9), $r = i$, therefore

$$Y = \left(\frac{1}{1 - b_1}\right)(a_1 + a_2 - b_2 i). \tag{6.12}$$

Equation (6.12) traces out all values of output and interest compatible with the investment and consumption functions and summarizes what has been said about real transactions in commodities. Combining (6.10) with (6.8a) and rearranging terms[10] yields (6.13a); combining (6.10) with (6.8b) yields (6.13b). Either of these link the supply and demand for money together:

$$i = a_3 + b_3 Y - c_3 \overline{m}; \tag{6.13a}$$

$$i = \alpha. \tag{6.13b}$$

Equation (6.13a) may be interpreted as follows: *if the money stock is constant*, then the rate of interest will vary directly with the level of output as the demand for transactions and precautionary balances increases, while, *at any level of gross output*, an increase in the quantity of money will lead to a decrease in the rate of interest as the additional money is absorbed into speculative balances. Equation (6.13b) indicates that at some positive rate of interest the demand for money (for speculative purposes) is infinite. Equation (6.13b) is applicable in the liquidity trap.

While (6.12) summarizes our view of the commodities markets, (6.13a) or (6.13b) summarizes our view of the money market.

The values of Y and i which satisfy both (6.12) and (6.13) (either a or b) reflect the interaction of the commodities and money markets. Output and interest are the determinates of the system, while the money supply, the demand for cash balances, the marginal efficiency of capital schedule, and the consumption function are its determinants.

[10] Letting $\frac{\beta_1 + \beta_2}{\beta_3} = b_3$, $\frac{\alpha_3}{\beta_3} = a_3$, and $\frac{1}{\beta_3} = c_3$, and rearranging terms, results in equation 13a.

Graphic solution

Further insight may be gained by a hypothetical example. Let

$$C = 10 + .5Y, \tag{6.6'}$$
$$I = 50 - 5.00r, \tag{6.7'}$$
$$i = .02 + .003Y - .0008\overline{m}, \tag{6.8a'}$$
$$i = .01, \tag{6.8b'}$$
$$\overline{m} = 150. \tag{6.10'}$$

Substituting (6.6′) and (6.7′) into (6.5) yields

$$Y = 60 + .5Y - 5.00r.$$

Rearranging terms,

$$Y = \left(\frac{1}{1 - .5}\right)(60 - 5.00r), \tag{6.11'}$$

or, making use of (6.9),

$$Y = \left(\frac{1}{1 - .5}\right)(60 - 5.00i). \tag{6.12'}$$

Substituting (6.10′) into (6.8a′) yields

$$i = -.10 + .003Y. \tag{6.13a'}$$

In Fig. 6.2, equation (6.12′) is plotted and labelled *CI*. Equation (6.13a′) is plotted as the curve L_1M in the same figure. This L_1M function envisages the possibility of the rate of interest falling as low as −.10. In our verbal analysis, however, the point was made that the rate of interest will not fall below some minimum positive level. Assume that the minimum rate of interest is about 1 percent. Accordingly, at the 1 percent rate, (6.8b′) (where $\alpha = .01$) is relevant. It is for this reason that the L_1M function is drawn as a dotted line below the 1 percent level. The discontinuous curve L_2M more realistically describes the money market. Given the *CI* curve and the L_2M curve, the resulting level of output is 55(= Y^*), while the interest rate is 6.5 percent (= i^*).

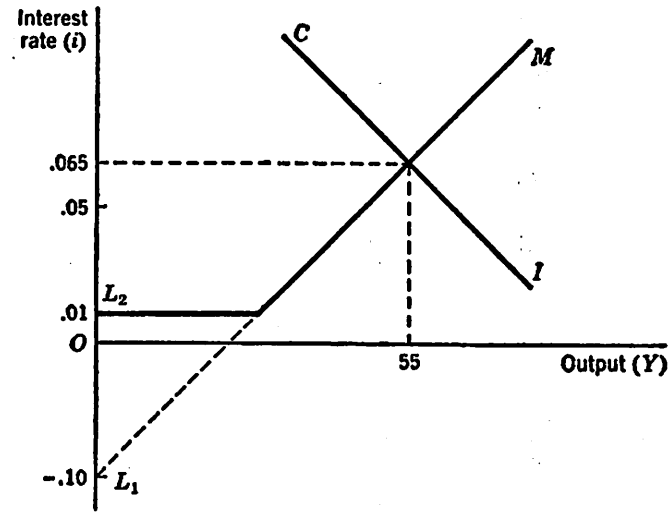

FIGURE 6.2.

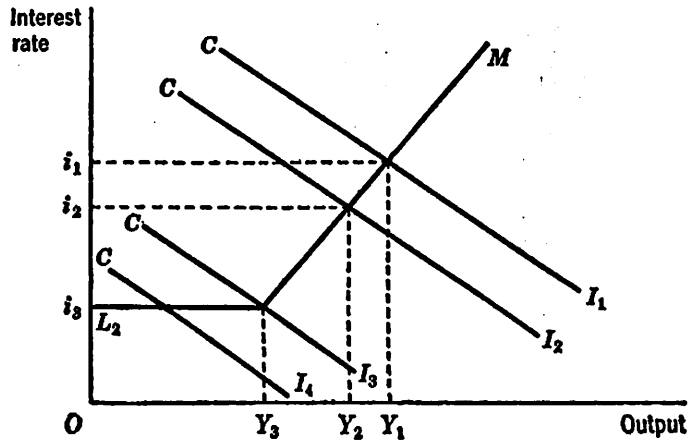

FIGURE 6.3.

Any change in the determinants of the system will yield a new Y^* and i^*. For example, let the CI_1 curve in Fig. 6.3 represent the initial relationship in the commodity markets which when taken with the L_2M schedule results in an output level and interest rate of Y_1 and i_1, respectively. If now we posit a decline in the consumption function, then the *CI* schedules shift downward to CI_2. As a consequence, output will decline to Y_2 while the rate of interest falls to i_2. If the *CI* curve were to decline to CI_3, then there would be a further drop in output to Y_3 and the rate of interest to i_3. At this point, however, the economy is on the boundary of the liquidity trap and any further downward shift in the *CI* function, say to CI_4, will reduce output but will leave the rate of interest unaffected.

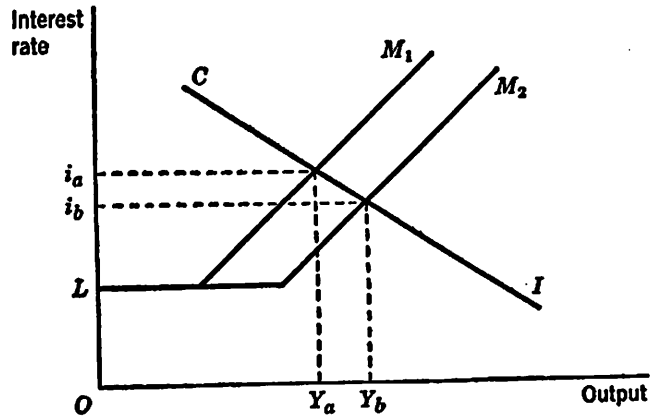

FIGURE 6.4.

In Fig. 6.4, effects of changes in the quantity of money are illustrated. If, for example, the initial stock of money was m_1, then the LM_1 curve describes the money market conditions; and given the marginal efficiency of capital and consumption functions, Y_a and i_a are the resulting levels of output and interest. If the quantity of money is increased to m_2, then at any level of output (outside the liquidity trap), the rate of interest is lower than before. Consequently, the *LM* curve shifts outward to LM_2, and the level of output rises to Y_b while the rate of interest falls to i_b.

Any change in the underlying determinants will affect the *CI* and/or the *LM* schedules. If, for example, the marginal efficiency of capital schedule rises as entrepreneurs become more optimistic, then the *CI* schedule would shift outward from CI_1 to CI_2 (in Fig. 6.5). At any given rate of interest, such as i_1, the corresponding output level (Y_2) on the CI_2 curve will be greater than the output level *at the same rate of interest* on the CI_1 curve (Y_1). The change in the level of output ($Y_2 - Y_1$) at any given rate of interest is, of course, equal to the change in the level of investment due to the shift in the marginal efficiency of capital schedule multiplied by the simple multiplier.

The actual change in the level of output, however, will be less than $Y_2 - Y_1$. When the marginal efficiency of capital schedule shifts up-

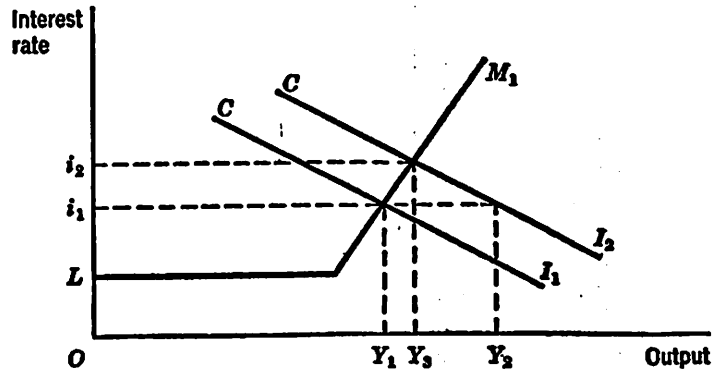

FIGURE 6.5.

ward, output increases and the demand for transactions and precautionary balances will increase. Thus, given the supply of money, there is upward pressure on the rate of interest. As the interest rate rises to i_2, the level of investment actually induced by the shift in the marginal efficiency of capital schedule will be less than if the interest rate remained unchanged. Consequently, the actual change in output (to the Y_3 level) will be less than it would have been had the interest rate remained constant.

Our present analysis indicates, therefore, that an implicit assumption of the simple multiplier analysis of Chapter 3 was that there was

monetary neutrality, that is, that the monetary authority always adjusts the supply of money to any changes in demand for cash balances, so that the rate of interest remains unchanged. Normally, however, we may expect that changes in spending will partly affect the level of output and partly affect the rate of interest, so that the simple multiplier overstates the effect on output of a shift in the marginal efficiency of capital schedule.

In summary, we note that the marginal efficiency of capital schedule and the consumption function are the basic determinants of the *CI* schedule, while the demand for cash balances and the supply of money are the basic determinants of the *LM* curve. Any change in any of the basic determinants will alter the level of output and the rate of interest.

Upward shifts in the *CI* schedule may be a result of either an outward shift in the marginal efficiency of capital schedule because of an improvement in the expected rates of return, or an increase in the consumption function because of a change in consumer tastes. Downward movements in the *CI* schedule will be due to either a decline in the marginal efficiency of capital schedule or a decline in the consumption function.

The *LM* curve will shift outward if either the supply of money increases or the demand for cash balances declines; while the *LM* function will shift inwards if either the supply of money decreases or the demand schedule for cash balances increases. Changes in the supply of money will be the result of action of the monetary authority and the commercial banks. Changes in the demand schedule for cash balances will be due to a change in expectations about future rates of interest.

In general, any outward shift of the *CI* schedule will increase output and the rate of interest, while an outward shift of the *LM* curve will raise output and *lower* the rate of interest (except in the liquidity trap).

IMPLICATIONS FOR MONETARY POLICY

Monetary policy is that set of decisions and actions taken by the monetary authority (usually the central bank) to affect aggregate economic activity. The monetary authority can affect the level of

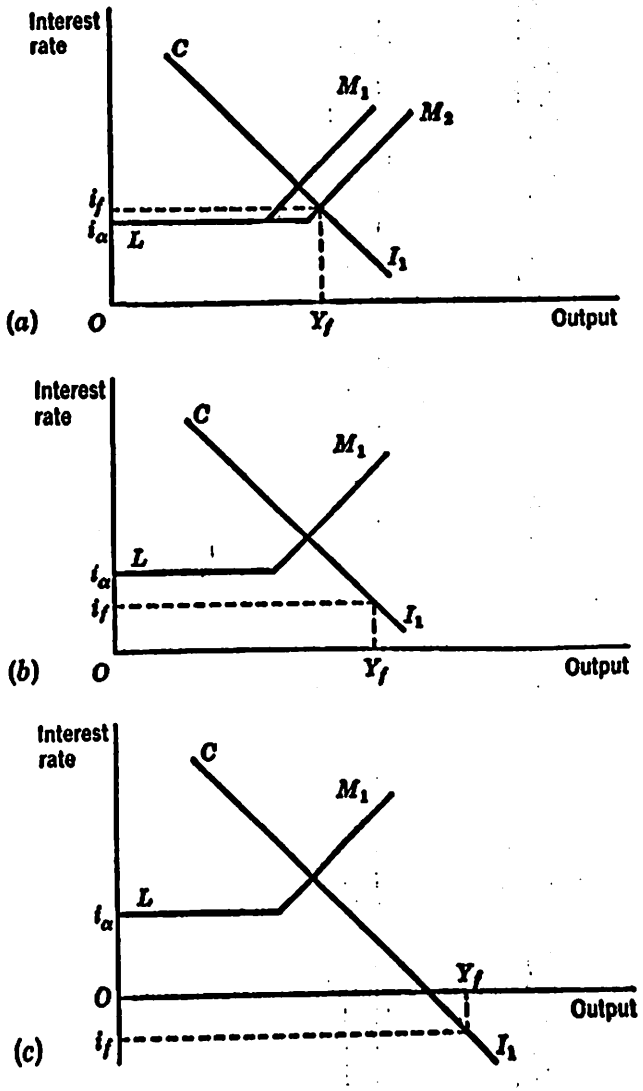

FIGURE 6.6.

aggregate economic activity either by changing the supply of money or by changing expectations of the public about the future rate of interest (i.e., by "moral suasion") or both. The *direct* impact of any policy taken by the monetary authority shifts the *LM* schedule.[11] An "easy money" policy, for example, is one which shifts the *LM* schedule outwards. Any monetary policy which increases the quantity of money (e.g., open market purchases of bonds by the central bank) tends to bring about "easy money." The effect of an easy money policy is to reduce the rate of interest (except in the liquidity trap) which stimulates additional investment spending, which, in turn, induces an increase in consumption expenditures. This sequence of induced additional expenditures will result in a higher level of gross output; the new level being given by the intersection of the original *CI* function with the new *LM* function. On the other hand, if the economy is in the liquidity trap, changes in the money supply, *ceteris paribus*, can not alter the rate of interest; consequently, monetary policy will be ineffective in the liquidity trap.

Given the *CI* schedule (i.e., the marginal efficiency of capital schedule and the consumption function), there will be some rate of interest which will bring forth just enough demand for investment and consumption goods to generate full employment. For example, in Fig. 6.6a, if Y_f is the full employment level of output, then, given the *CI* schedule CI_1, an interest rate of i_f will produce full employment. If i_f exceeds the rate of interest in the liquidity trap (i_a), as in Fig. 6.6a, then, given the liquidity preference of the community, a monetary policy which results in that supply of money which produces the LM_2 schedule would result in full employment. In this case, there is a monetary policy which can produce full employment. If, on the other hand, i_f is below i_a, as in Fig. 6.6b and 6.6c, then there is no monetary policy which can bring about full employment. In the latter case, only a sufficiently large outward shift of the *CI* schedule, that is, an increase in the demand schedule for goods, will make full employment possible. Government policy can affect the *CI* schedule. The effect of governmental policy on the aggregate demand for goods is the subject of the next chapter.

[11] It is conceivable that monetary policy might indirectly affect businessmen's state of confidence and therefore alter profit expectations. Under these circumstances, the *CI* schedule would be altered.

CHAPTER 7

Government and the level of output

FUNCTIONAL FINANCE

The preceding chapters are an abstract view of how an economy comes to produce aggregate private output in some year. Now, it is possible that gross private output, if left to the determinants thus far isolated would not be what the nation wants it to be. Output may be too large, or too small, or composed of the wrong things (where "too large," "too small," and "wrong" refer back to some national consensus about the ideal level and composition of output).

If an economy is to satisfy the national consensus by reaching the desired level of output, individuals may be required to take actions which are in conflict with their own self-interest. A small manufacturer, for example, who plagued by his social conscience raises the salaries of his employees during a recession in order to stimulate spending, will soon find himself out of business and ineligible for unemployment compensation. Since individuals cannot be expected to act against their own self-interest, some goals can be achieved only by a coordinated effort on the part of the whole community; and normally only governments can mobilize such an effort. Broad powers have been given to governments to effectuate such coordination. These powers fall mainly into two categories: monetary powers and fiscal powers. This chapter is concerned only with fiscal policies.

Fiscal policies are governmental decisions taken with respect to receipts and expenditures. These policies involve making decisions

CHAPTER 9

Aggregate supply

In this part of the book an aggregate equilibrium model will be developed. In the forecasting model developed in Part II, supply aspects were suppressed while aggregate demand was emphasized. In Part III both aggregate supply and aggregate demand will be incorporated into an equilibrium model.[1] This model will view the economy as being driven by two innately countervailing forces: (1) short-run profit maximization by entrepreneurs which underlies supply conditions, and (2) utility maximization by consumers and long-run profit maximization by entrepreneurs which form the foundation of aggregate demand. In most circumstances, this interaction of sellers and buyers will tend to create a situation which neither side will act to change, that is, a stable equilibrium results.

In order to develop the equilibrium model, some of the concepts developed in Part II must be redefined, and one new major concept, the aggregate supply function, will be developed. In Chapter 9 the aggregate supply function will be developed. In Chapter 10 the aggregate demand function will be redefined and the equilibrium solution obtained.

THE AGGREGATE SUPPLY FUNCTION

The aggregate supply function relates the number of workers that entrepreneurs would want to hire to each level of expected total

[1] Much of the analysis of Part III rests upon S. Weintraub's, *An Approach to the Theory of Income Distribution*, Chilton, 1958. See also P. Davidson, "More on the Aggregate Supply Function," *Economic Journal*, 72, 1962.

revenue. Entrepreneur's expectations of total revenue will depend upon the market price they expect to receive from selling the output produced by these workers. In short, the aggregate supply function links expected sales revenue to employment. If businessmen expect sales to rise, they will hire more workers. Expectations of sales changes and changes in employment are directly related. In a market economy in which goods are typically produced in anticipation of sales, the aggregate supply function describes a very realistic relationship.

Since all hiring decisions occur at the level of the individual business firm, it is the theory of the firm which provides the foundation for the aggregate supply function. In the following section, the aggregate supply function will be derived from the supply curve of the firm.

DERIVING THE AGGREGATE SUPPLY FUNCTION

Assumptions of the equilibrium model

It is best to list the assumptions underlying the equilibrium model at the outset. These suppositions are common to most short-run equilibrium models, although they are often not explicitly stated. These assumptions are, (1) a purely competitive, closed economy, with profit maximizing entrepreneurs, (2) a constant money-wage rate, (3) a homogeneous labor force as the only variable factor of production, and (4) fully integrated firms which have a given stock of equipment and a given technology.[2] These simplifying assumptions will be relaxed in the final section of this chapter to suggest how alternative assumptions will modify the aggregate supply function.

The supply curve of the firm

Each entrepreneur will hire that quantity of labor which, in combination with his existing plant and equipment, will be most efficient. For any level of output, therefore, the number of hired workers will be the least that technology allows. The relationship between the efficient utilization of workers and the resulting output is the total

[2] A fully integrated firm is one which carries on all the production processes from the raw material stage to the retail stage.

product function. This function typically has the shape shown by the curve *TP* in Fig. 9.1a. From the total product curve, a relationship between increments in output and increments in labor, i.e., the marginal physical productivity of labor, which is shown as the curve *M* in Fig. 9.1a, can be derived. The essential characteristic of the marginal productivity curve is that as labor is added to the stock of capital there

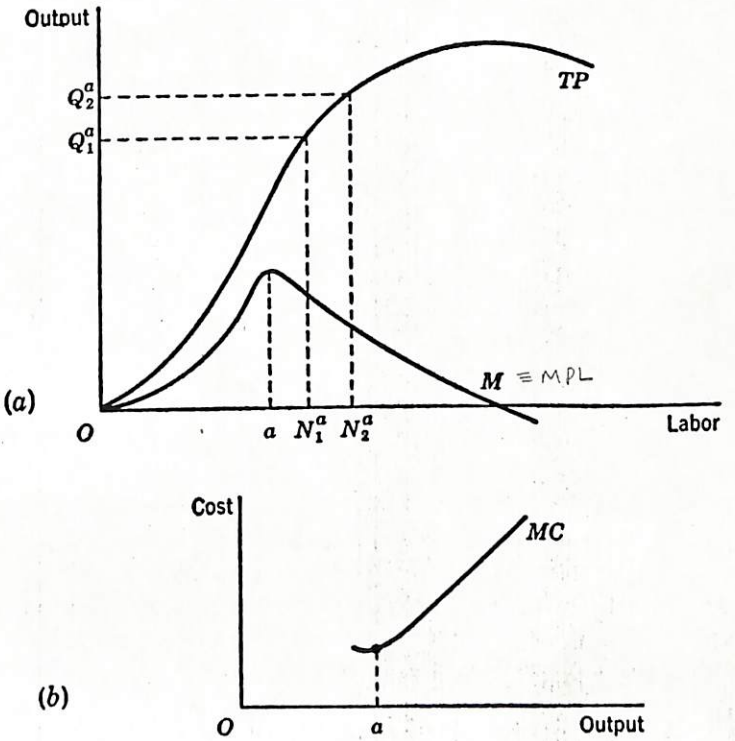

FIGURE 9.1.

is a point (*a* in Fig. 9.1a) beyond which increments in labor yield smaller and smaller increments in output, that is, eventually there are diminishing returns to labor.

The increase in cost associated with an increase in output is called *marginal cost*, and, when labor is the only variable input, is equal to

the money-wage rate divided by the marginal product of labor:

$$MC = \frac{w}{M}, \tag{9.1}$$

where MC is marginal cost, w is the money-wage rate, and M is the marginal product of labor. Given a constant money-wage rate, marginal cost varies inversely with the marginal product of labor. When output and employment of the firm exceeds the point of diminishing returns, marginal cost will rise (Fig. 9.1b). Since we are assuming profit maximizing firms which operate in purely competitive markets, each firm will choose to produce at that level of output (and hire a certain quantity of labor) at which market price equals marginal cost.[3] Consequently, the marginal cost curve of the firm is the firm's supply curve. That is, the marginal cost curve of the firm, where it is above the average variable cost curve, indicates the quantity the firm will be willing to sell at each price. Since the marginal cost curve is upward sloping, entrepreneurs will be encouraged to increase output and employment only if they expect prices to rise.

Once the level of output is determined from the marginal cost curve, the entrepreneur can then determine the number of workers required to produce that output by referring to the total product curve.

The industry supply curve and aggregate supply

Given the above assumptions, the industry short-run supply curve is easily determined. It is simply the lateral summation of the marginal cost curve of each firm in the industry. The supply curve for industry A is shown in Fig. 9.2. It represents the alternative collective offerings of output by the entrepreneurs of industry A for alternative market prices.

The variables involved in the industry supply curve are different from those used in the aggregate supply function. The industry supply function relates output quantities with expected market prices; the aggregate supply function, on the other hand, relates expected total revenue (i.e., output multiplied by expected market prices) to employment. The conversion of the industry supply curve to the aggregate

[3] In pure competition firms will always operate in the region of increasing marginal costs.

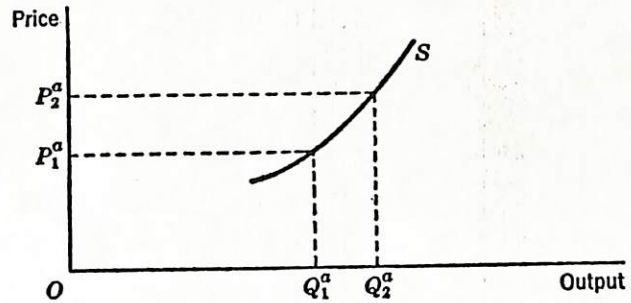

FIGURE 9.2.

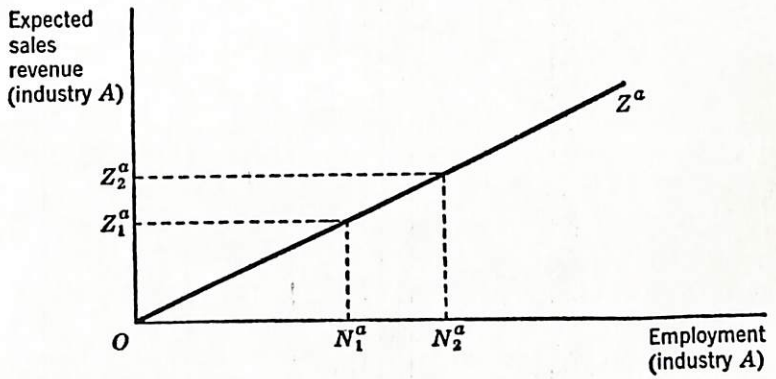

FIGURE 9.3.

supply curve may easily be accomplished with the aid of the total product curve of each industry.

Given industry A's supply curve in Fig. 9.2, if the entrepreneurs of that industry expect a price of P_1^a, they will be willing to produce Q_1^a units of output, and will expect total revenue Z_1^a, which is equal to $P_1^a Q_1^a$. To produce Q_1^a output, a certain number of workers will have to be hired. If the total product curve of industry A is represented by TP in Fig. 9.1a, then to produce Q_1^a output, N_1^a workers will have to be hired. Consequently, if entrepreneurs in industry A expect total revenue of Z_1^a, they will hire N_1^a workers (Fig. 9.3).

Similarly, if businessmen expect the price P_2^a to rule in the market, they will maximize profits by producing Q_2^a output which will neces-

sitate the hiring of N_2^a workers. Anticipated total sales revenue would be Z_2^a which equals $P_2^a Q_2^a$. Thus, an expected revenue-employment curve for industry A can be derived which relates expected total revenue to employment in the industry as in Fig. 9.3.

An expected revenue-employment function may be derived in the same way for each industry in the economy. The aggregate supply function is obtained by aggregating the industry expected revenue-employment functions over all industries. Thus, an aggregate supply function, Fig. 9.4, is derived from the industry supply curves. If the

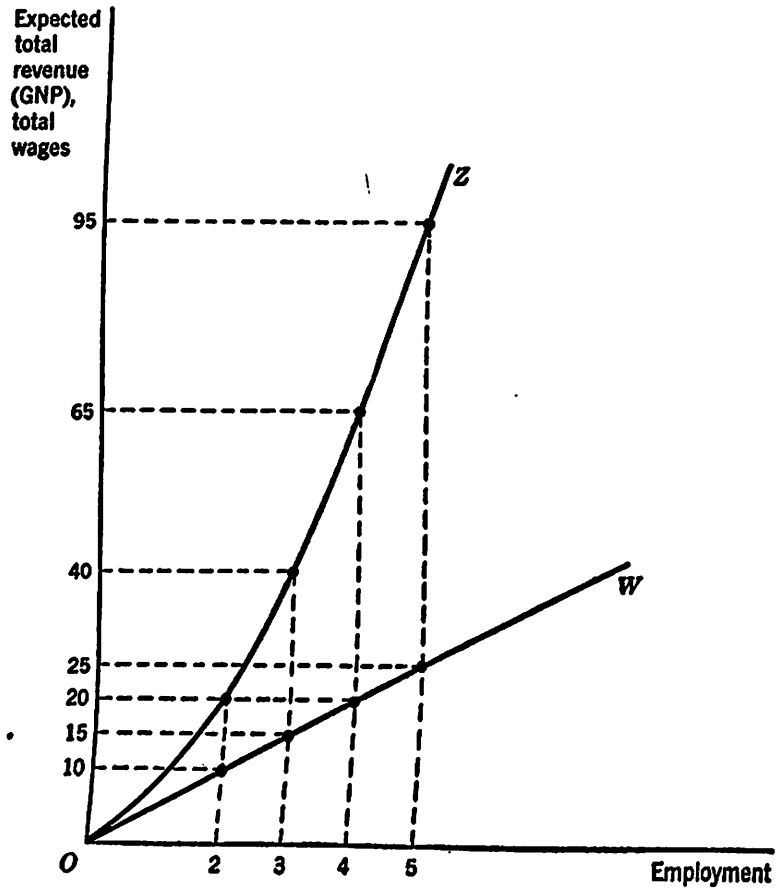

FIGURE 9.4.

industry supply curves are known, and if each aggregate level of expected total revenue corresponds to a unique distribution of this sales revenue among all industries, then a unique aggregate supply function is obtained.

The assumption that all firms are fully integrated implies that aggregate total revenue is equal to the value of gross output, i.e., the gross national product (GNP) of the economy.[4] The value of gross output is also equivalent to the gross money income of the economy. *Thus, the aggregate supply function relates expected levels of GNP to employment.*

A price level is implicit at each point on the aggregate supply function. Since market prices are related to marginal costs, which are rising due to diminishing returns, prices will increase as employment rises, even if the money-wage rate is constant.

A hypothetical example

It may be helpful to use a hypothetical example to indicate how the aggregate supply function should be interpreted. This hypothetical example will also be useful in suggesting several important implications of the aggregate supply function.

Using hypothetical data, the aggregate supply function is illustrated in Table 9.1. Underlying the figures in Table 9.1 is the assumption that the money-wage is \$5,000 per year. If entrepreneurs in the

Table 9.1. A Hypothetical Example of Aggregate Supply and the Distribution of Income

(1) Gross National Product Z (billions)	(2) Employment N (millions)	(3) Wage Bill $W = wN$ (billions)	(4) Fixed costs F (billions)	(5) Gross profits $R = Z - F - W$ (billions)
\$ 0	0	\$ 0	\$5	\$−5
20	2	10	5	5
40	3	15	5	20
65	4	20	5	40
95	5	25	5	65

[4] Implicit in this statement is the assumption that all production occurs in the private sector.

aggregate were to expect GNP to be zero, they would not hire any workers; consequently, the aggregate supply curve emanates from the origin. If GNP is expected to be $20 billion, then, according to Table 9.1, two million workers would be hired and the total wage bill would be $10 billion (two million multiplied by $5,000). Alternatively, if a GNP of $40 billion were expected, then three million workers would be hired. Thus, by using the data in columns (1) and (2) of Table 9.1, an aggregate supply function (Fig. 9.4) may be plotted. Furthermore, from the data in columns (2) and (3), a total wage bill line (OW) can be plotted. The slope of this line is equal to the money-wage rate, w, while the line indicates the relationship between total money wage payments and the level of employment.

A DIGRESSION: INCOME DISTRIBUTION AND AGGREGATE SUPPLY

At any level of employment, the position of the aggregate supply curve relative to the wage bill line determines the relative wage share, i.e., the proportion of GNP which is paid to wage-earners. Also, the vertical difference between the aggregate supply curve and the wage bill line at any employment level represents the difference between total revenue and total variable costs for all the firms in the economy. Thus, in Table 9.1, when two million workers are employed, entrepreneurs expect revenue to exceed variable costs (the wage bill) by $10 billion, or alternatively, they expect the wage share to be one-half of GNP. In this hypothetical example, entrepreneurs expect the wage share to decline with increases in employment. The distribution of income and the aggregate supply function are interrelated. A careful examination of the relationship between income distribution and aggregate supply conditions will enable us to draw generalizations about the shape and position of the aggregate supply function.

The distribution of income in the economy reflects the distribution of total revenue at the firm level. To analyze the relationship of employment and distribution, therefore, we must return to the theory of the firm. Under our assumptions of pure competition and profit maximization, each firm, accepting the money-wage rate as a datum,

will maximize profits by hiring workers until the additional revenue obtained from the sale of the output of an additional worker (the marginal revenue product) is equal to the money-wage rate. This profit maximizing condition can be expressed as

$$(P)(M) = w,$$

where P is expected market price, M is the marginal product of labor, and w is the money-wage rate. Rearranging terms, we obtain,

$$\frac{w}{P} = M. \tag{9.2}$$

The fraction of total revenue paid to wage-earners is the total wage bill divided by total revenue $\left(\frac{wN}{PQ}\right)$, where N is the level of employment and Q is the quantity of output. Consequently, if both sides of (9.2) are multiplied by the reciprocal of the average product of labor $\left(\frac{N}{Q}\right)$, the result is

$$\frac{wN}{PQ} = \frac{MN}{Q},$$

or

$$\frac{wN}{PQ} = \frac{M}{A}, \tag{9.3}$$

where A is the average product of labor. The important result is that the relative wage share in each firm depends on the firm's M/A-ratio. If all firms are attempting to maximize profits, then the fraction of GNP paid to wage-earners is equal, at any level of employment, to the average M/A-ratio[5] for the economy.

[5] This average may be expressed algebraically as

$$\frac{wN}{Z} = \sum_{i=a}^{m} \left(\frac{Z_i}{Z}\right) \frac{M_i}{A_i},$$

where Z_i is the expected total revenue in industry, i, there are m industries, and other symbols are as they were before.

THE SHAPE OF THE AGGREGATE SUPPLY FUNCTION

Making use of the M/A-ratio and the wage bill line it is possible to specify the shape of the aggregate supply curve. Clearly, the aggregate supply curve is upward sloping since expectations of greater total revenues will induce entrepreneurs to hire more workers. What must still be determined is whether or not the aggregate supply function is linear, is convex, or is concave to the employment axis. That is, which of the shapes in Fig. 9.5a appropriately represents the aggregate supply function?

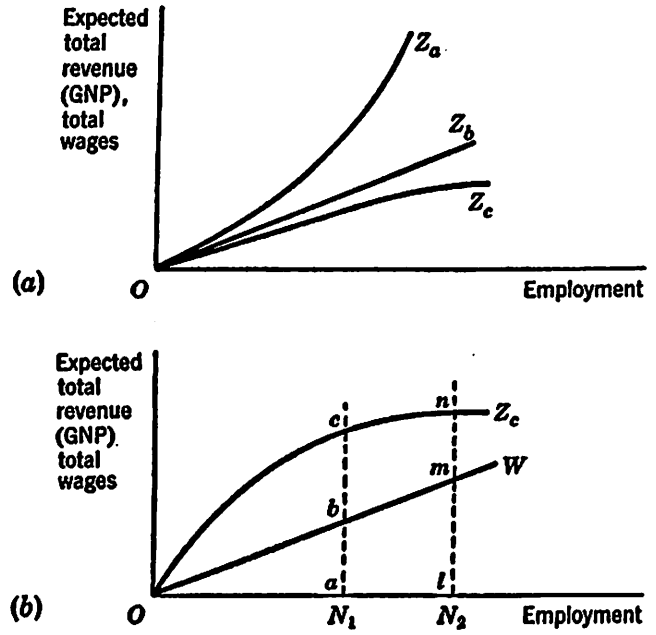

FIGURE 9.5.

At first sight, any of these three shapes may appear reasonable, but in fact, Z_c is not economically sensible. To demonstrate that Z_c cannot describe supply conditions, it is necessary to draw the implications which Z_c holds for productivity relationships. This, in turn, can be demonstrated by use of the wage bill line and the M/A-ratio.

Note that in Fig. 9.5b that as employment expands the wage share eventually increases. For example, at employment level N_1, the wage share is equal to ab/ac. At employment level N_2, the wage share is lm/ln, which is clearly larger than ab/ac. An increasing wage share implies that successively smaller increments in total revenue are required in order to induce entrepreneurs to hire each additional worker.[6]

From (9.3) we know that the wage share will rise only if the M/A-ratio increases. Normally, diminishing returns implies that the M/A-ratio will *not* rise as the quantity of labor employed with a fixed stock of capital grows, since an increasing M/A-ratio implies that as the labor to capital ratio increases, diminishing returns becomes relatively less important.[7] It is not realistic to assume that diminishing returns become less important as employment rises, so that it may be concluded that Z_c cannot describe the shape of the aggregate supply curve.

The same line of reasoning can be used to test the creditability of the Z_a and Z_b curves. The function Z_a implies that the wage share will fall as employment expands, which in turn implies a decreasing M/A-ratio. Production functions (functions which show the relationship between inputs and outputs) which embody this characteristic seem reasonable so that Z_a is a possible shape of the aggregate supply curve. The function Z_b implies a constant wage share at any level of employment, and therefore a constant M/A-ratio. Only if the production function is of a special form will the M/A-ratio be a constant at all levels of employment.

One function exhibiting this characteristic and which has been widely used in empirical research, is the Cobb-Douglas production

[6] More generally, the wage share will increase if the rate of change in the slope of the aggregate supply function is less than the rate of change in the slope of the wage bill line.

[7] If the M/A-ratio is to increase as more labor is hired, then the total product curve must asymptotically approach (from above) either an upward sloping straight line emanating from the origin, or a line parallel to such a ray. In other words, an increasing M/A-ratio implies a situation where, as the proportion of variable to fixed factor increases, diminishing returns rapidly become a relatively unimportant and practically negligible phenomenon. We should expect just the opposite, that is, we expect diminishing returns to grow in importance as output expands, with a fixed stock of capital.

function. This production function is expressed algebraically as

$$Q = jN^{\alpha}K^{1-\alpha},$$

where Q is output, j and α are empirically determined constants, N is labor, and K is capital. If the production function for each industry is of the Cobb-Douglas type, the M/A-ratio in each industry is a constant,[8] and therefore the average M/A-ratio will almost certainly be constant, the aggregate supply function will be linear, and the wage share will be unchanged as employment varies.[9] In fact, the Cobb-Douglas function has been widely used precisely because it implies a constant wage share. Empirical evidence has suggested that the wage share has been constant in many countries for a long time.

In summary, we expect the aggregate supply function to be upward sloping and either linear or convex to the employment axis.

RELAXING THE INITIAL ASSUMPTIONS

Having derived the aggregate supply function under simplifying assumptions, it will be valuable to suggest how changes in the initial assumptions will modify the aggregate supply function.

Monopoly and the aggregate supply function

First, the assumption of pure competition in the product markets will be relaxed, but the assumption of competition among buyers in labor markets will be maintained. In imperfect competition, each firm recognizing that its actions will affect the market price for its

[8] See Appendix B: Note 1.

[9] In a multiproduct, multifirm economy, a smooth linear or upward sloping convex (to the employment axis) aggregate supply function implies that as employment increases, the composition of output does not shift radically from industries with low M/A-ratios to industries with high M/A-ratios. Otherwise, it would be possible because of the changing importance of different industries, for the average M/A-ratio to increase with increasing employment levels, even though the M/A-ratio for each industry was a constant (the Cobb-Douglas case) or was declining. There is no reason to expect radical changes in the *importance of different* industries as employment increases.

products has some degree of monopoly power. The entrepreneur will conceive of this monopoly power as permitting profit maximization to occur at an output level where price exceeds both marginal revenue and marginal costs. In order to maximize profits, the entrepreneur will hire labor until the marginal revenue product equals the money-wage rate. This condition may be expressed algebraically as

$$(MR)(M) = w, \tag{9.4}$$

where MR is marginal revenue. Price exceeds marginal revenue by an amount which depends upon the entrepreneur's expectation of the absolute value of the price elasticity of demand (E_d) for the firm's output, that is, $P(1 - 1/E_d) = MR$.[10] Thus, (9.4) may be rewritten as

$$(P)(1 - 1/E_d)(M) = w. \tag{9.5}$$

Multiplying both sides of (9.5) by the reciprocal of the average product of labor and rearranging terms, we may express the wage share in the total revenue of the firm as

$$\frac{wN}{PQ} = \left(\frac{M}{A}\right)\left(1 - \frac{1}{E_d}\right). \tag{9.6}$$

When profits are being maximized, $1/E_d = P - MC/P$, which is a relative measure of the extent to which prices, set by a firm with monopoly power, deviate from the purely competitive situation of equating marginal costs and price.

Under pure competition the wage share is equal to the M/A-ratio, but once monopoly elements are introduced, the reciprocal of the

[10] Since

$$E_d = \frac{P\,\Delta Q}{Q\,\Delta P},$$

while

$$MR = P\,\Delta Q - Q\,\Delta P, \quad \text{or} \quad Q\,\Delta P = P\,\Delta Q - MR,$$

then, when $\Delta Q = 1$,

$$E_d = \frac{P}{P - MR},$$

therefore,

$$MR = P\left(1 - \frac{1}{E_d}\right).$$

elasticity of demand as well as the M/A-ratio are the determinants of the wage share. Since marginal revenue must be positive at the profit maximizing output position, the elasticity of demand must be greater than unity, and the term $(1 - 1/E_d)$ must be less than unity. The wage share in the monopolistic case, therefore, will always be smaller than the M/A-ratio.

Generalizing from equation (9.6), if each firm is attempting to maximize profits, then the wage share in the gross national product will depend upon the average M/A-ratio and the average degree of monopoly.[11] Using this generalized relationship we may note that at any given level of aggregate employment, given the production functions, the wage share will be lower (or the vertical distance between the aggregate supply curve and the wage bill line will be greater) under monopoly than under competitive pricing. Thus, both the degree of monopoly and the M/A-ratio affect the position and shape of the aggregate supply curve.[12]

What conclusions may we draw about the effect of monopoly on the slope of the aggregate supply function? Given the M/A-ratio at each employment level, in a mixed competitive-monopoly economy, if the degree of monopoly is invariant to employment changes, then conclusions about the slope of the aggregate supply function follow competitive theory, i.e., changes in the M/A-ratio determine the result. On the other hand, if changes in monopoly power are related to changes in the level of employment, then the slope of the aggregate supply function will be affected. If, for example, restrictive business practices are more important in a recession, then the average degree of monopoly may decline with rising employment levels and may, in the most

[11] This is expressed algebraically as

$$wN/Z = \sum_{i=a}^{m} \left(\frac{M_i}{A_i}\right)\left(1 - \frac{1}{E_{d_i}}\right)\left(\frac{Z_i}{Z}\right).$$

[12] It does not follow, however, that the equilibrium wage share in monopoly must be lower than the equilibrium wage share in pure competition. This result is inevitable only if the output of each firm is the same under monopoly and competition. Comparisons under different market structures are difficult. To the extent that monopoly affects the composition of output, the rate of introduction of new products and technological processes, and the distribution of income, monopoly power will have affects on both the aggregate supply and aggregate demand functions.

extreme case, more than offset any declines in the average M/A-ratio so that an aggregate supply function concave to the employment axis is possible. On the other hand, if buyers are less price conscious in prosperous periods, then the average degree of monopoly would tend to rise with employment levels and augment any possible convexity in the aggregate supply function due to productivity phenomena.

In the absence of strong empirical evidence favoring one hypothesis over the other, a tentative assumption that no change occurs in the degree of monopoly appears to be acceptable. It must be recognized, however, that changes in monopoly conditions could alter the slope of the aggregate supply function.

Changes in the money-wage rate and the aggregate supply function

Up to this point the analysis has assumed that the money-wage rate is constant at all levels of employment. Suppose that the money-wage rate tends to vary directly with the level of employment. If this is the case, each increase in the money-wage rate will rotate the wage bill line upwards. Thus, in Fig. 9.6a, OW_1 is the wage bill line when the money-wage rate is w_1; OW_2 implies a higher money-wage rate, w_2, etc. Suppose further that the money-wage rate remains at w_1 until N_1 workers are hired, but when the N_1 plus one worker is employed the wage rate is raised to w_2. The wage rate remains at that level until N_2 workers are hired, and then it increases to w_3, etc. Under these circumstances, the wage bill is described by the discontinuous curve *Oabcde* in Fig. 9.6a. If, however, we assume that the money-wage rate rises continuously as employment increases, then the wage bill curve will be the smooth function OW, which is derived from a locus of points, where each point is on a different wage bill (straight) line, and each straight line represents a different money-wage rate.

In a similar manner an aggregate supply function based on a changing money-wage rate can be derived. In Fig. 9.6b, Z_1 is the aggregate supply curve when the money-wage rate is w_1. Since the vertical distance between the wage bill line and the aggregate supply function depends only upon the M/A-ratio and the degree of monopoly, which are assumed given for any level of employment, when the money-wage rises, both the wage bill line and the aggregate supply curve

will have to shift upwards so that the vertical distance between the two remains unchanged. Z_2 therefore represents the aggregate supply function when w_2 is the money-wage rate. Accordingly, if wages rise discontinuously, the aggregate supply function is represented by the discontinuous curve $Oa'b'c'd'e'$ as employment rises. Alternatively,

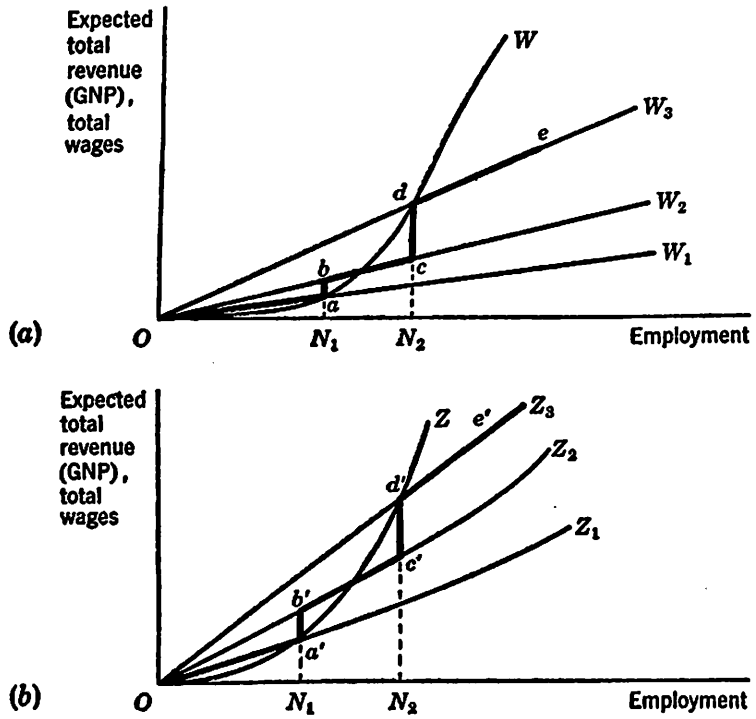

FIGURE 9.6.

the locus OZ in Fig. 9.6b represents the relevant aggregate supply function if the money-wage rate is a continuously increasing function of the level of employment. When both the OW and OZ curves are plotted on the same figure, the vertical distance between the two at any employment level is, as before, dependent on the M/A-ratio and the degree of monopoly.

In summary, increases in the money-wage rate will shift the aggregate supply function upwards. This result will have important implications for our analysis of inflation in Chapter 12.

Changes in capital stock, technology, and the aggregate supply function

Without attempting to catalog all the possible results of changes in the capital stock and/or technology, we may simply note that we would expect these changes to primarily affect the aggregate supply function through their effects on the M/A-ratio.

In the next chapter, the aggregate demand function will be developed, which when used with the aggregate supply function constitutes the equilibrium model.

APPENDIX A. Entrepreneurial Motivation and the Aggregate Supply Function

Some economists believe that entrepreneurs who possess monopoly power do not strive to maximize profits; instead, they seek to maximize total revenue as long as some minimum profit level is maintained. The output and employment decisions of such a firm may be analyzed with the aid of Fig. 9.7, where TR represents the expected total revenue function of the firm, TC represents its total costs, and π is the profit function of the firm. In Fig. 9.7, Q_p is that output level at which profits will be maximized. It will require the hiring of N_p workers. If the minimum profit level which entrepreneurs will accept is OA, then a sales maximizing entrepreneur will produce Q_e output which will require the hiring of N_e workers. Since Q_e exceeds Q_p, N_e must be larger than N_p.

What then would the effect be on the aggregate supply function if it is assumed that all firms are sales maximizers instead of profit maximizers? Figure 9.7 indicates that our hypothetical firm would receive a total revenue of TR_1 at the profit maximizing position. However, if our entrepreneur was a sales maximizer, he would be willing to hire the same N_p workers even if the expected total revenue were only TR_2, since given the total cost curve, total revenue at TR_2 would be just sufficient to yield the requisite minimum profits, OA. Generalizing this result for the economy, for any employment level which yields profits in excess of the minimum required by sales maximizers, expected total revenue would be less for sales maximizers than for profit maximizers.

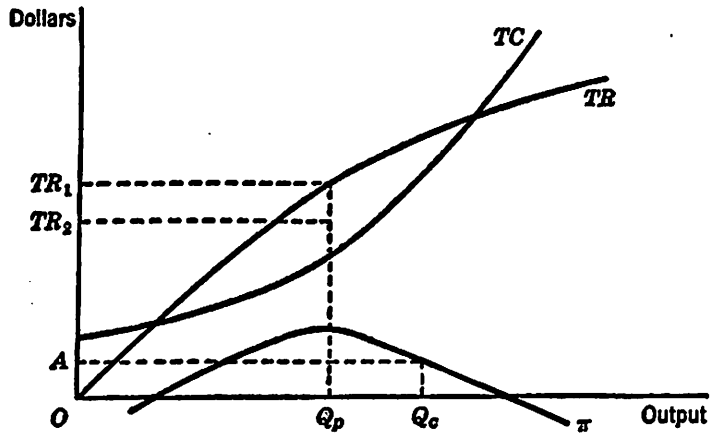

FIGURE 9.7.

Accordingly, when the minimum profit levels are specified, a unique aggregate supply function can be derived under the sales maximizing hypothesis. The vertical distance of the aggregate supply curve from the employment axis at each level of employment will be less with sales maximizers than with profit maximizers.

APPENDIX B. Mathematical Notes

Note 1

Proposition: To demonstrate what form the production function must have to have a constant ratio of marginal to average product (M/A) at all levels of employment.

Let the M/A-ratio for labor be equal to a constant (α):

$$\frac{dQ/dN}{Q/N} = \alpha,$$

where Q is output and N is labor. Hence,

$$\frac{dQ}{Q} = \alpha \frac{dN}{N}.$$

Integrating, we obtain:

$$\log Q = \alpha \log N + \log a,$$

where a is a constant. Thus, the production function will have the following form:

$$Q = aN^{\alpha}.$$

This function in one variable is mathematically akin to the two-variable Cobb-Douglas function, $Q = jN^{\alpha}K^{1-\alpha}$, the latter being the production function usually associated with constant relative shares.

Note 2

Proposition: To demonstrate that the M/A-ratio either remains constant or declines with diminishing returns, when the output function is a smooth, continuous, monotonic function within the region of rational factor hire.

Mrs. Robinson has shown[13] that at any given abscissa value, the relation between the points on the marginal and average curves can be expressed as

$$M = A\left(\frac{\epsilon - 1}{\epsilon}\right), \quad \text{or} \quad \frac{M}{A} = \left(1 - \frac{1}{\epsilon}\right),$$

where ϵ is the absolute value of the elasticity of A, at that point.

It follows that the M/A-ratio varies in the same direction as ϵ. It can be shown that if the average curve is a normal, downward-sloping curve, then either ϵ is a constant (and A has the general form $A = (a/N)^{1/b}$, where a and b are constants) or ϵ declines towards unity as employment increases, and M approaches zero.[14] Since M must always be greater than zero in the region of rational factor hire, ϵ can never be equal to or less than unity in this region.[15]

[13] J. Robinson, *The Economics of Imperfect Competition*, Macmillan, 1934, 36.

[14] See S. Carlson, *Pure Theory of Production*, Kelley and Mellman, 1956, pp. 56–8.

[15] For a further discussion of the M/A-ratio, see D. E. Horlacher and E. Smolensky, "Increasing Employment, Diminishing Returns, and Relative Shares," *Canadian Journal of Economic and Political Science*, 26, 1960.

CHAPTER 10

Aggregate demand

Aggregate demand is the sum total of expenditures of all the buyers in the economy. The term demand emphasizes purchases and turns the intellect towards matters of taste, satisfactions, prices, the level of income and its distribution, and expected profits. Except for the previous chapter, it has been the buyers' side of the market which has received most of our attention, and it is to the buyer that we return again in this chapter.

In the equilibrium model, the *aggregate demand function* relates money expenditures of all buyers on domestically produced goods to the level of aggregate employment.[1] It is the schedule which shows the alternative spending totals for alternative levels of employment. Prices, output, income, and perhaps even the money-wage rate will vary as employment varies and, therefore, these factors will have repercussions on the aggregate demand function. Somehow, all these interrelationships must be put into a logical and determinant sequence if spending behavior is to be understood. The aggregate demand function which

[1] In the forecasting model of Part II, on the other hand, the aggregate demand function related real spending by all buyers to the level of real output. The advantages of dealing with Keynesian functions *in money terms* was observed by B. Ohlin to be a considerable improvement over dealing with functions in real terms. Ohlin argued, "A reasoning in monetary terms does not prevent any amount of considerations of the 'real' implications, whenever such considerations may be desirable, e.g., in a discussion of policy. But it has the advantage of permitting a much simpler and less sophisticated explanation of the market phenomena, which are *price* phenomena." (B. Ohlin, "Some Notes on the Stockholm Theory of Savings and Investments II," *Economic Journal*, 47, 1937, p. 230.) Ohlin believed that reasoning in money rather than real terms was one of the two "outstanding characteristics of Keynes' theoretical system." (*Ibid.*, p. 229.)

will be derived, taken together with aggregate supply function which has been derived in Chapter 9, will yield a useful theory of spending behavior. In this chapter, the appropriate aggregate demand function will be developed and then the simplest form of the equilibrium model will be examined.

DERIVING THE AGGREGATE DEMAND FUNCTION

Deriving the aggregate demand function will require a complicated line of reasoning which it is best to summarize briefly at the outset. Four groups of buyers are normally identified in the theory of employment determination—consumers, businesses, governments, and foreign purchasers. Each category consists of buyers who are prompted by a common set of motives but these motives are different for each group. As in the forecasting model, we will initially assume that there are no government and foreign purchases, so that aggregate demand will be the sum of two quantities: (1) the amount spent on consumption, and (2) the amount spent on investment. While this simple dichotomy of spending behavior was adequate for the forecasting model, it will not be sufficient for the equilibrium model where price is a variable, for even though all consumers are similarly motivated, price and money-wage changes will affect the real income of various groups of consumers differently and will lead to diverse behavior patterns among individuals within the consumer category.

The difficult task will be to describe the dependence of aggregate consumption spending (in money terms) on the level of employment. *This aggregate consumption function will be based on the same assumption as in the forecasting model, namely, that real consumption is a function of real income.*[2] Since the price level varies with employment, and since different consumer groups will find that their money income, on the one hand, and that their real income, on the other, are affected differently by wage, price, and employment changes, we will have to

[2] At this stage, we ignore the real balance effect, i.e., we ignore the possibility that changes in the price level will affect the real wealth of the community and as a result may alter the consumption function. This effect will be discussed in Chapter 11. Similarly, we will postpone the discussion of expectations of future price changes on present spending decisions until Chapter 13.

distinguish between groups of consumers. The most useful distinction turns upon the way each group of consumers obtains its income. For each of three consumer groups—wage-earners, rentiers, and profit recipients—the effect of changing employment levels on real income will be deduced. Once the relationship between money income, real income, and employment has been obtained for each group, it will be possible to achieve our first objective which is to describe how consumption expenditures in money terms vary for each group as the level of aggregate employment changes. Adding up these relationships of money consumption to total employment will yield the aggregate consumption function. Finally, real investment spending will be converted to money terms and then added to the aggregate consumption function to obtain the aggregate demand function.

This aggregate demand function, which relates money expenditures to the level of employment, can then be placed on the same axes as the aggregate supply function, which relates expected sales revenue (in money terms) to the level of employment. The intersection of these two functions determines the equilibrium level of spending and employment.

CONSUMPTION BEHAVIOR AND THE LEVEL AND DISTRIBUTION OF INCOME

The consumption function developed in Chapter 3 related real consumption to real income. That real consumption is largely dependent upon real disposable income for each family continues to be fundamental to the analysis. We now introduce the complication that the family must engage in money transactions in order to achieve their real consumption objectives. Since the price level varies with employment, and the real income of individuals will be affected by price level changes, it is necessary to relate the changes in money income, real income, and prices for various consumer groups.

At each level of employment, there will be a flow of money payments from business enterprises to individuals. These payments, which are the personal incomes of individuals, the propensities to consume of these income recipients, and the price level, determine the consumption outlays of the community.

MONEY INCOME AND THE LEVEL OF EMPLOYMENT

It is useful to identify three groups of income recipients: rentiers, wage-earners, and profit recipients. This tripartite division is necessary in order to understand aggregate consumption behavior, since price and employment phenomena will have a different impact on the real income of each of these groups. In this section, variations in money income will be examined and diagrammatically represented in Fig. 10.1. In the next section, money income variations will be related to variations in real income, in order to explain consumption spending of the groups.

Rentiers

At any point of time, most business enterprises will have outstanding debts as a consequence of having borrowed funds in earlier periods. At the time these debts were incurred, these firms entered into contractual agreements to pay the lenders fixed sums of money (interest payments) at specified dates. The current holders of these debt contracts must be paid no matter what the level of economic activity or the profit position of the firms. These payments to the holders of the debt contracts are the fixed costs of the firms. The holders, who are receiving fixed sums of money, are called *rentiers*. Accordingly, the relationship between total rentier income and the level of aggregate employment is represented by the horizontal line FF' in Fig. 10.1a.[3]

Wage-earners

At any given employment level, of course, there will be a flow of money-wage payments to workers to compensate them for their efforts. If the money-wage rate does not vary as employment changes, then total money-wage payments will increase by a constant amount as employment increases. For example, if the wage rate is $5,000 per year, each additional hired worker will raise total wage payments by an additional $5,000. Since, if no workers were to be hired, the wage bill would obviously be zero, the relationship between the aggregate

[3] Besides interest payments, firms may be contractually committed, for short periods of time, to pay salaries and rents. The receivers of these payments may also be considered to be rentiers.

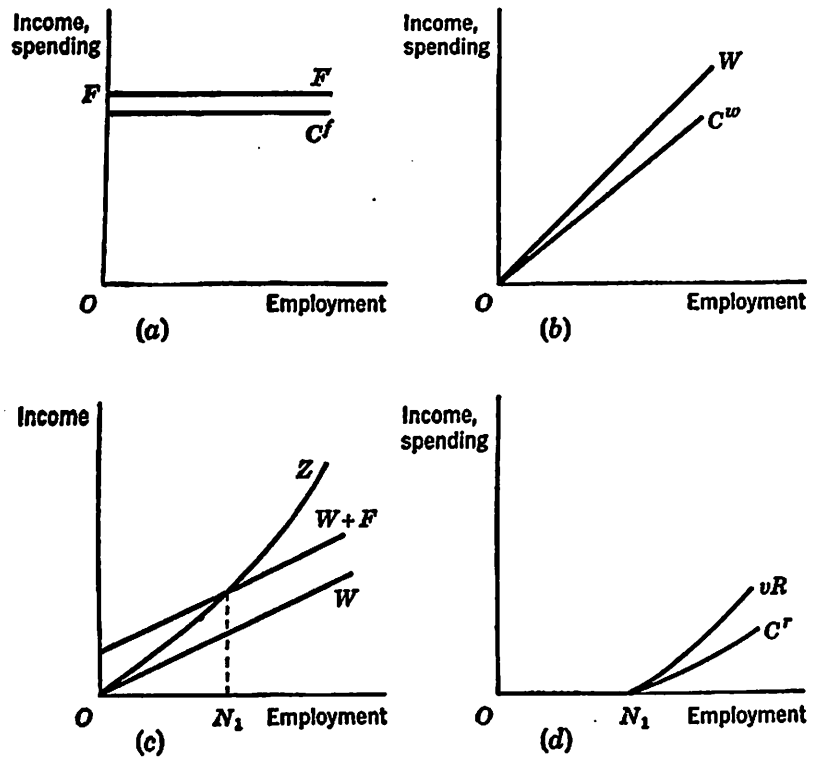

FIGURE 10.1.

wage bill and the level of employment is represented as the straight line OW beginning at the origin, and having a slope equal to the money-wage rate (Fig. 10.1b).

Profit recipients

Subtracting total costs from total revenue at each level of employment yields gross profits.[4] Total costs for fully integrated firms are simply wage payments plus fixed costs, so that adding the FF' line

[4] Gross profits contain many elements which are not often thought of as components of profits, e.g., depreciation and excise taxes.

of Fig. 10.1a to the OW line of Fig. 10.1b, yields the total cost curve $W + F$ in Fig. 10.1c. Total revenue at each level of employment is shown by the aggregate supply curve OZ in Fig. 10.1c.

Since profits equal total revenue less total costs, the difference between the aggregate supply curve (OZ in Fig. 10.1c) and the $W + F$ curve represents aggregate profits. In Fig. 10.1c, at all employment levels below N_1, aggregate profits are negative since the total revenue curve is below the total cost curve. This does not necessarily mean that all firms are making losses; only that total business losses of some firms exceed total profits of the others.[5] At employment levels above N_1, enterprises are, on the average, making profits. For simplicity, it can be assumed that some fraction (v) of total profits (R) is paid out as dividends. Profit recipients begin to receive dividends at N_1, and consequently the curve vR in Fig. 10.1d represents the relationship between dividends and employment.[6]

REAL INCOME AND THE LEVEL OF EMPLOYMENT

Having developed the relationship between money income payments and employment for each income group, the next step is to relate the real income of each group to the level of aggregate employment, and to determine the money consumption expenditures of each group.

In the short run, real income is the basic determinant of real consumption. For simplicity, assume that the real consumption of each income group is a simple proportionate function of the real income of each group. In other words, assume that if the real income of a group of consumers is zero, then their consumption expenditures will also be

[5] Employment levels below N_1 may normally be neglected, for in that range firms will be going bankrupt, so that employment below N_1 will be only temporary. Bankruptcy proceedings will, for the economy as a whole, involve a scaling down of total fixed costs.

[6] Since some firms earn profits even when aggregate profits are negative, and since some corporations pay dividends even with current losses, dividends are likely to appear at employment levels below N_1. The vR function abstracts from this realistic but not very consequential factor, since employment levels below N_1 will involve wholesale bankruptcy proceedings.

zero; and, moreover, that as their real income rises, their marginal propensities to consume remain unchanged.[7]

At this point, it is necessary to explicitly introduce price relationships into the system, so that real consumption behavior can be related to money expenditures. The price level is implicit in every point of the aggregate supply curve. As indicated in Chapter 9, in a competitive economy prices depend on the relationship between the money-wage rate and the marginal productivity of labor. Assuming a constant money-wage rate, as employment increases prices rise due to diminishing returns.

1. Rentier spending on consumption

As employment and therefore prices increase, the real income of rentiers declines, even though their money income remains constant. Since rentiers' real consumption is related to their real income, as the latter declines rentiers' real consumption falls off even though their money outlays on consumption remain unchanged.[8]

The relationship between rentiers' money consumption expenditures and aggregate employment is, therefore, expressed as the horizontal straight line C^f in Fig. 10.1a. The line C^f lies below the line FF', because the marginal propensity to consume of rentiers is less than one. Since rentier consumption behavior is one component of the aggregate consumption function, the C^f line implies that even at zero employment levels, there will be some consumption spending, that is, the aggregate consumption function will have a positive intercept.

[7] Although individual families may continue to consume even though their income is zero, they normally can finance these expenditures for any length of time only because other individuals with positive incomes are willing to transfer some of their income to the zero income families. These transfer payments usually take the form of charity payments, unemployment compensation, loans, proceeds from the sale of assets, or gifts. To simplify the algebraic analysis, however, it is expedient to assume that no transfer payments occur; so that the consumption out of zero income for any group can be assumed to be negligible. (The introduction of these transfer payments will not affect the analysis, although the magnitude of some of the parameters may be different.)

[8] If, for example, an increase in employment led to a price rise of 2 percent, then rentiers' real income and their real consumption would decline by 2 percent. In order to buy 2 percent less output at 2 percent higher prices, rentiers would have to spend the same amount of money on consumption as before.

2. Wage-earner spending on consumption

As employment increases, total money-wage payments increase. The newly employed experience a rise in real income and, therefore, increase their real consumption and money consumption expenditures. To the extent that prices increase while the money-wage rate remains constant, those wage-earners who were previously employed are in the same position as rentiers; that is, they find their real income declining in proportion to the price level increase. As with rentiers, these previously employed workers reduce their real consumption while maintaining the same money expenditures on consumption. Thus, total money outlays on consumption by wage-earners is the summation of a constant money outlay by the previously employed and an increase in the money expenditures of the newly employed. Consequently, the relationship between wage-earners' expenditures on consumption and aggregate employment is represented by the upward sloping line C^w, in Fig. 10.1b. The C^w line lies below the OW line because the marginal propensity to consume out of wages is less than one.

3. Profit recipient spending on consumption

As employment rises above N_1, aggregate profits increase. Profit maximizing entrepreneurs are induced to hire more workers only if prices of the goods which they produce rise. This is, in fact, the primary reason for the upward slope of the supply curve of firms and it is the mechanism by which diminishing returns transmits an increase in employment into an increase in prices. Therefore, as employment rises, total real profits as well as money profits must increase. Consequently, if dividends are directly related to profits, then real dividends and real consumption by profit recipients will rise as employment increases. The relationship between money expenditures by profit recipients on consumption goods and aggregate employment is, therefore, represented by the upward sloping C^r line in Fig. 10.1d. The line C^r is below the line vR because the marginal propensity to consume out of profits is clearly less than one since only that part of gross profits distributed as dividends is available for consumption.

THE AGGREGATE CONSUMPTION FUNCTION

The aggregate consumption function is merely the vertical sum of the consumption functions of rentiers, wage-earners and profit re-

cipients and is represented as the upward sloping line D_c in Fig. 10.2. The positive slope of the aggregate consumption function results from the increase in income going to wage-earners and profit recipients and their consequent increase in expenditures as employment rises.

INVESTMENT BEHAVIOR

The forces that determine the level of real investment have been discussed in Chapter 4. For the moment, we will asume that the investment decision is made in real terms at the beginning of the period and then businessmen budget a given sum of money to carry out investment

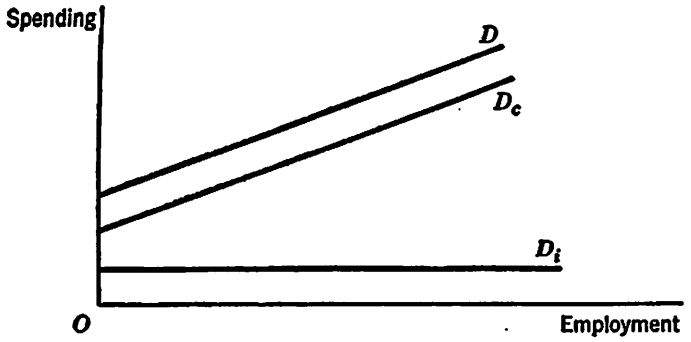

FIGURE 10.2.

during the period. (This assumption will be relaxed in Chapter 13.) Consequently, money investment remains fixed during the period although real investment may depart from the goal set by management at the beginning of the period because of changes in prices. The relationship between expenditures on investment and the level of employment can be depicted as the horizontal straight line (D_i) in Fig. 10.2. The aggregate demand function (D in Fig. 10.2) is obtained by adding D_c to D_i.

EQUILIBRIUM

The aggregate demand and aggregate supply functions have been redrawn in Fig. 10.3. This diagram must be interpreted in the following way. Suppose entrepreneurs expect total revenue to be Z_a.

This will lead them to hire N_a workers. The flow of money payments at the N_a employment level, however, will lead to a D_a level of money expenditures. Since aggregate demand exceeds aggregate supply at the N_a level, entrepreneurs will find that buyers wish to purchase more than sellers wish to sell at going prices and, therefore, entrepreneurs will be induced to expand output. Suppose they now expect Z_b proceeds and hence hire N_b workers. As the stream of payments from

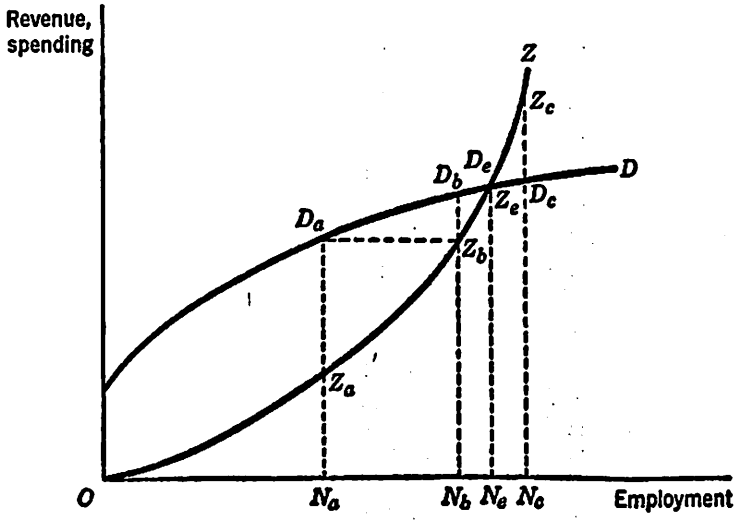

FIGURE 10.3.

firms to wage-earners and profit recipients increase, money consumption outlays will increase raising total spending to D_b. Since D_b is greater than Z_b, entrepreneurs will again find that desired purchases are greater than anticipated and employment will expand again. When entrepreneurial expectations of revenue equal Z_e, they will hire N_e workers, and will discover that the concomitant demand outlays (D_e) are such that their expectations are just fulfilled. At that point, *ceteris paribus*, there will be no inducements to change the employment level.

Similarly, if we start from a level of employment to the right of the intersection of the aggregate demand and supply functions, say N_c,

then at that level of employment, entrepreneurs would expect total sales to be Z_e, and they would be disappointed to find that buyers only wished to spend D_e. Thus, actual sales would fall short of sales expectations. This disappointment would induce entrepreneurs to reduce employment as they lowered their sales expectations. As long as entrepreneurs hired more than N_e workers, however, realized sales would continue to be less than expectations. At the N_e employment level, desired purchases equal sales expectations.

The value of total spending as given by the aggregate demand function where it is intersected by the aggregate supply function is called *effective demand*. Effective demand is the point where aggregate spending equals aggregate expectations of sales; it represents an equilibrium level of expenditures, where entrepreneurial expectations are just being realized so that there is no inducement to change hiring policy.

To summarize, given our assumptions, an aggregate supply function reflecting productivity, prices, and wage phenomena can be constructed. From this aggregate supply function a flow of money payments can be derived. Given this income stream, an aggregate consumption function can be obtained. Finally, given investment expenditures, the aggregate demand function can be constructed in such a way as to reflect the same set of prices as are built into the aggregate supply function at corresponding employment positions. So long as the slope of the aggregate demand function is less than the slope of the aggregate supply function, a stable and determinate equilibrium emerges.

EMPLOYMENT AND INCOME MULTIPLIERS AND THE PRICE LEVEL

Our primary objective is to understand the causes of changes in the level of aggregate employment. In other words, we want to understand how the economy moves from one equilibrium position to another, as the exogenous variables change. The starting point in the study of fluctuations in the level of employment is the simple multiplier of Chapter 3. In that chapter, changes in real income were related to exogenous changes in investment or government spending, i.e., to changes in demand conditions (with constant supply prices). In the

equilibrium model, an initial change in aggregate demand induces changes in output, employment, and prices. For policy decisions, it is clearly necessary that these resultant effects be separated and the magnitude of each determined.

For expositional purposes, it is useful to summarize in advance all that will be happening in the model. Many things will be occurring simultaneously, but it will be necessary to speak as if things proceed in a simple sequence.

When aggregate spending increases, entrepreneurs will initially hire more workers and (because of diminishing returns) expect higher prices. The relative magnitudes of the price and employment changes will depend on productivity conditions as expressed via the aggregate supply function. As the economy expands, in addition to the increase in aggregate income, there will be a redistribution of income away from fixed income groups as the price level rises. These changes in the level of total income and its distribution will affect aggregate consumption spending and a second round of spending increases will ensue. This process will be repeated until new equilibrium levels of employment, output, and prices are reached.

With this overall view in mind, we can now turn to the derivation of employment and income multipliers which reflect the interaction of demand and supply conditions. First, we will summarize the aggregate supply conditions as discussed in Chapter 9. Then, the related demand conditions will be specified, and the relevant multipliers will be derived.

Supply conditions and the multiplier

As indicated in Chapter 9, the form of the aggregate supply function depends upon three factors: (1) technological relationships between inputs and outputs, i.e., the aggregate production function, since the willingness of employers to hire workers will depend, in part, on the contribution which these workers will make to output, (2) the cost of labor, i.e., the money-wage rate, since workers will be hired only if the contributions they make to total revenue equals or exceeds the cost of hiring the workers, and (3) the degree of monopoly, since the greater the monopoly power, the greater total revenue will be for any level of output, given the money-wage rate and technological conditions.

For simplicity, we will assume pure competition, a constant money-wage rate, and a Cobb-Douglas production function. This production function is written as

$$Q = jN^{\alpha}K^{1-\alpha}, \tag{10.1}$$

where Q is output, N is the level of employment, K is the stock of capital, and j and α are constants. Under these assumptions, the aggregate supply function will be linear,[9] i.e.,

$$Z = kwN, \tag{10.2}$$

where Z is aggregate supply, k is equal to $\frac{1}{\alpha}$, and w is the money-wage rate. Thus, the aggregate supply function is plotted as the straight line OZ in Fig. 10.4.

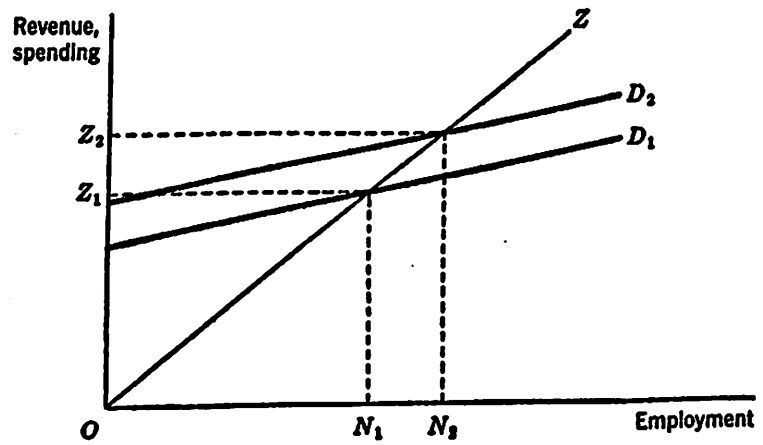

FIGURE 10.4.

The price level (P) is a function of the money-wage rate and the marginal product of labor, i.e.,

$$P = \frac{w}{M}, \tag{10.3}$$

where M is the marginal product of labor. It follows from (10.3)

[9] See Chapter 9.

that changes in the price level will be directly proportionate to changes in the money-wage rate and inversely proportionate to changes in the marginal product of labor. If wages are constant, as it is initially assumed, then the more significant diminishing returns is, the more rapid the price level will rise with expansion.

Equations (10.1) through (10.3) summarize all the interrelated supply conditions in the model.

Demand conditions and the multipliers[10]

The real aggregate demand function is the sum of the real consumption functions of each consumer group and real investment expenditures,

$$D_r = C_r^w + C_r^f + C_r^r + I_r, \tag{10.4}$$

where the subscript r indicates that the variables are expressed in real terms, D is aggregate demand, C^w is the consumption of wage-earners, C^f is the consumption of fixed income recipients, C^r is the consumption of profit recipients, and I is investment expenditures. Assuming the real consumption of each income group is a simple proportional function of the real income of the group, then each consumption function can be expressed as:
wage earners,

$$C_r^w = b\left(\frac{wN}{P}\right); \tag{10.4a}$$

rentiers,

$$C_r^f = f\left(\frac{\overline{F}}{P}\right); \tag{10.4b}$$

profit recipients,

$$C_r^r = r\left(\frac{Z - \overline{F} - wN}{P}\right) = r\left(\frac{(k-1)wN - \overline{F}}{P}\right), \tag{10.4c}$$

where b, f, and r are the marginal propensities to consume out of wages, fixed money income payments, and gross profits, respectively, and $\overline{F}$ is the exogenously determined fixed money payments to rentiers.

[10] The following section is based on P. Davidson, "Income and Employment Multipliers and Price Level," *American Economic Review*, 52, 1962.

In this chapter, it will also be assumed that once the real investment decision has been made, businessmen budget a certain sum of money to finance these investment expenditures, i.e.,

$$I_r = \frac{\bar{I}}{P}, \tag{10.4d}$$

where $\bar{I}$ is exogenously determined. If prices rise during the period, monetary investment expenditures will be constant while actual real investment (contrary to businessmen's plans) will decline. If the period is relatively short, this supposition may approximate reality.[11]

Since the aggregate supply equation (10.2) is in money terms, the real aggregate demand function must be converted into money terms in order that it may be compatible with the supply function. The aggregate demand function in money terms can be obtained by substituting (10.4a) through (10.4d) into (10.4) and multiplying through by the price level to obtain:

$$D = bwN + r(k - 1)wN + (f - r)\bar{F} + \bar{I}. \tag{10.5}$$

Aggregate demand is, therefore, linearly related to employment and is drawn as the D_1 line in Fig. 10.4.

In equilibrium, aggregate supply equals aggregate demand, so that the equilibrium condition can be obtained via (10.2) and (10.5) as

$$Z = D,$$

or

$$kwN = bwN + r(k - 1)wN + (f - r)\bar{F} + \bar{I}. \tag{10.6}$$

The equilibrium level of aggregate employment is determined by the intersection of these functions (as N_1 in Fig. 10.4, while the equilibrium level of money income is Z_1). Suppose there is an exogenous increase in money investment expenditures (ΔI). If the money-wage rate is constant, then the aggregate supply function will be unchanged, while the aggregate demand function will shift up to D_2, raising the level of employment to N_2 and money income to Z_2 (in Fig. 10.4).

[11] This assumption will be relaxed in Chapter 13.

The change in money income due to a change in investment is given by[12]

$$\Delta Z = \left[\frac{1}{1 - \beta}\right]\Delta I, \tag{10.7}$$

while the change in employment due to an exogenous change in investment is given by[13]

$$\Delta N = \left[\frac{1}{kw(1 - \beta)}\right]\Delta I, \tag{10.8}$$

where β is the weighted average of the marginal propensity to consume out of wages and gross profits. The weighting of these respective marginal propensities will be based on the distribution of income between wages and profits as expressed through the factor k.

Clearly, the money income multiplier in (10.7) is the same as the simple multiplier of the forecasting model. Since prices were assumed constant in the forecasting model, changes in money income could be directly converted into changes in real income.

[12] Letting $\left[b\left(\frac{1}{k}\right) + r\left(1 - \frac{1}{k}\right)\right]$ equal β, and substituting $\frac{Z}{kw}$ for N into (10.6), and solving for Z, we obtain

$$Z = \left[\frac{1}{1 - \beta}\right][(f - r)\bar{F} + \bar{I}]. \tag{10.6a}$$

Therefore,

$$Z + \Delta Z = \left[\frac{1}{1 - \beta}\right][(f - r)\bar{F} + \bar{I} + \Delta I]. \tag{10.6b}$$

Subtracting (10.6a) from (10.6b) yields (10.7).

[13] Solving (10.6) for N,

$$N = \left[\frac{1}{kw(1 - \beta)}\right][(f - r)\bar{F} + \bar{I}]. \tag{10.6c}$$

Therefore,

$$N + \Delta N = \left[\frac{1}{kw(1 - \beta)}\right][(f - r)\bar{F} + \bar{I} + \Delta I]. \tag{10.6d}$$

Subtracting (10.6c) from (10.6d) yields (10.8).

The employment multiplier in (10.8) is merely the money income multiplier multiplied by a conversion factor $\left(\frac{1}{kw}\right)$ which converts the increase in total spending into employment units. The rationale behind this conversion factor is as follows. For every dollar of additional spending, given the production function, the wage bill will increase by $\frac{1}{k}$ dollars. To hire an additional worker, the employer will have to pay the going money wage, w. Consequently, dividing the increase in total spending by k, gives the increase in the wage bill, while dividing the wage bill by w indicates the number of additional workers who will be hired for that increase in the money-wage bill.

These multipliers indicate that for any exogenous change in investment expenditures, the resultant change in the money income of the economy will depend on (1) the marginal propensity to consume out of wages and profits, and (2) the distribution of the increment in income between wages and profits. The resultant change in employment will depend on the money-wage rate and the proportion of total spending that goes to wages (as expressed by k) as well as the weighted average of the marginal propensities.

As might be expected, the magnitudes of the multipliers vary directly with the marginal propensities to consume, i.e., the greater the additional real consumption out of a given increment in real income for wage-earners and/or profit recipients, the greater the multiplier repercussions. Moreover, since normally the marginal propensity to consume out of wages will be greater than the marginal propensity to consume out of profits, if there is a redistribution of income, at any level of employment, from wages to profits (i.e., if k increases), then the magnitudes of the multipliers will be reduced as overall spending repercussions decline.[14]

The multipliers when the money-wage rate is a variable

Although a complete analysis of the effects of changes in the money-wage rate must wait until Chapters 11, 12, and 13, we may, at this point, inquire into the affects on the multipliers of having the money-wage rate vary concomitantly with changes in effective demand.

Assume that the money-wage rate is an increasing function of the level of employment, i.e., $w = \phi(N)$. This money-wage rate function is *not* to be interpreted as the supply function of labor. Following Keynes' lead, the supply of labor will, in Chapter 11, be related to the real wage rate. Our analysis in the next chapter will, however, show that a function relating labor offerings to the money-wage rate can be derived from the demand curve for labor and its implicit real wage phenomena. Without delving into the analysis of labor supply and the money-wage rate at this point, however, the reader should recognize that the assumption that the money-wage rate increases as employment rises is a good approximation of the real world.

Substituting $\phi(N)$ for w in (10.6) and solving for ΔZ, we obtain the same money income multiplier as before, i.e.,

$$\Delta Z = \left[\frac{1}{1 - \beta}\right]\Delta I. \tag{10.7'}$$

Similarly, solving for the change in employment due to an exogenous change in investment, when the money-wage rate is a variable, yields,

$$\Delta N = \left[\frac{1}{k(\phi N + N\phi' N)(1 - \beta)}\right]\Delta I. \tag{10.8'}$$

A priori reasoning suggests that the money-wage rate function $\phi(N)$ should have a positive minimum value (m) and should be an increasing function of employment. Hence, for illustrative purposes, we may assume that

$$\phi(N) = m + nN^2. \tag{10.8'a}$$

Substituting (10.8'a) into (10.8') yields

$$\Delta N = \left[\frac{1}{k(m + 3nN^2)(1 - \beta)}\right]\Delta I. \tag{10.8''}$$

Thus, the additional employment created by a given increment in money expenditures depends on the distribution of income (k), the average (weighted) marginal propensity to consume (β) and the initial

[14] If the aggregate supply curve is convex rather than linear, then the wage share declines with rising employment levels (i.e., k rises) and, therefore, the magnitudes of the multipliers will decline with expansion.

level of employment. The relationship between changes in the magnitude of the employment multiplier and changes in k and β are the same as in the constant money-wage case. When the money-wage rate is a function of the level of employment, however, the higher the initial employment level, the smaller the increment in employment from the multiplier repercussions, as more of the increment in money spending spills over into bidding up money wages and prices and less into increasing real output.

The price variable

If the money-wage rate is constant, (10.3) indicates that the price level varies inversely with the marginal product of labor; while changes in the marginal product of labor are related to changes in the level of employment via the production function. For the Cobb-Douglas function, the proportionate change in the marginal product of labor is $(\alpha - 1)$ times the proportionate change in employment.[15] Thus, for example, if α equals $\frac{1}{2}$ then a 2 percent increase in employment when the money-wage rate is constant, will lead to a 1 percent increase in the price level.

When the money-wage rate is an increasing function of the level of employment, then price level changes will, according to (10.3), vary directly with the money-wage rate and inversely with the marginal product of labor. Because of diminishing returns, the relative price increase for any given increase in employment will be greater than the relative money wage increase; therefore, any exogenous increase in spending must decrease the real-wage rate while increasing the level of employment.

The ratchet effect

Finally, if it is assumed that changes in the money-wage rate produces a ratchet effect, that is, if money-wage rate increases are irreversible, then once a given money-wage rate is established in the market place it can not be lowered. In such a situation, the employment multiplier presented in (10.8′) is applicable to an increment in money expenditures, while the employment multiplier of (10.8) is relevant for exogenous decreases in money expenditures. Accordingly, the employment multiplier may be asymmetric, its magnitude being larger in a contraction than in an expansion. Furthermore, given a ratchet effect for the money-wage rate, (10.3) implies that the price variable may be relatively more stable during a contraction than during an expansion. Consequently, it is not surprising that recessions chiefly affect the level of employment while expansions affect both the employment and the price level.

The full implication of the ratchet effect on prices must be postponed until a theory of the money-wage rate determination is developed. This will be our task in Chapter 11. Using the tools developed in that chapter, we will then be able to obtain useful insights into the process of inflation as analyzed in Chapter 12.

[15] For the Cobb-Douglas function, $M = \alpha \frac{Q}{N}$. Hence,

$$NdM + MdN = \alpha dQ.$$

Dividing both sides of this equation by NM, it can be shown that

$$\frac{dM}{M} = (\alpha - 1)\frac{dN}{N}$$

APPENDIX A. A Digression on the Micro-Foundations of Aggregate Demand

The reader may be confused by the fact that the ordinary demand curve for a single product is typically represented as downward sloping, while the aggregate demand function is upward sloping. There is no contradiction between downward sloping individual demand curves and the upward sloping aggregate demand curve. In fact, the aggregate demand function is logically derived from the micro-theory of consumer behavior.

In Fig. 10.5, S_a represents a typical supply curve for industry A based on factor productivity, and factor prices. (Such a supply curve can be constructed simultaneously for all industries.) At the price P_1, entrepreneurs will supply quantity Q_1 and expect total revenue of z_1 $(= P_1Q_1)$. However, output Q_1 in industry A implies concomitant prices and outputs of other industries which will generate a level of aggregate income such that the normal micro-demand curve for the products of industry A is D_1. (The micro-demand curve is always based on the assumptions of (1) given tastes, (2) given aggregate income and its distribution, (3) all other prices given, and (4) a given number of consumers.)

Thus, at supply price P_1, consumers would like to buy Q_1' output and their intended outlay is $d_1(= P_1Q_1')$. If entrepreneurs in industry A produce Q_1

output, then intended spending will exceed expected total revenue, i.e., $d_1 > z_1$. Similarly, at supply price P_2, entrepreneurs expect total revenue to equal $z_2 (= P_2Q_2)$. Since as industry A has increased output and employment (as have other industries at the same time), the level of aggregate income has risen and its distribution changed, D_2 is the relevant micro-demand curve. At the supply price of P_2, consumers intend to spend $d_2 = P_2Q'_2$, so that d_2

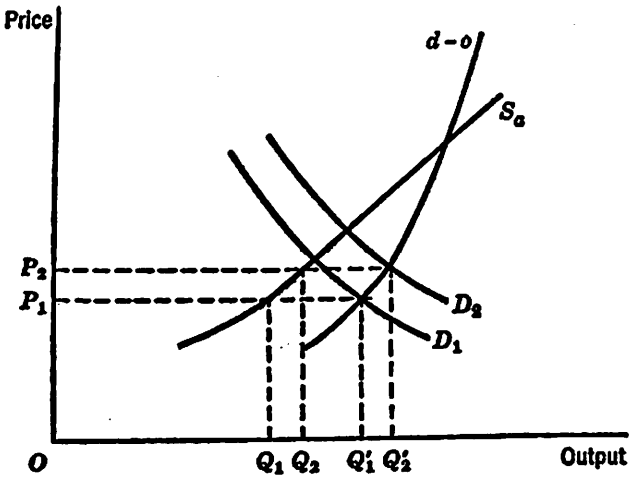

FIGURE 10.5.

exceeds z_2. In this way, a demand-outlay function ($d - o$) for industry A connecting intended demand outlays at different supply prices which are based on rising outputs in A and other industries, and the attending money income flows throughout the economy, can be derived. This micro-demand outlay curve is the industry analogue of the aggregate demand curve. At any level of aggregate employment, aggregate demand is the summation of intended demand outlays over all industries.

APPENDIX B. An Estimate of the Income and Employment Multipliers

A. The Values of the Parameters

1. *The Income Distribution Factor* (k). Statistical evidence indicates that the value of k is approximately 2 for the private sector of the United States economy.

2. *The Marginal Propensity to Consume Out of Wages* (b) *and Out of the Gross Profit Residual* (r). Although a number of statistical studies on the consumption-savings behavior of various economic groups have been published, none of the marginal (or average) propensity estimates have precise applicability to our theoretical concepts. Nevertheless, by using several studies of consumption propensities by occupational groups, in conjunction with the national income data of the Department of Commerce, crude estimates of b and r can be made.

Estimate of b. The consumption behavior of "all employees" can be used as an approximation for the marginal propensity to consume out of wages. Evidence tends to suggest that b would be in the .75 to .85 range, or approximately .80.

Estimate of r. The marginal consumption out of the gross profit residual is more difficult to estimate. The aforementioned studies suggest that entrepreneurs' marginal propensity to consume out of their disposable income is between 1/2 and 2/3. These estimates, however, are only for entrepreneurs of unincorporated enterprises, self-employed professionals, and farmers, whose total income receipts were only approximately one-third of the total gross

Table 10.2 Gross Profit Residual—1960
(Billions of Dollars)

Business and professional income	$36.2		
Farm income	12.0		
Rental income	11.7		
			$59.9
Capital consumption allowances		$43.1	
Indirect business taxes		45.6	
Corporate profit before taxes		45.1	
			133.8
Gross profit residual			$193.7
Dividends—$14.1			

SOURCE: *Federal Reserve Bulletin*, September 1961, pp. 1102–1103.

profit residual in 1960 (see Table 10.2). From the other two-thirds of the gross profit residual, a little more than 10 percent was paid out as dividends and was consequently available for consumption by profit recipients. If we assume that the marginal propensity to consume out of profit distributions is approximately the same as the marginal propensity to consume out of wages (i.e., 4/5),

then the marginal propensity to consume out of the total gross profit residual can be computed as a weighted average:

$$r = (e)(g) + (d)(h)(1 - g),$$

where e is the marginal propensity to consume out of entrepreneurial income, g is the fraction of the gross profit residual going to entrepreneurs, d is the marginal propensity to consume out of profit distribution, h is the fraction of the corporate gross profit residual that is distributed, and $(1 - g)$ is the fraction of the gross profit residual accruing to corporations. Hence,

$$r = (.50 \textit{ to } .67)(.33) + (.80)(.10)(.67) = .220 \textit{ to } .275,$$
$$r \approx .25.$$

Thus, the marginal propensity to consume out of the gross profit residual (r) would approximate .25.

3. *The Money-Wage Rate* (w). The money-wage rate may be estimated by dividing total employee compensation in 1960 by total employment in that year (293.7 billion ÷ 66.7 million), i.e., w = \$4.40, or approximately \$4,400 per annum per employee.

4. *The Parameters of the Function for the Money-Wage Rate* (m, n). Our posited money wage function in the second model, $w = m + nN^2$ suggests an *a priori* relationship, where (1) there is a minimum money-wage rate level (m), and (2) as employment increases and the pools of unemployment dry up, the money-wage rate tends to rise at an increasing rate. Crude estimates for m and n can be made as follows.

Given a legal minimum wage rate of \$1.00 per hour in 1960 and a 40-hour work week, the value of m would be \$2.08 (i.e., \$2,080 per annum). If, in 1960, the level of employment was 66.7 million, while the going money-wage rate was \$4.40 and the minimum was \$2.08, then n would be .000521.

B. The Magnitude of the Multipliers

Using the above values for the parameters, the money income multiplier can be estimated from (10.7) to be 2.11. If w is constant, then the employment multiplier in (10.8) is .239; if w is an increasing function of N, then the employment multiplier in (10.8″) is .116. Thus, for example, an increment of \$1 billion in exogenous spending would increase *GNP* by \$2.11 billion, while employment would rise by 239 thousand, if the money-wage rate were constant, or by 116 thousand if the money-wage rate were an increasing function of employment.

With these multiplier values, the output, income, and price effects and consequently the anti-recessionary policy implications of President Kennedy's decision, in July 1961, to increase military expenditures by \$3.5 billion (without increasing taxes) can be estimated. If wages increase with employment (as in our second model) then the additional defense expenditures will induce a 1 percent increase in prices and a \$7.39 billion increase in money *GNP*. The reduction in unemployment would be only 406 thousand, as much of the increase in total spending will raise the average money-wage rate by almost .7 percent. Consequently, unemployment (which was 5.1 million in July of 1961) would still be significantly large. On the other hand, if the money-wage rate could be constrained (by moral suasion or legislative action) then, for the same initial increase in expenditures, the employment effect would be more than twice as large; 837 thousand new jobs would be created, while the concurrent price rise would be relatively small (approximately .6 percent).

CHAPTER 11

The money-wage rate[1]

Until now it has been assumed that the money-wage rate is exogenously determined. This aggregate equilibrium model would not be complete, however, without making the determination of the most important of all prices—the price of labor—endogenous to the system. In this chapter, the aggregate demand and supply functions for labor will be derived, so that the money-wage rate is endogenously determined. Furthermore, the use of these functions will lead to an analysis of the effects of changes in the money-wage rate on the level of employment, prices, and the rate of interest.

THE DEMAND FOR LABOR

What will be the effect of a change in the money-wage rate on the amount of labor that businessmen will want to hire? The answer to this question depends upon the aggregate *demand curve for labor*, which shows the quantity of labor entrepreneurs would want to hire at every conceivable price (i.e., at every conceivable money-wage rate). This aggregate demand curve for labor is derived from a loci of effective demand points, where each point depends on a given money-wage rate. It has already been demonstrated that the level of employment is determined by the intersection of the aggregate supply and aggregate demand functions. This point of intersection is the level of

[1] Most of the analysis of this chapter has its origins in S. Weintraub's, *An Approach to the Theory of Income Distribution*, Chilton, 1958, pp. 108–130.

effective demand. Both the aggregate supply and the aggregate demand functions are dependent, in part, on the money-wage rate, and both will shift when the money-wage rate changes.

In Chapter 9, it was shown that aggregate supply was a function of the money-wage rate and the level of employment:

$$Z = f_1(w, N). \tag{11.1}$$

In Chapter 10, it was shown that aggregate demand is also a function of the money-wage rate and the level of employment:

$$D = f_2(w, N). \tag{11.2}$$

In equilibrium, aggregate demand equals aggregate supply, so that once the money-wage is specified, the equilibrium level of employment is determined.

For any specified money-wage rate, there is a unique aggregate supply and a unique aggregate demand function which can be derived. By varying the money-wage rate and observing the resulting shifts in the aggregate supply and demand curves, the resulting effective demand points can be obtained and the new equilibrium levels of employment determined. The effective demand points are used to derive the demand curve for labor.

For example, in Fig. 11.1a, if the money-wage rate is w_1, then the aggregate supply function is Z_1, and the aggregate demand function is D_1. The resulting level of employment is N_1. We have therefore derived one point on the aggregate demand function for labor (Fig. 11.1c), for when the money-wage rate is w_1, the number of workers demanded will be N_1. If the money-wage rate rises from w_1 to w_2, then both the aggregate supply and aggregate demand functions will shift upward to Z_2 and D_2 (Fig. 11.1b), respectively, and the new level of effective demand for labor is N_2. We have now derived a second point on the aggregate demand curve for labor (Fig. 11.1c), for when the money-wage rate is w_2, the level of employment is N_2. Repeating this process for each conceivable money-wage rate will enable us to derive the locus of effective demand points that will make up the demand curve for labor. Figure 11.1c suggests that the demand curve for labor is downward sloping. This implies that when the money-wage rate rises, the quantity of labor demanded will fall, which in turn

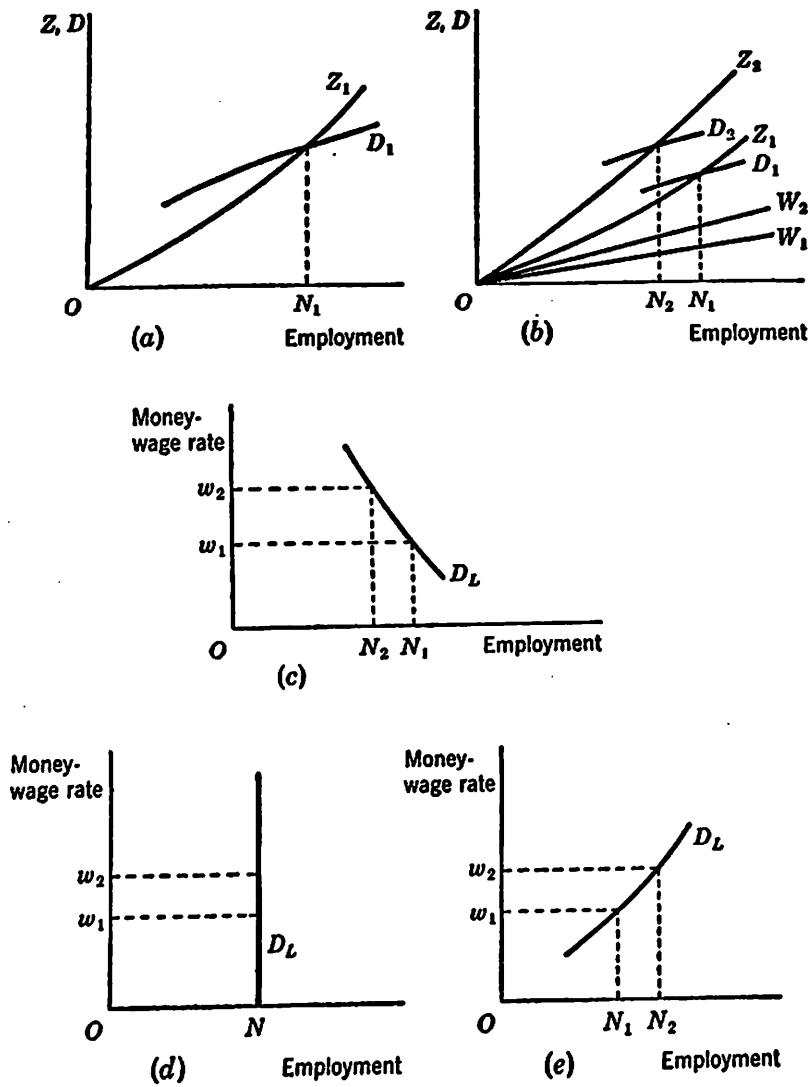

FIGURE 11.1.

implies that as a consequence of the rise in the wage rate the upward shift in the aggregate supply function (in the schedule sense) is greater than the upward shift in the aggregate demand function (in the schedule sense). At first glance, there does not seem to be any reason to expect the shift in the aggregate supply function to exceed the shift in the aggregate demand function and, therefore, it may be that the demand curve for labor is not downward sloping. Indeed, alternative slopes for this function have been suggested. We turn now to an examination of all possibilities.

The classical demand curve for labor

Figure 11.1c depicts what may be called "the classical demand curve for labor," since its downward slope is what most pre-Keynesian economists believed to be the appropriate one.

The Keynesian demand curve for labor

Keynes argued that changes in the money-wage rate were unlikely to change the level of employment. This implies that when the money-wage rate increases, the upward shift of the aggregate demand and supply curves are equal. The resulting aggregate demand curve for labor will be perfectly inelastic as in Fig. 11.1d.

The underconsumptionist demand curve for labor

There have always been a small group of economists who have argued that increase in money wages will lead to a rise in the quantity of labor demanded. In terms of aggregate supply and demand analysis, this result would occur if a rise in the money-wage rate shifted the aggregate demand curve upward by a larger amount than the shift upward induced in the aggregate supply curve. The resulting demand curve for labor would then be upward sloping as in Fig. 11.1e.

Deriving the relevant demand curve for labor

While an absolute statement as to which of these alternatives is, in fact, correct is not possible, it is useful to explore those factors which must be considered if a judgment as to the shape of the demand curve for labor is to be made. The relevant factors are (1) the physical conditions of production, (2) the distribution of income and the spending habits of the different economic groups, (3) inflationary expectations of entrepreneurs and consumers, and (4) the rate of interest.

For the moment assume that production techniques are constant and that whatever the present price level is, individuals believe it will continue into the future. Also assume that the monetary authority takes whatever steps are necessary to maintain a constant rate of interest. Under these assumptions it is only the consumption behavior of the different income groups and investment spending which will affect the demand for labor. If initially the money-wage rate is w_1, then N_1 (Fig. 11.2a) is the level of employment. Suppose the money-wage were to rise to w_2. What would be the effect on the aggregate supply and demand functions?

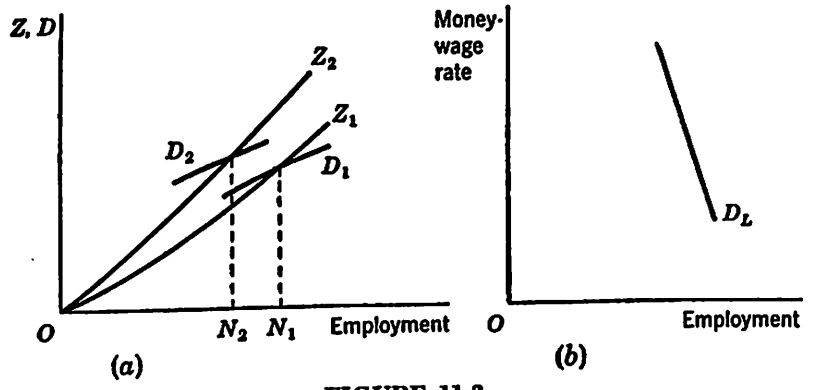

FIGURE 11.2.

A rise in the money-wage rate will increase total money-wage payments at each level of employment, so that, for example, if the money-wage rate were to rise by 5 percent, the wage bill here would be 5 percent higher at each employment level. Since the M/A-ratio at each employment level is unchanged, the aggregate supply curve will also shift upwards by 5 percent so that the wage share, at each level of employment, is unchanged. In other words, a rise in the money-wage rate will lead to a proportionate increase in the aggregate supply function (see Fig. 11.2a).

The effect on the aggregate demand function is more complex for the effects on both the marginal efficiency of capital schedule and the consumption function must be determined. We will take up the effect on each of these behavioral functions in turn.

The marginal efficiency of capital is a relationship between the expected revenue stream, net of future variable costs, and the present

cost of capital. Suppose there is a rise in wages of 5 percent. Assuming wage costs to be total variable costs, a 5 percent rise in wages is a 5 percent rise in variable costs. Entrepreneurs, however, will expect prices to rise proportionately *at any given level of employment*, as the marginal cost curves of all firms rise proportionately. Expected net revenue, therefore, will rise by 5 percent. As the marginal cost schedules in the capital goods industries shift upwards, however, the present cost of capital goods will also rise by 5 percent so that the marginal efficiency of capital schedule is unchanged. *Given the rate of interest*, therefore, we can expect real investment to be unaffected by the change in the money-wage rate and consequently employment in the capital-goods industries will be unaltered. If there is to be any change in the total employment, under our assumption that the monetary authority assures a constant rate of interest, it will be due to the impact of a wage change on aggregate consumption.

The major effect of changes in the money-wage rate on consumption results from concomitant changes in the distribution of income. Since money-wages and prices rise proportionately (at each level of employment) real wages, and therefore the real consumption of wage-earners is unchanged at each employment level. The money income of rentiers is unchanged, hence, the consequences of a rise in money-wages is to redistribute real income, at each employment level, from rentier income towards profits. Real consumption by rentiers will decline by an amount as given by their marginal propensity to consume. The transfer of real income to profits is not likely to increase real consumption of profit recipients by the same amount, since some of the increase in profits will remain the property of the firm and will not be distributed as dividends. Since only the dividends are available for consumption spending, profit recipients are not likely to increase their purchases by an amount sufficient to offset the reduction in real consumption of rentiers.

Thus, while real investment is constant, real consumption and therefore total real demand declines at each employment level.[2]

Thus, in Fig. 11.2a, when the money-wage rate rises to w_2, the aggregate demand curve does not shift up sufficiently to intersect Z_2 at the same level of employment (N_1) as before. Instead, since real

[2] Since the marginal efficiency of capital schedule is unaffected, the additional retained earnings will not induce additional investment spending.

effective demand has declined, only N_2 workers will be hired. As the money-wage rate rises, the demand for labor (Fig. 11.2b) tends to decline, i.e., the demand curve for labor takes the classical downward sloping shape because of the redistribution of income from rentiers to profits and the fact that marginal propensity to consume out of gross profits is lower than the marginal propensity to consume out of rentier income. However, the larger the marginal propensity to consume out of gross profits, the more inelastic the demand curve for labor will be.

Expectations and the demand for labor

Changes in money-wages may alter peoples' expectations about the future. In particular, if the money-wage rate rises, people may expect wages and prices to continue to rise in the future. This inflationary psychology will have an impact on aggregate demand. If inflation is expected, entrepreneurs will anticipate a larger future net money income stream from each investment. Expectations of future inflation will not affect the present marginal cost curves of the capital goods industries, so that the present cost of capital is unchanged. Consequently, the marginal efficiency of capital schedule will shift outwards and, given the rate of interest, real investment will increase. This increase in real investment demand will tend to offset the decline in real consumption demand resulting from the shift of real income from rentiers to profits at each employment level. Moreover, if consumers expect money-wages and prices to continue to rise in the future, each group of consumers will tend to increase their present real consumption out of their present real income, so that this change in consumption behavior patterns will tend to offset the depressing effects of redistribution on real consumption. Because of these inflation expectations, real demand at each level of employment may not decline. Thus an inflationary psychology on the part of the public will make possible a Keynesian vertical demand curve for labor.

Moreover, if the inflationary psychology was sufficiently strong, the upward sloping underconsumptionist demand curve for labor would become conceptually admissable. This possibility, however, may be rejected as unrealistic on two grounds: (1) the rise in domestic wages and prices would reduce foreign demand for the economy's products and would divert home demand to foreign sources (these foreign effects will be taken up in Chapter 14), and (2) the central bank would take

action to raise interest rates if inflationary psychology became that strong.[3]

The real balance effect

It has been suggested that real consumption depends on the real wealth of individuals as well as their real income. If wages and prices were to rise, then the real wealth of those who hold money or interest bearing government debt would decline without any concomitant increase in the real wealth of other individuals in the economy. Holders of money and government bonds would feel poorer, and, it is argued, they would cut real consumption at any level of real income.[4] This effect of changing price levels on real consumption is called *the real balance effect.*

The significance of the real balance effect on aggregate demand depends on the extent of the price rise which is necessary to make creditors feel sufficiently poorer so that their real consumption out of real income would decline. Price changes of this magnitude are likely to wreck confidence in the economy anyway, and it is doubtful therefore that consumers could behave rationally under such circumstances. For less violent, but more realistic price movements, there is little evidence that the real balance effect is significant.[5]

[3] A complete discussion of simultaneous changes in the rate of interest, the money-wage rate, the level of employment, and the price level must be deferred until Chapter 13.

[4] Holders of private debt (creditors) would, of course, feel poorer, and as a consequence might reduce their real consumption, but debtors whose money incomes increase at each level of employment (wage-earners, and profit recipients) would find the burden of debt reduced and might consequently expand their real consumption. The action of the debtors would tend to offset the action of the creditors, so that in the aggregate, the existence of private debt should not give rise to any real balance effect.

[5] Even one of the leading proponents of the real balance effect has suggested that, for all practical purposes, it is not significant. D. Patinkin (*Money, Interest, and Prices*, Harper & Row, 1956), indicated that it would take a major money-wage and price decline to significantly increase the demand for labor and, "it is precisely this necessity for a major price decline which makes this process unacceptable as a primary ingredient of a modern full-employment policy" (*Ibid.*, p. 233). On the other hand, a slow decline in prices and wages will create expectations of further price declines, so that, "the stimulating real-balance effect of a price decline may be more than offset by its depressing expectation effects" (*Ibid.*, p. 235). (We will discuss price expectational effects, which may at times be quite significant, in Chapter 13.) Patinkin argues that it is only in a secular (i.e., long-run) context that it is "almost certain" that the real balance effect will bring about changes in the demand for labor (*Ibid.*, pp. 253–254). Since our model is a short-run policy-oriented model, the real balance effect may safely be ignored.

In summary, a period of moderately rising money-wages will generate some expectations of continuing inflation which, if not frustrated by monetary policy, is likely to result in a highly inelastic, but not necessarily perfectly inelastic, demand curve for labor. Thus, modest changes in the money-wage rate are likely to lead to negligible changes in employment. With large and rapid changes in money-wages, monetary policy and perhaps the real balance effect will tend to mold the extremes of the demand curve for labor into the classical shape.

THE SUPPLY FUNCTION FOR LABOR

In the relevant range, labor supply is normally taken to be an increasing function of the real wage rate, that is, as the real wage rate rises, the number of workers who will offer their services on the market tends to increase. However, since the demand curve for labor relates the level of labor demanded to the money-wage rate, it is necessary to convert the typical supply curve of labor from real to money-wage units.

Deriving the supply function for labor

The real wage is determined by the marginal product of labor.[6] With diminishing returns, the larger the number of workers hired, the lower must be the real wage rate. At any given money-wage rate, it is necessary to determine the number of workers who will be hired, in order to determine the corresponding real wage rate. With a given technology, for any money-wage rate, the quantity of labor that will be demanded is given by the demand for labor curve. Once the quantity of labor that will be hired has been determined, labor's real wage is equal to the marginal product of the last worker that would be hired. For every possible money-wage rate, therefore, there will be a unique real wage rate which will call forth a particular supply of labor.

In Fig. 11.3, a classical demand curve for labor is drawn (D_L). If the money-wage rate is w_1, N_1^d workers will be demanded, and the real wage rate will depend on the marginal product (M_1) of that amount of labor. At the real wage rate implicit in M_1, a given number of workers (N_1^s) will offer their services. Since the quantity of labor

[6] Since $P = w/M$, while the real wage rate is equal to w/P, therefore, $w/P = M$.

demanded falls as the money-wage rate increases, if the money-wage rate is w_2 (which is greater than w_1), then only N_2^d workers will be demanded. The marginal productivity of labor (M_2) and the real wage rate, will be higher when less workers are demanded. The real

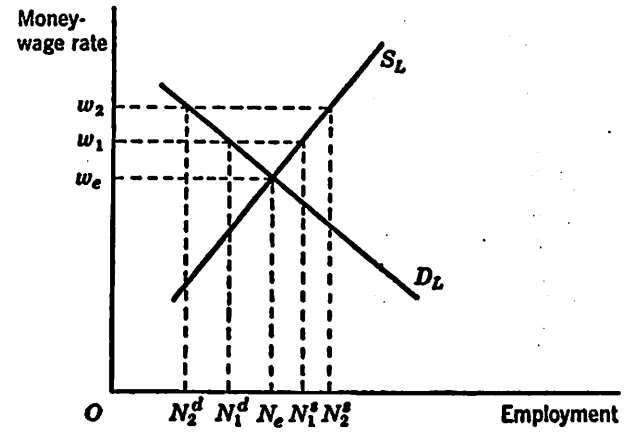

FIGURE 11.3.

wage rate will be higher, therefore, at N_2^d then at N_1^d. At this higher real wage rate, more workers (N_2^s) than before will offer their services.[7] Repeating this procedure for every possible money-wage rate, generates an upward sloping supply curve for labor (S_L).[8] The intersection of the

[7] It is essential to note that what is being analyzed here is the demand and supply schedules for labor and not equilibrium quantities supplied and demanded. It is in this schedule sense, that a rise in the money-wage rate has the same effect as a rise in the real wage rate, that is, in the schedule sense, a rise in the money-wage rate reduces demand and increases the supply of labor.

[8] Alternatively, the supply schedule of labor can be derived directly from effective demand points in the product market. For example, if the money-wage rate is w_1, then the product aggregate supply and aggregate demand functions are Z_1 and D_1 respectively (Fig. 11.2a). At the intersection of the Z_1 and D_1 curves, there is an equilibrium product price level, say P_1 (where $P_1 = w_1/M_1$). If, the money-wage rate is w_2, then Z_2 and D_2 (Fig. 11.2a) are the relevant aggregate supply and demand curves, and the implied equilibrium price level is, say, P_2 (where $P_2 = w_2/M_2$). Since as the money-wage rate rises, the quantity of labor demanded declines ($N_2 < N_1$), therefore, the marginal product rises ($M_2 > M_1$). It follows, therefore, that if the money-wage rate rises from w_1 to w_2, the associated rise in prices (from P_1 to P_2) will be less than proportional to the rise in money wages; consequently, the real wage rate is higher. Accordingly, an increase in the money-wage rate implies a rise in the real wage rate, and hence the supply curve of labor (S_L in Fig. 11.3) will be upward sloping.

demand and supply schedules for labor sets the equilibrium level of employment (N_e) and the equilibrium money wage rate (w_e) in Fig. 11.3. The real wage rate will depend on the marginal product of labor (M_e) at the N_e employment level.

Full employment

This level of employment, where the quantity of labor demanded equals the quantity of labor supplied, is called *full employment*. At full employment, all workers who are willing to work at the going real wage rate can find jobs. Since the number of people who will be willing to work is an increasing function of the real wage rate, full employment does not connote a fixed number of employed workers. It is possible for the economy to move from one full employment level to another.

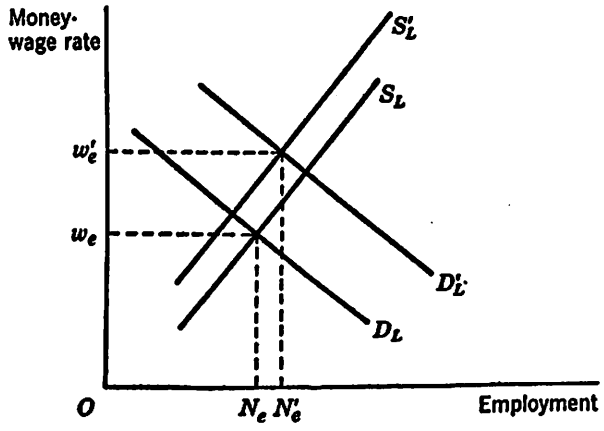

FIGURE 11.4.

Suppose there is an autonomous rise in the government component of aggregate demand, when the economy is already at the N_e full employment level. What are the resulting effects on employment and the money-wage rate? Assuming no change in production functions (and therefore a unique aggregate supply function for any money-wage rate), the increase in effective demand will shift the demand for labor curve to the right to D'_L (Fig. 11.4). A rightward shift in the demand for labor curve, however, involves greater demand for labor

at each money-wage rate and therefore a lower marginal product and lower real wage rate at each money-wage rate. Hence the supply for labor curve will shift leftwards to S'_L. The new full employment money-wage rate (w'_e) and employment level (N'_e) is determined by the intersection of the D'_L and S'_L curves. The shift of both curves suggests that an increase in effective demand at full employment is likely to induce a small change in the level of total employment and a large increase in the money-wage rate, since the demand and supply curves for labor shift in opposite directions.

If the new equilibrium level (N'_e) is greater than the original equilibrium level of employment (N_e), then the new equilibrium real wage rate must be greater than the initial real wage rate in order to induce more workers to offer their services. This increase in real wages will occur when the money-wage rate rises more rapidly than consumer good prices which, in the short run, can happen only if the marginal product of labor in the wage-goods (all consumption goods) industries (and therefore the real wage rate) increases. This implies that aggregate real consumption must decline when real investment rises.[9] Since the real income and the real consumption of workers and profit recipients will increase, the money-wage rate and consumer prices must rise sufficiently so that the real consumption of rentiers is reduced by more than the increase in real consumption of workers and profit recipients. Under these circumstances, real aggregate consumption would fall and allow the economy to move from one full employment level to another, as wages and prices rose substantially. If the economy is going to move from one full employment level to a higher full employment level, then consumer prices must rise sufficiently to generate a considerable reduction in the real consumption of rentiers.

Involuntary unemployment

A market economy does not often move from one full employment level to another (except perhaps in times of war). Full employment is a rare phenomena. Most often, the economy is at a level of employment at which some workers are seeking employment at the going real wage rate but cannot find jobs. These workers are *involuntarily un-*

[9] Thus the classical position that increases in real investment can occur only at the expense of real consumption (i.e., when people "save" more at any level of employment), is correct, as this analysis shows, only when moving from one full employment level to another.

employed. Involuntary unemployment can exist because the supply curve for labor (in money units) has a perfectly elastic floor which is set by institutional factors. For example, unionized workers cannot take jobs for less than the union scale even if as individuals they would prefer to work at a wage below "scale" rather than be unemployed. Also, no one engaged in interstate commerce can work at an hourly wage lower than that set by the federal minimum wage law.

Figure 11.5 shows how the supply curve for labor is modified by introducing the money-wage floor w_0. Below the money-wage rate w_0, the dotted portion of the S_{L1} curve shows what the supply curve for labor would look like in the absence of the wage floor.

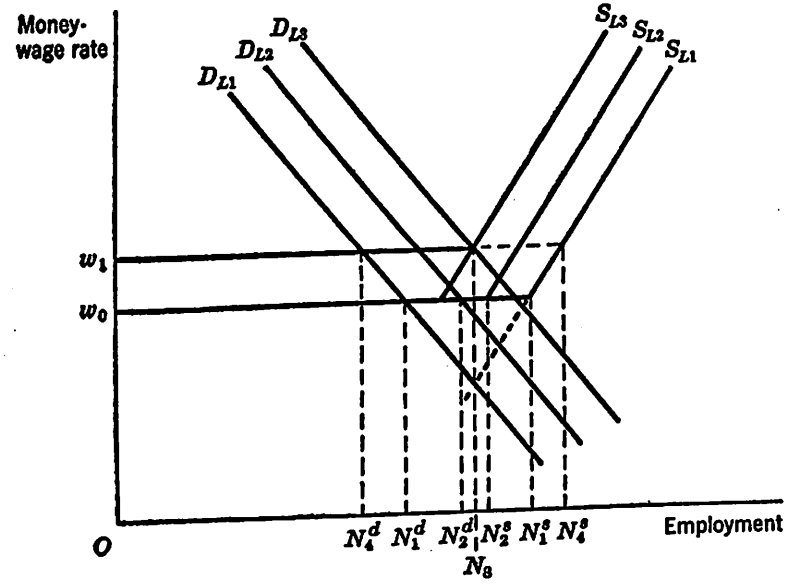

FIGURE 11.5.

Given the demand curve for labor D_{L1} and the concomitant supply curve for labor S_{L1}, the going money-wage rate will be w_0, N_1^d laborers will be demanded while N_1^s workers will be seeking jobs. The difference between N_1^s and N_1^d is the number of involuntarily unemployed workers.

Suppose, despite the existence of involuntary unemployment, profit expectations improve. This leads to an outward shift in the marginal efficiency of capital schedule. What will be the effect on wages and employment? With an increase in the marginal efficiency of capital schedule, entrepreneurs will be willing to hire more workers at each money-wage rate, and therefore, the aggregate demand curve for labor shifts to the right (D_{L2} in Fig. 11.5). Since at each money-wage rate, the demand for workers is greater than before, the real wage at each money-wage rate will be lower. As a consequence, fewer workers will offer their services at each money-wage rate, i.e., the supply curve for labor is shifted to the right (S_{L2} in Fig. 11.5). In equilibrium, w_0 is the money-wage rate, N_2^d workers are hired, and N_2^s workers are willing to work. In this situation involuntary unemployment would decline and is equal to the difference between N_2^s and N_2^d.

If the outward shift of the marginal efficiency schedule is great enough, then the resulting demand for labor curve (D_{L3}) will intersect the relevant labor supply curve (S_{L3}) at a money-wage rate in excess of the money-wage floor. The resulting equilibrium level of money wages will be w_1, and the level of employment will be N_3. In this instance, involuntary unemployment has been eliminated and full employment has been reached.[10]

It has thus far been assumed that the money-wage floor remains fixed. Consequently, the money-wage rate could not increase until full employment was reached. This supposition is unrealistic for several related reasons. As the number of involuntary unemployed decreases and sales increase, unions can become more truculent in their money-wage demands while employers become more willing to grant money-wage increases. As employment expands, prices will rise because of diminishing returns even if the money-wage is unchanged. Those workers who were employed at the outset will find their real wage declining and will seek cost of living increases. Also, as the pools of unemployment dry up, management finds the cost of searching out those who remain unemployed increasing so that it becomes less expensive to bid away workers from other employers than to search out the remaining unemployed. Finally, legislators may now find that the

[10] Any further outward shift of the D_L function will intersect the upward sloping portion of the resultant S_L curve. Thus any increase in demand past the initial full employment level will induce an increase in the money-wage rate. The resulting full employment wage-price relationship has already been analyzed in the previous section of this chapter.

legal minimum wage becomes substandard and therefore they may raise the legal minimum. For all these reasons, the perfectly elastic portion of the labor supply curve may move upward before full employment is reached. The rise in the money-wage rate that will result will add impetus to the price rise as employment increases.

Having suggested the inflationary situation which will accompany an increase in effective demand, we may now investigate the effects of a decline in effective demand. Suppose, for example, that "peace breaks out" in the world and as a result, the marginal efficiency of capital schedule shifts towards the origin. Consequently, there will be a leftward shift of the demand for labor curve, say back to D_{L1}, and therefore a rightward shift of the labor supply schedule to S_{L1}. If the money-wage floor has already moved to w_1 before the decline in effective demand occurs, many institutional barriers exist which make it unlikely that the wage floor will fall back to w_0. (These institutional factors and their impact on wages and prices will be discussed in the next chapter.) In other words, there will be a *ratchet effect* on the money-wage rate. As a result, a smaller number of workers will be demanded (N_4^d), while more workers (N_4^s) are willing to offer their services (since the real wage rate is higher) than initially. The labor force has therefore increased in the face of a recession and involuntary unemployment is greater than it was initially.

The interrelationships between the money-wage rate, the price level, and employment as developed in this chapter, will enable us to understand the phenomenon of inflation and to evaluate the policies designed to prevent it. Inflation is the subject of the next chapter.

IMPLICATIONS FOR WAGE POLICY

The money-wage rate is intimately tied to the price level and, therefore, a discussion of the effects of a government policy aimed at controlling money-wages must wait until the phenomenon of inflation has been discussed. Nevertheless, it might be appropriate, at this stage, to indicate the impropriety of attempting to reduce the money-wage rate via public policy in order to increase the level of employment. Assuming a monetary policy which prevents changes in the rate of interest (this assumption will be relaxed in Chapter 13), the analysis

of this chapter has suggested that modest changes in the money-wage rate will result in negligible changes in the quantity of labor demanded. A large wage cut would be required to significantly increase the quantity of labor demanded. But large changes in the money-wage rate are, because of legal and other institutional barriers, for all practical purposes, unattainable in a free enterprise society. Moreover, even if such large changes were attainable, the result of a wage policy aimed at altering the level of employment every time aggregate demand changed, would be to concomitantly induce such large fluctuations in prices, that business calculations of expected income streams would become futile.[11]

Accordingly, wage policy should not be oriented towards affecting the level of employment, rather it should be utilized (as will be discussed in Chapter 12) to prevent inflation.

APPENDIX. The Neoclassical Demand for Labor Schedule

Since the demand for labor schedule derived in this chapter departs radically from earlier formulations of the demand for labor schedule, it would appear to be desirable to explain why we, following the lead of Keynes and Weintraub, have rejected the typical formulation.

For many years, economists have attempted to derive an aggregate demand curve for labor based on the supposition that no matter what price was paid for labor services, the demand schedule for any good could be assumed constant.[12] In this typical neoclassical approach, the aggregate demand curve for labor was built up from the firm level in the following manner.

The firm's demand for labor depends upon the marginal revenue productivity of labor. If the firm sells in a purely competitive market, then the firm's labor demand function is obtained by multiplying the marginal physical productivity of labor at each employment level by the product price. The resulting marginal revenue product function shows the addition to total revenue that an additional worker will bring forth at each employment level. An entrepreneur will maximize profits by hiring workers until the money-

[11] The impact of "reasonable" money-wage changes on expectations will be developed in Chapter 13.

[12] See, for example, J. B. Clark, *The Distribution of Wealth*, Macmillan, 1889, pp. 360–361, 365.

wage rate is equal to the marginal revenue product of the last worker hired.

If the product demand curve is assumed unchanged, then if the price of labor falls, all firms in the industry expand output. Given the product demand curve, as the output of the industry expands, the price of the product will decline. If the product price declines, then each firm in the industry will face a new marginal revenue product curve. To obtain the relevant labor demand curve of the firm as the industry's output and product price changes, we must use a cross-cut technique which can best be explained by an example.

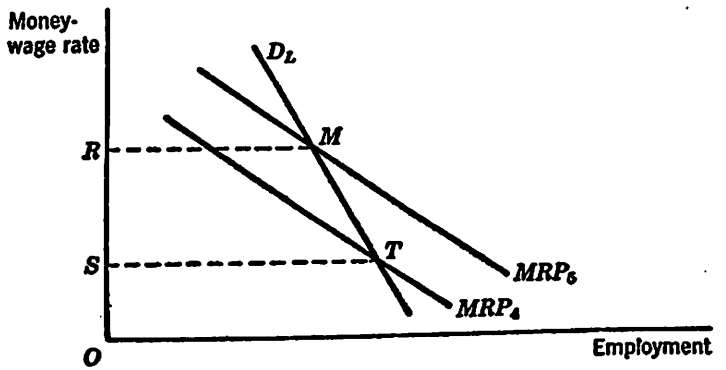

FIGURE 11.6.

In Fig. 11.6, let MRP_5 be the labor demand curve for the firm when the product price is \$5.00. If the price of labor is OR, the firm will hire RM workers. If the price of labor falls to OS for all firms, then the output of the industry will increase so that the product price will fall to say \$4.00. The firm's labor demand curve when the product price is \$4.00 will be MRP_4, and it will hire ST workers. If points such as M and T are connected, we can trace out the labor demand curve of the firm for industry-wide product price changes. The industry's demand curve for labor is then obtained by the lateral summation of the individual firm's demand curve (such as MT). Finally, a summation of all the industry demand curves for labor would, it is usually argued, lead to an aggregate demand curve for labor.

This neoclassical demand curve for labor absolutely requires the assumption of unchanging product demand schedules. The stability of these product demand functions depend on assumptions about (1) the constancy of consumer tastes, (2) the constancy of income and its distribution among consumers, and (3) the constancy of all other prices. These assumptions are obviously inapplicable for any analysis attempting to determine what the effect of changes

in money-wages will have on effective demand. With any change in employment due to a change in the money-wage rate, there must be concomitant changes in aggregate real income (and its distribution) in the economy. Thus, at least, assumption (2) underlying the individual product demand curve is inapplicable. Accordingly, the neoclassical aggregate demand curve for labor must be rejected as being inapplicable to an analysis which involves changes in output and employment, and an aggregate demand curve for labor must be derived which is based on shifting rather than constant product demand curves.

CHAPTER 12

Inflation

In 1958, the Consumer Price Index rose significantly while the level of employment in the United States declined. The unusual nature of these events is illustrated in Fig. 12.1. As shown in this figure, employment declined in 1949 and in 1954. In 1949, the price index showed a marked decline, while in 1954, a slight decline in prices was observed. The 1958 experience stands out in sharp contrast to these other periods of unemployment.

Until 1958, many economists believed that there was a direct relationship between changes in price and changes in employment (because of diminishing returns). It was widely believed, however, that until full employment was approached, price movements would be insignificant. To simplify the theoretical analysis, therefore, the typical Keynesian approach discussed two distinct cases: (1) the involuntary unemployment case, where prices are assumed constant and output is variable, and (2) the full employment case, where output is constant and prices are variable. Events during the 1958 recession, however, emphasized the need for a theoretical model in which simultaneous changes in prices and employment can be handled. Such a model has been developed in the last few chapters. In this chapter all those parts of the model which bear on price changes will be brought together. An attempt will be made to suggest why prices and employment, which normally increase concomitantly, can, on occasion, move in opposite directions.

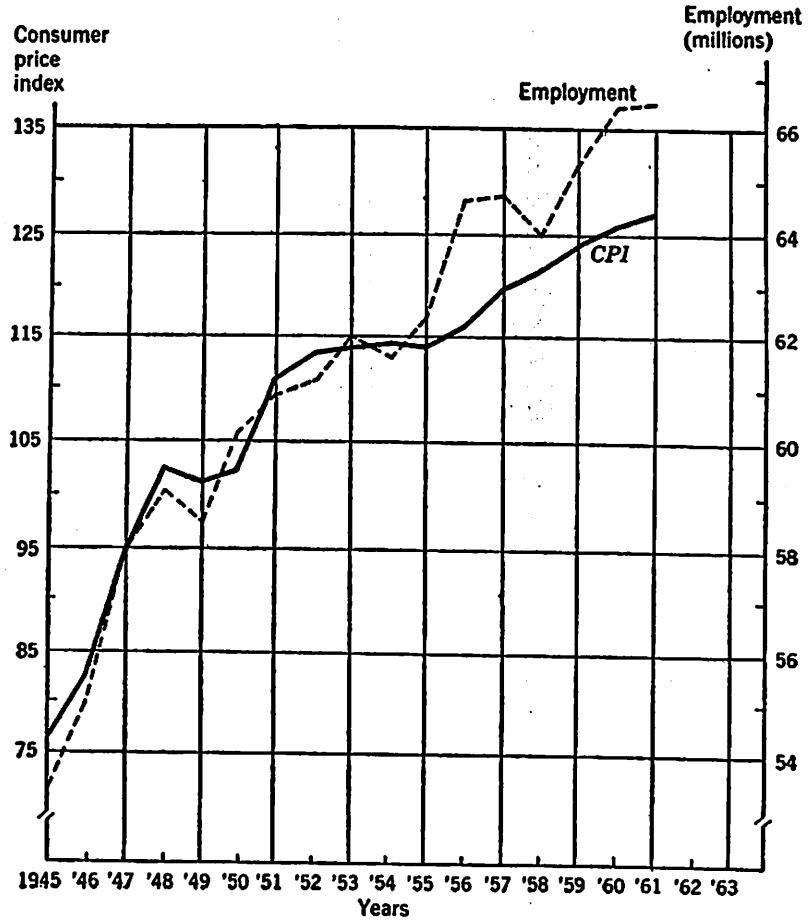

FIGURE 12.1.

Analytically, three basic types of inflation can be identified. Observed price rises will often be due to some combination of these three distinct inflationary processes. If public policy is to stabilize prices with a minimum of undesirable side effects, then it will be demonstrated that it is necessary to design different policies to control each type of inflation.

THE THREE KINDS OF INFLATION[1]

In this section, inflation will be analytically related to either movements along—or shifts in—the aggregate supply function. This aggregate supply classificatory scheme is adopted because of its analytical simplicity and convenience; it in no way implies that inflation is completely a supply determined phenomenon. As Marshall, many years ago, pointed out (and the analysis of Part III is based on this fundamental assertion) prices are determined by both demand *and* supply. The oft-used terms "demand-pull inflation" or "cost-push inflation" can "be excused only so long as it claims to be merely a popular and not a strictly scientific account of what happens."[2]

1. Diminishing returns inflation

We have already alluded to the fact that entrepreneurs will be induced to expand output and employment, in the short run, only if they expect that potential buyers will pay higher prices for this greater output. This will be true, even if the increase in employment, due to an increase in aggregate demand, does not induce any increase in the money-wage rate, because diminishing returns involve rising marginal costs with increases in output.

As long as the output of the economy is rising, but is not at full employment, diminishing returns inflation will be an inevitable and unavoidable consequence of further expansion. Although diminishing returns is inevitable, the significance of diminishing returns inflation will vary with the level of employment. When the rate of unemployment is high (say above 5 percent), idle capacity will exist in most firms, so that diminishing returns is likely to be relatively unimportant. As full employment is approached, however, an increasing number of firms will experience rapid increases in marginal costs as expansion occurs, and, consequently, diminishing returns inflation will become increasingly more important.

In the short run, diminishing returns inflation is an inevitable consequence of an expansion in employment. In the long run, however, diminishing returns inflation can be prevented by improvements in technology and/or increases in real capital per worker.

[1] S. Weintraub, *An Approach to the Theory of Income Distribution*, Chilton, 1958, pp. 162–164.

[2] A. Marshall, *Principles of Economics*, 8th edition, Macmillan, 1938, p. 348.

2. The degree of monopoly: profits inflation

Suppose, for any reason, businessmen come to believe that the demand curves they face have become less elastic at each level of output. Entrepreneurs will then increase the spread between price and marginal costs (i.e., the degree of monopoly power will increase).[3] As a result, at each level of employment, marginal costs are unchanged but prices and therefore profits have increased and the economy experiences a profits inflation.

A recent incident which illustrates the possibility of a profits inflation occurred in the Spring of 1962. After signing a money-wage contract which assured that the marginal cost schedule would remain unchanged during the year, the major steel companies announced an increase in steel prices. This announcement, which implied an increase in the spread between prices and marginal costs, can be interpreted as evidence that profit maximizing entrepreneurs in the steel industry believed that the demand schedule for their output had become less elastic. Since, at each level of aggregate employment, steel prices (and the prices of other products using steel as a raw material) would be higher than before, a profits inflation would result.

Normally, a profits inflation due to a change in monopoly-pricing practices would be combatted via the antitrust laws. In the case of the steel oligopoly, however, it is unlikely that the antitrust laws are applicable. President Kennedy, therefore, used the direct and forceful measures of publicity and an aroused public opinion (as well as government induced dissention by a few firms in the steel industry) to force management to rescind the price increase and prevent the profits inflation temporarily.[4]

[3] Since $MR = P\left(1 - \frac{1}{E_d}\right)$ while $MR = MC$ at the profit maximizing position, $MC = P\left(1 - \frac{1}{E_d}\right)$. Thus if the elasticity of demand (E_d) decreases, at any level of output, the spread between price and marginal cost increases.

[4] By the Spring of 1963, both the steel industry and the President had learned much from their brief but bitter encounter of the previous year. The initial announcement of the price rise by a relatively small steel company rather than by the acknowledged price leader, as well as the selectivity of the products on which prices were increased strengthened the industry's hand. The President's position was weakened by having called "wolf" once already.

3. Wage-price inflation

Every increase in the money-wage rate will, in the short run, shift marginal cost curves upwards, so that entrepreneurs will require higher market prices at any given level of output and employment.[5] Consequently, prices will rise at each level of employment, and a wage-price inflation results. The obvious short-run policy for this type of inflation is the maintenance of a constant money-wage rate.

In the long run, the total product curve can be shifted upwards by either an increase in capital per worker or a change in technology. In either case, if the money-wage rate increases in proportion to the increase in marginal productivity of labor, then the marginal cost curves would be unchanged, and, therefore, in the long run, it is possible for the money wage to rise without producing inflation.

INFLATION AND THE AGGREGATE SUPPLY FUNCTION

The three varieties of inflation can be analytically distinguished by their different effects on the aggregate supply function. Inflationary tendencies may be associated with either movements along the aggregate supply curves or shifts in the aggregate supply curve.

Diminishing returns inflation is associated with a movement along the aggregate supply function induced by an increase in aggregate demand. Movement up an aggregate supply function always implies rising prices if there is diminishing returns. Thus, in Fig. 12.2, a movement from N_1 to N_2 (while the money-wage rate is constant) will involve diminishing returns inflation. Profits inflation will involve an upward shift in the aggregate supply function while the money-wage rate is unchanged; while wage-price inflation is associated with an upward shift in the aggregate supply curve when the money-wage rate increases.

A movement in effective demand along an aggregate supply schedule (diminishing returns inflation), will always increase equilibrium prices. With profits and wage-price inflation, although the price level at each level of employment will be higher, the change in equilibrium prices cannot be specified until changes in the equilibrium level of employment are determined. It is possible, for example, that as a result

[5] See S. Weintraub, *Price Theory*, Pitman, 1949, p. 257.

of an increase in the money-wage rate the equilibrium level of employment declines. Although at any level of employment prices are higher than they would have been before, whether equilibrium prices at the new lower level of employment are higher or lower than the price level that was associated with the original higher equilibrium level of employment is not immediately obvious. In moving from the higher equilibrium employment level to the lower, there are two offsetting factors: prices are being increased because of the upward shift in the

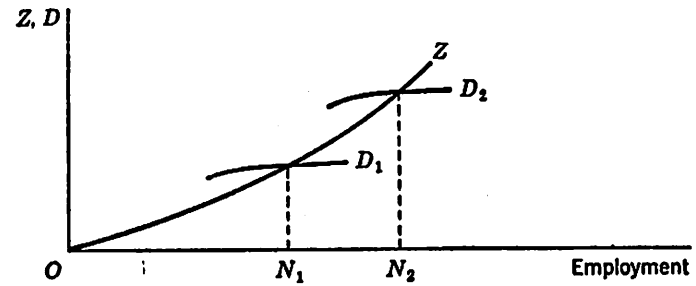

FIGURE 12.2.

aggregate supply schedule, but the downward movement in employment reduces the pressure on prices due to diminishing returns. The movement in equilibrium prices depends upon the net result of these two opposing forces. As indicated in Chapter 11, an increase in the money-wage rate is not likely to substantially reduce employment, so that normally a rise in the money-wage rate can be expected to result in an increase in equilibrium prices.

With profits inflation, on the other hand, the same two offsetting factors must be taken into account in determining the effect on equilibrium prices. In this case, however, the ultimate effect on equilibrium prices cannot be determined *a priori*.

Identifying the "causes" of inflation as diminishing returns, the degree of monopoly, and the money-wage rate, does not imply that any of these factors are necessarily the initiators of any particular inflationary event. For example, an increase in aggregate demand may induce changes in the degree of monopoly and/or the money-wage rate; or, on the other hand, these inflationary forces may be unleashed even in the absence of changes in aggregate demand. Public policies may also affect these inflationary factors directly or indirectly. It is

impossible to put these factors into two mutually exclusive compartments marked demand-induced inflation and supply-induced inflation. As the following discussion suggests, our classificatory scheme is oriented towards indicating what policy levers are required to control inflation, rather than towards setting up exclusive, and exhaustive lists of supply factors and demand factors. In the final analysis, inflation is the result of the interplay of demand and supply and is not the exclusive domain of either separately.

CHANGES IN AGGREGATE DEMAND AND TWO KINDS OF INFLATION

Since there is no evidence on the effects of changes in aggregate demand on the degree of monopoly, it will be assumed that monopoly power does not change. Lack of evidence, at this time, should not imply that anti-inflationary policies can ignore monopoly pricing practices. Lack of knowledge does mean, however, that the remainder of this chapter can deal only with diminishing returns and wage-price inflation.

Assume that the labor supply function depends only on the real wage rate implied in the aggregate demand for labor curve. Moreover, assume that the level of the perfectly elastic floor of the labor supply schedule depends, in part, on the number of workers that are hired. What now will be the effects of a change in aggregate demand on wages and equilibrium prices?

Any change in the aggregate demand function implies a change in the demand for labor schedule. Assuming that physical productivity relationships are unchanged at each level of employment, an aggregate supply function can be hypothesized, such as the heavy discontinuous curve in Fig. 12.3a. The reasoning which lies behind this peculiarly shaped aggregate supply function is as follows.

If the initial money-wage rate is w_1, it can be assumed that that rate will continue to prevail as long as employment is less than N_3 (in Fig. 12.3a). If employers desire to hire more than N_3 workers, but less than N_4 workers, however, although there will still be involuntarily unemployed workers, the increase in the demand for labor will induce labor and legislators to raise the wage floor to w_2. Consequently, at the N_3 level, the aggregate supply curve will shift upward to the Z_2 level. Similarly, when the demand for labor exceeds N_4, the wage floor will rise once again so that the new money-wage rate will be w_3. Thus, again at the N_4 level, the aggregate supply curve

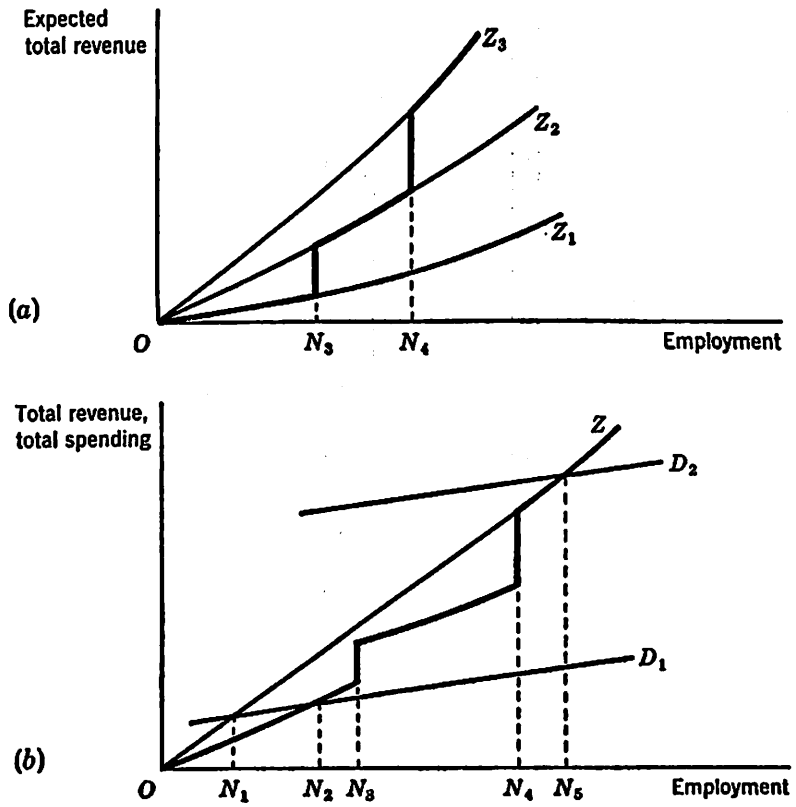

FIGURE 12.3.

will shift upwards to the Z_3 function. Hypothesizing discrete movements in the money-wage rate at critical employment levels results in a discontinuous aggregate supply function.[6]

[6] To make the analysis neater, it could be assumed that beyond the N_3 level, the wage floor rises continuously. The above analysis, however, appears to be more realistic. See J. M. Keynes, *The General Theory of Employment, Interest and Money*, Harcourt, Brace, 1936, p. 301.

The resultant aggregate supply function is redrawn in Fig. 12.3b. If the initial aggregate demand function is D_1, then N_2 is the equilibrium employment level, w_1 is the money-wage rate, and some price level (P_1) exists initially. Suppose now, some foreign nation takes action which precipitates a war scare domestically which induces an increase in government spending so that the aggregate demand curve rises to D_2. The new equilibrium level of employment will now be N_5, while the money wage rate will be w_3. Prices at the N_5 level are higher than they were at the N_2 level for two reasons: on the one hand, the increase in employment has raised prices because of diminishing returns, and, in addition, prices have risen because the money-wage rate has increased. This inflationary rise in equilibrium prices, as is true in most observable rises, is due to a combination of these two forces.

If, after the economy reaches the N_5 level, the crises pass and aggregate demand falls back to D_1, then the equilibrium level of employment would decline to N_1. While demand has returned to its initial schedule, employment is lower and both the money-wage rate and the real wage rate are higher than in the initial situation. The money-wage rate will not return to its initial level, for once the perfectly elastic segment of the labor supply curve has risen, institutional barriers will prevent its fall. Legislators, for example, will not revise the legal minimum wage downwards and unions will not cut "union scale." Consequently, a decrease in the aggregate demand schedule will have a greater impact on employment and less of an impact on prices than the equivalent increase in aggregate demand. Prices will decline when the economy moves from N_5 to N_1 but the fall will be small and attributable only to diminishing returns.

PRICE INCREASES AND DECREASING EMPLOYMENT

The model has, thus far, shown why only small price declines are to be expected in a recession. It is still necessary to explain how it was possible for prices to rise while employment fell in 1958. Two possible theoretical explanations are suggested by the previous analysis.

Since we do not know the relationship between profits inflation and changes in effective demand, it is possible that, during this period, profits inflation occurred simultaneously with the fall in employment.[7] Another possibility is that the strong wage-price inflation of 1955–1957 persisted into the recessionary period. Since the demand for labor was obviously falling during the recession, wage-price inflation could only have occurred if there were semi-autonomous changes in the supply schedule of labor, i.e., if the money-wage floor increased even as employment declined.

Although a perfectly mobile labor force has been assumed, in reality immobilities do exist in the labor market and workers do not move freely from one industry to another. The average real wage rate at any given level of aggregate employment is, of course, set by the marginal product of labor. Thus, at any given level of employment, there is a unique total real wage bill. The struggle for money-wages by different labor groups primarily affects the distribution of total real wages between the different labor groups, but does not affect the average real wage rate at any level of employment.[8] Each group of workers will attempt each year to raise its money-wage in the hope of improving its position vis-a-vis other workers. The amount of increase in the money-wage rate that any group of workers can secure in any given year will depend, in large measure, on their bargaining position, which, in turn, will be related to such diverse factors as the present state of the economy, the profit situation in their own industry, what other workers are getting, and when their wage contract comes up for renewal. In any event, there is continuous pressure on the money-wage floor at all times, although the extent to which the floor can be raised in any year will be partly related to current levels of aggregate economic activity. Thus, with the relatively small decline in employment in the recession of 1958, the money-wage floor may have increased and more than offset the decreasing pressure on prices exerted by diminishing returns, so that the price level crept up while employment declined.

[7] See Lerner's analysis of "sellers' inflation," in A. P. Lerner, "On Generalizing the General Theory," *American Economic Review*, 50, 1960, pp. 138–142.

[8] See J. M. Keynes, *op. cit.*, pp. 13–14. This assumes that the distribution of output between consumption and investment is uniquely determined at each level of employment.

THE ROLE OF MONETARY AND FISCAL POLICY IN INFLATION AT LESS THAN FULL EMPLOYMENT

Productivity relations, the degree of monopoly, the money-wage rate, and the level of effective demand are the determinants of the general price level. Since it is often claimed that the price level depends primarily upon the quantity of money, it may seem strange to some that the price level has been made to depend directly upon a large number of variables and only indirectly upon the quantity of money. Our line of reasoning, which was fully anticipated by Keynes, follows from the main body of the theory of the firm; and, after all, it is at the firm level that prices are made. Keynes, expecting doctrinal controversy with followers of the quantity theory of money approach to price level determination, noted that, given the degree of monopoly:

> In a single industry its particular price-level depends partly on the rate of remuneration of the factors of production which enter into its marginal costs, and partly on the scale of output. There is no reason to modify this conclusion when we pass to industry as a whole. The general price-level depends partly on the rate of remuneration of the factors of production which enter into marginal cost and partly on the scale of output as a whole, i.e., (taking equipment and technique as given) on the volume of employment.[9]

Given this view of price level determination, what are the policy implications? Monetary and fiscal policy can affect the price level only by altering one or more of the strategic determinants which are:

1. Productivity relations.
2. The average degree of monopoly.
3. The money-wage rate.
4. The level of effective demand (i.e., the level of employment).

It is difficult to see any direct relationship, in the short run, between a monetary or fiscal policy which is likely to be implemented, and productivity, the degree of monopoly, or the money-wage rate.

[9] J. M. Keynes, *op. cit.*, p. 294.

Both fiscal and monetary policy are directed primarily at altering the level of effective demand. Thus, it is through changes in demand, whether induced by public or private spending, and the concomitant changes in employment that such policies can affect the price level. An easy money policy, for example, stimulates demand for investment goods which via the multiplier leads to an increase in employment. Prices will rise because of diminishing returns. Prices may also rise because the increase in demand leads to an increase in the money-wage rate. Alternatively, an increase in government spending will increase effective demand and consequently raise employment and prices. Whether the source of the increase in effective demand is from the public or the private sector, the effect is always to raise prices and employment simultaneously.

If the increase in public spending stimulates different industries than those stimulated by an increment in private spending, then the effect on the price level of an increase in public spending may differ from the effect of an increase in private spending. To the extent that different industries face different rates of diminishing returns, have different degrees of monopoly power, and have different money-wage rates, the resulting increase in prices for an increment in spending will be different. Nevertheless, there is no way of knowing *a priori* whether these possible differential effects are significantly large, or even if they are significant; that is, there is no way of predicting whether an increase in public spending is more, or less, or just as inflationary as an increase in private spending.

A public policy aimed at preventing all price increases before full employment can be successful only if it perpetuates involuntary unemployment. Such a policy which sacrifices employment for price stability has often been recommended and accepted. The reason for the acceptance of such a policy derives from the effects of inflation on the distribution of income. Only the unemployed and the impersonal corporation (and perhaps the entrepreneur of the small unincorporated enterprise) stand to reap unmitigated benefits in real income from a simultaneous increase in employment and prices. Those who are already employed and those who receive fixed money incomes have nothing to gain but much to lose.

THE ROLE OF FISCAL POLICY IN INFLATION AT FULL EMPLOYMENT

Full employment occurs when everyone who is willing to work at the going real wage rate can find a job. Since the number of people who will enter the labor force rises as the real wage rate rises, full employment is a variable and not a fixed number of workers. It is perfectly possible, therefore, for the economy to move from one full employment level to another full employment level, where the latter involves a greater total of employed workers. For this to occur, however, total real consumption must fall as workers' real consumption and aggregate demand rises.

As long as there is involuntary unemployment, the real wage rate can decline as employment rises. Once a full employment level is reached, any further increase in real effective demand requires additional workers to enter the labor force. More workers, however, can be induced to join the labor force only if the real wage rate rises.[10] The real wage rate will rise when the money-wage rate and *prices* rise sufficiently to reduce the real consumption of rentiers by more than the increase in real consumption of workers and profit recipients.[11] In this case, the marginal physical product of labor in the wage-goods industries (all consumption goods) will rise as the number of workers engaged in these industries decline. Since the real wage rate is essentially dependent on the marginal product in the wage goods industries, the real wage rate will rise. Under these circumstances, inflation is likely to be very severe and/or prolonged. In the real world, however, full employment inflations rarely occur, except perhaps in times of war. In wartime, an effort is made to obtain the highest full employment level compatible with other fundamental goals such as freedom of job choice. Governments will normally pursue a policy of price stability at the same time. Relatively successful price stabilization will be achieved if aggregate consumption is restrained while employment is expanding. There are many techniques available to governments to achieve this goal. For example, individuals may be urged to purchase

[10] Assuming no change in leisure-income preferences.

[11] This may result in moving individuals from the rentier class into joining the labor force.

war bonds and therefore reduce their consumption. A heavy tax on all consumption expenditures, on the other hand, makes consumption less attractive. Finally, government control of prices combined with rationing can constrain consumption demand and inflation.

INFLATION POLICY: A PROBLEM IN INCOME DISTRIBUTION

The distribution of income is both a cause and a consequence of the inflationary process. As has already been indicated, as employment and prices rise, fixed income groups and already employed workers (including managers) find their real incomes declining while the real income of the previously unemployed, the owners of unincorporated enterprises, and corporations increase. Thus, a consequence of inflation is to increase the well being of some groups in society, while others tend to suffer.

Inflation, on the other hand, may be the result of attempts by some groups to increase their share in the total real income. The aim of these groups is to increase their share of the pie—*no matter what the size of the pie may be*. Profits inflation is clearly such a case. Attempts by unions to raise the money-wage floor is another.

Society has apparently decided that the exercise of increased monopoly power to increase the profit share is socially undesirable. Antitrust laws have indirectly as one of their consequences the prevention of profits inflation. On the other hand, society has, by and large, accepted attempts on the part of labor to raise its share in real income. The primary tool relied upon by labor in attempting to raise the wage share is bargaining for higher money-wages. As is obvious from the model, the attempt to increase the wage share at any level of employment by increasing the money-wage rate will be frustrated by management as it increases prices *pari passu* with the increase in labor costs. Ironically, the upshot of all this is that at any level of employment, it is the gross profit share and not the wage share which rises at the expense of the rentier share, as the money-wage rate increases. Accordingly, if society does in fact wish to redistribute income towards wage-

earners, then the appropriate procedure would be a judiciously chosen system of taxes and transfers, rather than by encouraging free wage bargaining.

It is often said that inflation is undesirable because its effects on income distribution are capricious. Nothing is further from the truth. The effects of inflation on redistribution are clear enough. Inflation redistributes real income away from fixed income groups including those who remain unemployed towards corporate profits and, given the progessive income tax, governments. If there are objections to inflation, it is precisely because the effects on redistribution are predictable and the outcome is socially undesirable.

CHAPTER 13

Prices, money-wages, and the simultaneous determination of the rate of interest and the level of employment

In Chapter 6, a simple model which demonstrated the simultaneous determination of output and the rate of interest was presented. In that model, price, wage, and productivity effects were suppressed. Making use of the concept of aggregate supply, a more generalized model which takes into account prices, wages, and productivity elements in the simultaneous determination of the level of employment and the rate of interest can be developed. As in Chapter 6, it will be useful to derive one equation that summarizes transactions in goods and services, and another summarizing demand and supply conditions in the money market. Little needs be added in this chapter to the discussion of transactions in goods presented in Chapters 9 and 10, but the treatment of the money market needs to be expanded. In particular, it will be necessary to show that the money-wage rate, as well as the interest rate, links the commodities and money markets.

THE MONEY-WAGE AND THE DEMAND FOR CASH BALANCES

In Chapter 6, the supply of money was determined by the decisions of the monetary authority and the commercial banks. These decisions

of the banking system, however, determine the quantity of money in *money* units and not in *real* units. As long as prices were assumed constant, there was no difficulty in reconciling a demand for cash balances in real terms with a supply of money in money units. However, once it is recognized that prices and outputs vary together, then it is necessary to express the demand and supply for money in a common unit. In the following, demand for real cash balances will be converted into a demand in money terms.

The demand for transactions and precautionary balances, in money terms, depends upon the dollar volume of current transactions. It is the size of these monetary sums that matter and the size of these sums depends on (1) the volume of real goods purchased, and (2) the prices of these goods. Prices, therefore, are an important determinant of the demand for cash balances.[1] Since both the demand for goods, and commodity prices tend to increase as employment rises, every increase in economic activity will exert at least a twofold pressure on the demand for cash balances. First, the demand for money will increase to facilitate the exchange of the larger volume of goods. Secondly, demand for cash increases to pay the higher prices resulting from diminishing returns even with a constant money-wage rate. If the money-wage rate were also to increase with expansion, then there would be a third force raising prices and thereby increasing the demand for cash balances. It is inevitable, therefore, that an increase in effective demand will increase the demand for cash balances and, given the supply of money, the rate of interest will increase. To ignore price level movements which occur at less than full employment is to ignore an important factor which tends to create "tight money" during expansion.

One obvious consequence of introducing wage and price phenomena into the system is to highlight the fact that labor unions share responsibility with the monetary authority in affecting the rate of interest. The monetary authorities can either alter the supply of money or induce

[1] For example, from 1940 to 1961, the gross national product of the United States (in constant 1961 dollars) increased from $236.3 billion to $518.7 billion, an increase of 119.5 percent. In current dollars (i.e., unadjusted for price changes) gross national product over the same period increased from $100.6 billion to $518.7 billion, an increase of 415.6 percent. Surely the demand for transactions balances during this period rose more as a consequence of price level changes than in response to increases in real output.

the public to change their expectations about future interest rates while the unions via their wage policy can affect the demand for transactions and precautionary balances. We will live in interesting times when labor unions recognizing their ability to affect the rate of interest advocate across the board wage cuts so as to reduce the rate of interest in order to stimulate new investment.

THE COMPLETE EQUILIBRIUM MODEL

A complete equilibrium model of a purely competitive, fully integrated economy would consist of the following relationships.

First, there is the aggregate supply function which relates entrepreneurs' expectations of sales revenue to any specified level of employment hiring that they would want to offer. For any level of workers employed, entrepreneurs' expectations of total revenue will be related to total wage costs, where the latter is equal to the money-wage rate multiplied by the level of employment. Thus, as indicated in Chapter 9, changes in expected total revenue are related to changes in the wage bill. The aggregate supply function can be generalized, therefore, as

$$Z = f_1(w, N), \tag{13.1}$$

where Z is entrepreneurial expectations of total revenue, w is the money-wage rate, and N is the level of employment.

The price level is implicit in the aggregate supply function since profit-maximizing entrepreneurs will be equating expected price and marginal costs. Since marginal cost is equal to the money-wage rate divided by the marginal productivity of labor, while the latter is related to the level of employment, the price level is a function of the money-wage rate and the level of employment,[2] i.e.,

$$P = f_2(w, N), \tag{13.1a}$$

where P is the price level.

[2] Monopoly elements can be introduced into the system via the aggregate supply function but, as indicated in Chapter 9, there is no evidence of significant changes in the degree of monopoly in the short-run, so that the shape of the aggregate supply function tends to follow competitive theory relationships.

Secondly, there is an aggregate consumption function which relates total money consumption spending to the level of employment. This relationship depends upon the real demand for consumption goods by each major category of consumers (wage-earners, rentiers, and profit-recipients) which, in turn, depends upon the level of money income of each group and the price level. Given the fixed money income of rentiers, their real income, which depends upon the price level, is a decreasing function of employment. The money income of wage-earners and profit-recipients varies with the money-wage rate and the level of employment. Consequently, given the propensity to consume out of real income of each group, aggregate consumption spending (D_c) in money terms, depends upon the fixed income payments of rentiers ($\overline{F}$) which is an exogenously determined constant, the money-wage rate, the level of employment, and the price level. Using (13.1a), the aggregate consumption function can be generalized as

$$D_c = f_3(\overline{F}, w, N). \tag{13.2}$$

The demand for real investment goods depends upon the marginal efficiency of capital which in equilibrium must be equal to the rate of interest. Monetary investment expenditures (D_i) are therefore a function of real investment as determined by the rate of interest and the price level. The generalized investment demand function can be written as

$$D_i = f_4(i, w, N). \tag{13.3}$$

The last equation required for describing the commodity side of the economy is the equilibrium condition that aggregate supply must equal aggregate demand, i.e.,

$$Z = D_c + D_i. \tag{13.4}$$

The money market is summarized in the following equations. The demand for transactions and precautionary balances (L_1) depends upon the volume of goods produced and the price level where output is a function of employment, and prices depend upon both the level of employment and the money-wage rate. Therefore,

$$L_1 = f_5(w, N). \tag{13.5}$$

The speculative demand for money (L_2) is a function of the rate of interest (i) and expectations of the future rate of interest. Taking expectations as given,

$$L_2 = f_6(i). \tag{13.6}$$

The quantity of money (m) is exogenously determined by the banking system, so that

$$m = \overline{m}, \tag{13.7}$$

where $\overline{m}$ is a constant.

The final equation, which completes the system, is the equilibrium condition that the total demand for money equals the supply of money, i.e.,

$$L_1 + L_2 = \overline{m} \tag{13.8}$$

Equations (13.1) through (13.4) reduce to one equation in three unknowns (w, N, i). Assuming the money-wage rate is exogenously determined, these equations reduce to a single equation in two unknowns, N and i, which summarize all that has been developed concerning transactions in the commodity markets:

$$N = f_7(i). \tag{13.9}$$

This function is the composite of the consumption, investment, and aggregate supply functions and will be referred to as the *CIZ* function. The *CIZ* function traces out all the values of employment and the rate of interest which, for a given money-wage rate, are compatible with equilibrium between aggregate demand and aggregate supply. The *CIZ* function, a form of which is plotted on Fig. 13.1, is downward-sloping, since as the interest rate declines, real investment will rise and induce a rise in real consumption and a further rise in employment via the multiplier.

Equations (13.5) through (13.8) also reduce to a single equation, and if the money-wage is taken as exogenously determined, then the resulting equation has the same two unknowns, N and i as (13.9), and summarizes what has been said about the money market:

$$i = f_8(N). \tag{13.10}$$

This *LM* function is a composite of the demand and supply for money and it traces out all the values of employment and the rate of interest

which, for a given money-wage rate, are compatible with the equilibrium between the demand and supply of money.

A form of the *LM* function is plotted on Fig. 13.1. This function will have a perfectly elastic section at some low level of interest when the economy is in the liquidity trap. Once employment and transac-

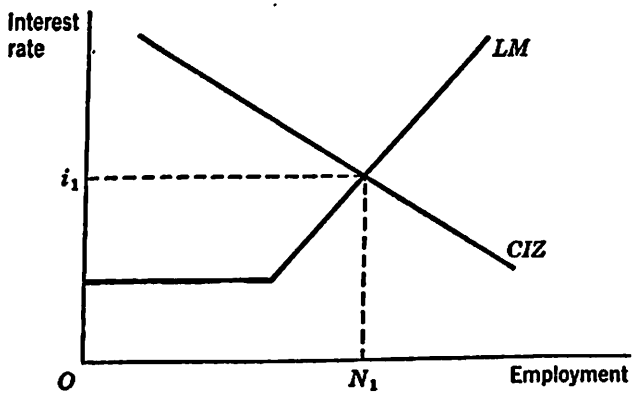

FIGURE 13.1.

tions rise to a level which exceeds the trap, the function slopes upwards, as with a constant money supply and money-wage rate, increasing employment increases the demand for L_1 balances and raises the rate of interest.

Employment and interest are the determinates of the system while the quantity of money, the demand schedule for cash balances, the money-wage rate, and the aggregate demand and supply functions are its determinants. As in Chapter 6, shifts in any of the underlying determinants will shift the *CIZ* or *LM* functions and will change the equilibrium levels of interest and employment.

INTERDEPENDENCE OF THE COMMODITY AND MONEY MARKETS INTRODUCED BY THE MONEY-WAGE RATE

A one-time upward shift in the money-wage rate

In the previous section the money-wage rate was held constant. Now let us examine the effect of changes in the money-wage rate.

We start with the simplest (but most unrealistic) case. What are the implications for the level of employment and the rate of interest when the money-wage rate rises and it is generally expected the wage-rate increase will *not* be repeated in the future? This change will affect both the *LM* and the *CIZ* functions.

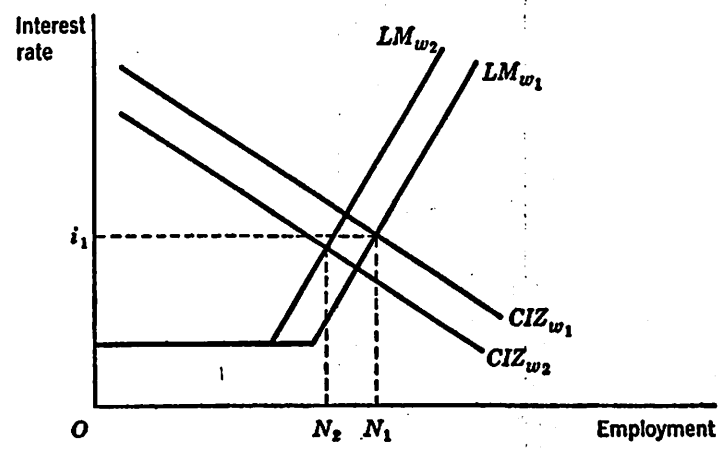

FIGURE 13.2.

The *LM* function will be affected since an increase in money-wages results in an increased demand for L_1 balances at each level of employment. If LM_{w_1} (in Fig. 13.2) is the money market curve when the money-wage rate is w_1, and if the money-wage rate rises to w_2, while the money supply is unchanged, then at every level of employment (except in the liquidity trap), the increased demand for L_1 balances will raise the rate of interest and induce an upward shift in the *LM* function to LM_{w_2} in Fig. 13.2.

The effect of a money-wage rate change on the *CIZ* function is more complex for it is necessary to examine the effects on both the marginal efficiency of capital schedule and the real consumption function.

The effects on the marginal efficiency of capital schedule can be discussed first. The marginal efficiency of capital is a relationship between the expected revenue stream, net of variable costs, and the present cost of capital. Suppose there is a rise in wages of 5 percent. Assum-

ing wage costs to be total variable costs, a 5 percent rise in wages is a 5 percent rise in variable costs. Entrepreneurs, however, will expect prices to rise proportionately at any given level of employment, as the marginal cost curves of all firms rise proportionately. Expected net revenues, therefore, will rise by 5 percent. As the marginal cost curves in the capital goods industries shift upward, however, the present cost of capital goods will also rise by 5 percent so that the marginal efficiency of capital schedule is unchanged. *At any given rate of interest*, therefore, we can expect real investment to be unaffected by the change in the money-wage rate and consequently employment in the capital goods industries will be unaltered. If there is to be any change in total employment at each rate of interest, it will be due to the impact of a wage change on aggregate consumption.

The major effect of changes in the money-wage rate on consumption results from concomitant changes in the distribution of income. Since wages and prices rise proportionately (at any level of employment), while the money income of rentiers remains unchanged, the consequence of a rise in money-wages, at any level of employment, is to redistribute real income away from rentier income towards profits. Real consumption by rentiers will decline by an amount as given by their marginal propensity to consume. The transfer of real income to profits is not likely to increase real consumption by the same amount, since some of the increase in profits will remain the property of the firm and will not be distributed as dividends. Since only the dividends are available for consumption spending, profit recipients are not likely to increase their purchases by an amount sufficient to offset the reduction in real consumption of rentiers. In other words, as a result of the redistribution of income from rentiers to profits and the smaller marginal propensity to consume out of gross profits than out of rentier income, a one-time increase in the money-wage rate will reduce the slope of the aggregate real consumption function. Consequently, the magnitude of the multiplier will decline, which will lead to a lower level of total output and employment for any given level of real investment. The upshot of all this is that at any rate of interest, the level of real investment is unchanged, but total real spending is reduced.[3] A once-over change in the money-wage rate will, therefore,

[3] Since the marginal efficiency of capital schedule is unaffected, the additional retained earnings will not induce additional investment spending, and effective demand will decline at each rate of interest.

shift the CIZ schedule leftward from CIZ_{w_1} to CIZ_{w_2} (Fig. 13.2). At the original money-wage rate, say w_1, the equilibrium level of employment is N_1 and the equilibrium interest rate is i_1. The rise in the money-wage rate to w_2 will lead to a reduction in employment (N_2 in Fig. 13.2), but the effect on the equilibrium interest rate is uncertain. If employment falls off enough, the actual quantity of transactions and precautionary balances demanded may fall and therefore reduce the rate of interest. Alternatively, if total money spending at the new equilibrium level of employment is greater than it was at N_1, the demand for transactions and precautionary balances and, hence, the interest rate, would be greater.

The money-wage rate as a continuous function of the level of employment

Now we turn to the more complex, but more realistic situation in which the money-wage rate rises continuously as employment increases. In Fig. 13.3a, there is a family of LM curves. Each curve represents the money market at a given money-wage rate. As the money-wage rate rises ($w_1 < w_2 < w_3$), the LM function shifts upward from LM_{w_1}, to LM_{w_2}, and to LM_{w_3}, respectively. The reason for this upward shift is, as before, the rise in the demand for L_1 balances at each level of employment. As employment expands and the money-wage rate rises, at each given level of employment, there is a point on one of the curves of this LM family which is relevant for that employment and money-wage rate. The locus of such points is drawn as LM in Fig. 13.3a.

If entrepreneurs expect that each money-wage rate increase will be the last, the effect of any wage rate increase is the same as with a once-over money-wage rise. In Fig. 13.3b, there is a family of CIZ curves where each curve assumes a particular money-wage. If $w_1 < w_2 < w_3$, the CIZ functions shift leftward from CIZ_{w_1} to CIZ_{w_2} to CIZ_{w_3} on Fig. 13.3b. Combining the resultant CIZ and LM curves on Fig. 13.3c. yields the simultaneous solution for interest and employment. The equilibrium money-wage rate which is compatible with this i and N solution is derived as in Chapter 11.

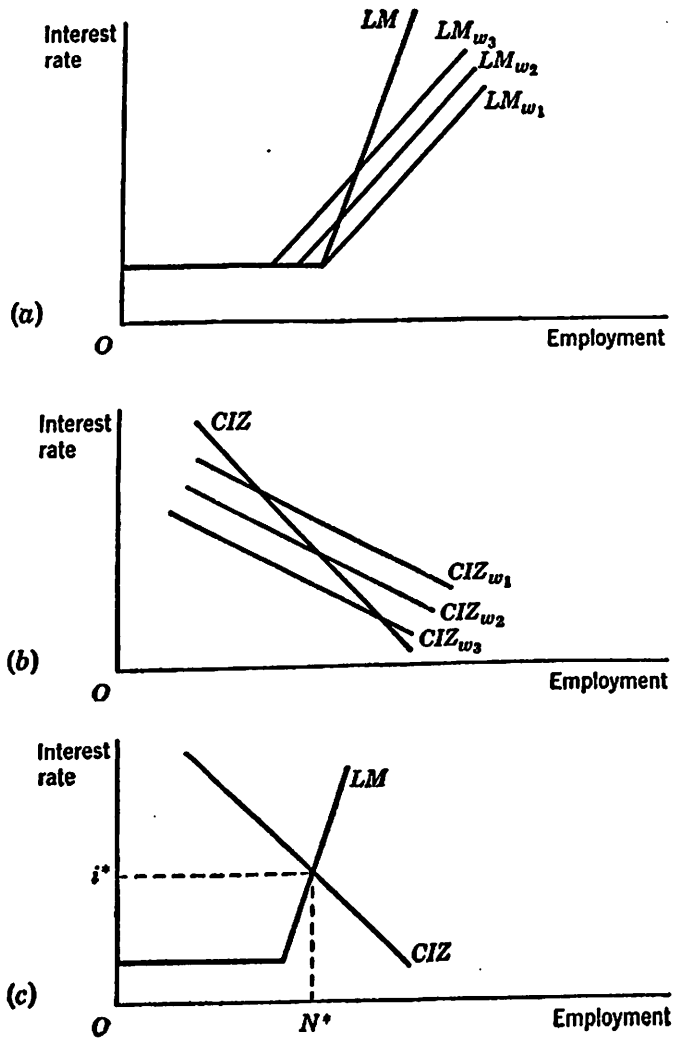

FIGURE 13.3.

EXPECTATIONS OF FUTURE CHANGES IN THE MONEY-WAGE RATE: THE INFLATION PSYCHOLOGY EFFECT

Things are more difficult yet in the most realistic case of them all. When money-wages begin to rise, entrepreneurs may expect wages to rise again in the future. Such expectations will shift the marginal efficiency of capital schedule upward. Expectations of future money-wage increases will not affect the present cost of capital goods, while it will increase the expected net future money income stream of capital goods, therefore raising the marginal efficiency schedule. This outward shift in the marginal efficiency of capital schedule when money-wages rise and are expected to continue to rise in the future will tend to offset the decline in the real consumption function at each employment level due to the redistribution of income. Under these circumstances, when the money-wage rate changes, the upward shift in the marginal efficiency of capital schedule, therefore, will tend to offset the downward shift in the real consumption function due to the change in the distribution of real income. As a result there may be little or no downward shift in the *CIZ* function. Moreover, if consumers expect wages and prices to rise again in the future, they may decide to increase real consumption out of real income now. As a result, the real consumption function will shift upward augmenting the upward shift in the marginal efficiency of capital function, so that the resulting *CIZ* function may shift upward from CIZ_{w_1} to CIZ_{w_2} in Fig. 13.4.

As before, an increase in the money-wage rate increases the demand for transactions and precautionary balances at every employment level. Given the supply of money, these increases in demand for transactions and precautionary balances will, if the speculative demand is unchanged, raise the rate of interest at each level of employment and result in an upward shift in the *LM* function.

Holders of speculative cash balances, however, must also make a judgment. If, as the liquidity preference theory has assumed so far, the speculative choice is between money holdings and a riskless perpetual bond, then as long as an individual expects the future rate of interest to rise at a more rapid per annum rate than he expects the price level to rise, he will desire to hold cash for he expects the price of bonds

to decline at a more rapid rate than the decrease in the purchasing power of money. A change in the money-wage rate will alter the speculative demand for money, therefore, only if it has a differential impact on price expectations and interest rate expectations. The total demand for money will increase at each level of employment if individuals expect that the rate of increase in prices will be equal to, or less than,

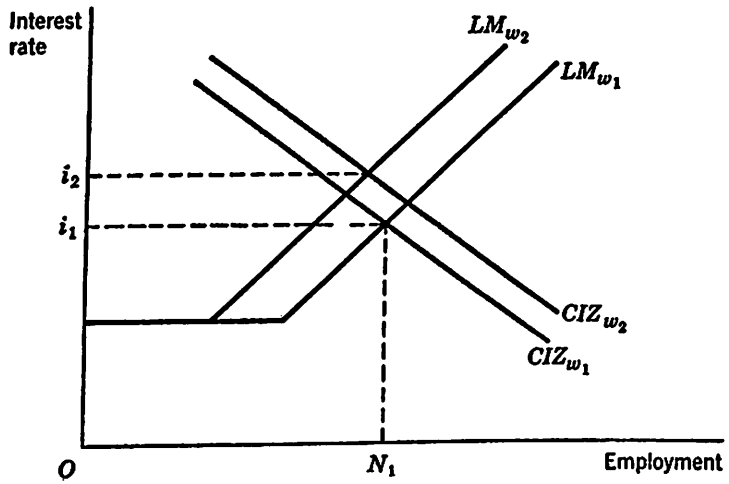

FIGURE 13.4.

the expected rate of change in the rate of interest, for the speculative demand for money will be at least as large as before but the demand for transactions and precautionary balances will be greater. Hence, with a constant money supply, the rate of interest at each employment level will rise, and therefore the *LM* curve will shift upwards.

Of course, in the real world, perpetual bonds are not the only alternatives to holding money. Another important class of assets are equities and other second-hand assets. To avoid the complexities of a complete theory of asset choice at this stage, assume equities to be the only other alternative. If equity prices are believed to move with changes in the price level and if the rate of interest on bonds is expected to move more slowly than the price level, people will prefer, for speculative purposes, equities to bonds. Consequently, the price of equities

will rise while the price of bonds will fall until in equilibrium the rate of interest has risen sufficiently to compensate bond purchasers for their expectations of inflation. Moreover, if there is an inflationary psychosis then we can expect the rise in the rate of interest to be augmented by central bank policy. The central bank will be struggling to curtail demand in the domestic market. Their tool will be the quantity of money and their objective will be an increase in interest rates in order to cut down spending. For all these reasons, then, a rise in the money-wage rate will shift the *LM* curve upward to LM_{w_2} in Fig. 13.4, so that the new equilibrium rate of interest will always be higher than the initial level. The level of employment may or may not be less than at the outset; it all depends on the relative shifts in the two functions. Except in the case of expectations of hyper-inflation, however, it is not unreasonable to expect that an inflationary period will be ended by labor "pricing itself out of the market."

CHAPTER 14

Foreign trade and the equilibrium model

It was only necessary to redefine the components of the aggregate demand function when the forecasting model was restructured (in Chapter 8) to take account of the fact that individuals in the domestic economy may buy abroad and foreigners may choose to purchase domestic goods and services. It is, however, more complicated to introduce foreign trade into the equilibrium model, since in reality, foreign trade affects aggregate supply as well as aggregate demand. To summarize the rest of this chapter in advance, purchases abroad and purchases by foreigners of domestic goods affects both the level and composition of output and thereby aggregate supply and the price level in all the trading countries, which, in turn, affects the distribution of income and the level and composition of aggregate demand in each country. The task of this chapter is to present an orderly analysis of these diverse interrelationships.

AGGREGATE IMPLICATIONS OF COMPARATIVE ADVANTAGE

A major theorem of the theory of international trade states that, with free trade, the entrepreneurs of each trading nation will find it profitable to specialize and to produce those goods and services which they can make most efficiently and to trade with the entrepreneurs of the other countries for those products which they are least efficient at producing. This proposition has been called the *law of comparative advantage.*

In addition to comparative advantages, difference in the degree of monopoly, tax laws, tastes, and other factors will be reflected in the relative price structure of each trading nation. The exchange rate, that is, the price of one nation's currency in terms of the other's, represents some form of average adjustment of price levels in the two countries. Between the trading nations the relative price structure will be different, and these differences are the signals to which importers and exporters respond.

Foreign trade will modify the equilibrium model in two ways. First, since the domestic economy will specialize in those industries in which it will have a comparative advantage, the composition of output, at each level of domestic employment, will be affected and therefore the shape and position of the aggregate supply function will be different when trade occurs as opposed to a situation in which there is no trade.

Secondly, the aggregate demand function must be defined so that (1) the demand concept involved is only the demand of buyers for domestically produced goods and services, (2) it reflects the internal prices in each trading country which vary with the level of employment in each country, and (3) changes in income abroad, as well as at home, will affect the level of aggregate demand.

Assume constant money-wage rates in the domestic economy and in the rest of the world. Any exogenous increase in domestic expenditures will raise domestic income and induce additional imports. These additional purchases from abroad will raise income and output abroad. As output at home and in the rest of the world increases, prices at home and abroad will rise due to diminishing returns in each country.

If the rate of diminishing returns is not markedly different at home and abroad, domestic prices will rise more than foreign prices since the impact on domestic employment is greater than the induced effect on employment abroad. As a result, foreigners will find import prices rising relative to the prices of their own produced goods,[1] while domestic residents will find foreign products becoming cheaper relative to domestically produced goods. These relative price changes should affect the domestic and foreign marginal propensities to import—the former should rise, while the latter ought to fall.

[1] Assuming a fixed rate of exchange.

The upshot of all this is that an exogenous increase in domestic expenditures will tend to raise employment, domestic prices, and imports, while exports are likely to rise only slightly because of the induced expansion abroad. Consequently, there are three implications to be derived from this equilibrium analysis of the effects of an increase in exogenous expenditures on domestic output: (1) in an open economy, a smaller increment in employment will be induced than would be the case in a closed economy since some of the induced spending will be on goods produced abroad, (2) if prices are permitted to rise, then more of the induced spending will spill over into foreign purchases than if prices are held constant at home and abroad, and (3) since imports will increase more than exports, the domestic balance of trade will deteriorate.

Although these conclusions will generally be correct, there is an instance in which an initial increase in expenditures on domestic output will lead to an improvement in the balance of trade. For example, assume two trading countries, A and B. If domestic expenditures in A for A's output are exogenously increased, then A's prices will tend to rise more than B's prices. If B's price elasticity of demand for A's products is inelastic, then B's total expenditures in A will rise. Similarly, if A's price elasticity of demand for B's products is inelastic, A's spending in B will rise but by a smaller amount, since B's prices have increased less than A's. If there were no changes in income levels, there would be a net increase in spending in country A and a decrease in spending in country B. Income levels, however, do change; nevertheless, if price elasticities are low, then income elasticities must be low.[2] Consequently, the shift in spending due to the change in relative prices at home and abroad will more than offset any increase in the domestic demand for imports due to the rise in domestic real income. The upshot of this would be that the domestic expansion would induce a slump in the rest of the world while improving the

[2] The price elasticity of demand depends upon the income elasticity and the elasticity of substitution, i.e.,

$$E_p = kE_y + (1 - k)E_s,$$

where E_p is price elasticity, E_y is income elasticity, E_s is elasticity of substitution, and k is the proportion of income spent on the good in question. Since all goods are ultimately substitutes, i.e., $E_s > 0$, then it follows that $E_p > E_y$.

domestic balance of trade and keeping the multiplier repercussions at home.[3]

The necessary conditions for this perverse situation to occur are (1) a low domestic income elasticity for imports, (2) a high rate of domestic diminishing returns so that domestic prices rise substantially as domestic expenditures increase, and (3) the price elasticities of demand for imports in both of the trading countries must be less than unity, so that when foreign products become relatively cheaper, domestic and foreign buyers do not significantly reduce their domestic purchases. The mere statement of these necessary requirements indicates the exceptional nature of this example. In the usual foreign trade situation, not all of these conditions will be met and, therefore, we may expect an increase in domestic expenditures to induce increases in output, prices, and employment at home and abroad. As a result, with an exogenous increase in spending on domestic output, the domestic balance of trade will deteriorate since the domestic demand for the products of the rest of the world will rise more than the foreign demand for domestic exports. Domestic prices will tend to rise more than foreign prices (unless diminishing returns is much more important in the rest of the world than it is domestically). Although the balance of trade will deteriorate, since the increase in domestic prices will be greater than the increase in foreign prices, the real terms of trade will tend to move in favor of the domestic economy, that is, the domestic economy will receive more units of foreign produced goods for every unit of domestically produced goods it sells abroad.

MONEY-WAGE CHANGES AND FOREIGN TRADE

If the money-wage rate at home (abroad) varies directly with the domestic (foreign) level of employment, then the money-wage rate will give added impetus to variations in the price levels of the trading nations. Consequently, the effect of an increase in domestic expenditures on the domestic and foreign levels of economic activity will be reinforced by money-wage rate phenomena. In general, the result will be to raise prices, wages, and employment domestically more than

[3] See J. E. Meade, *The Balance of Payments*, Oxford University Press, 1951, pp. 73–74.

their counterparts abroad and, therefore, to reduce the multiplier ramifications on domestic employment and output. Thus, the magnitude of the multiplier is likely to be smaller in an open economy with flexible wages and prices than in an open economy with constant wages and prices, which in turn will have a smaller multiplier than in a closed economy.

Given stable exchange rates, the international relationship of money prices among the trading nations is clearly a fundamental determinant of world trade, and the role of money-wages must be fully understood when formulating world trade policy. Up to now, this problem has received little theoretical attention. The analysis of this chapter suggests that future developments of international trade theory will have to take into account domestic money-wage changes and variations in the level of employment, as well as the more traditional aspects of international money and commodity markets.

FOREIGN TRADE, THE LEVEL OF EMPLOYMENT, AND THE WAGE SHARE

The multitude of open economy situations which can be analyzed via aggregate supply and demand analysis is too large to be presented in a book that does not deal exclusively with foreign trade. Given the supply conditions and the demand elasticities of prices and incomes, aggregate supply and demand curves can always be derived and the equilibrium solution determined.

One possible situation is presented below, mainly for its pedagogical value, but it does also have some important implications.

Assume there are only two economies (A and B), which produce only two goods (X and Y), using only two factors of production, labor (N) and capital (K). Moreover, assume that initially there is no trade between the two economies and that both commodities are produced in each country by fully integrated firms. In country A, labor is relatively scarce so that capital intensive methods of production are used; while in country B, capital is relatively scarce and therefore labor intensive methods are employed. Under these circumstances, what will be the effect on employment in A if the two nations begin to trade?

The initiation of trade will alter the composition of output at each level of employment as each country tends to specialize in the industry in which it has a comparative advantage. Assuming identity of tastes and identity of production functions (which are assumed to be linear and homogeneous), then in the labor scarce country (A), resources will be shifted from the labor intensive industry (X) into the capital intensive industry (Y). Moreover, as the output of X is reduced, the bundle of resources freed contains a higher proportion of labor to capital than is optimal for industry Y at the prevailing ratio of factor prices, so that labor tends to become cheaper relative to capital at each level of employment. Profit maximizing entrepreneurs will therefore increase the labor to capital ratio in each industry by substituting some of the cheaper factor for the more expensive factor. Finally, assume that because of diminishing returns in each country, neither country completely specializes in the production of only one good, so that the output of industry Y expands, while the output of X is reduced but not eliminated in country A.

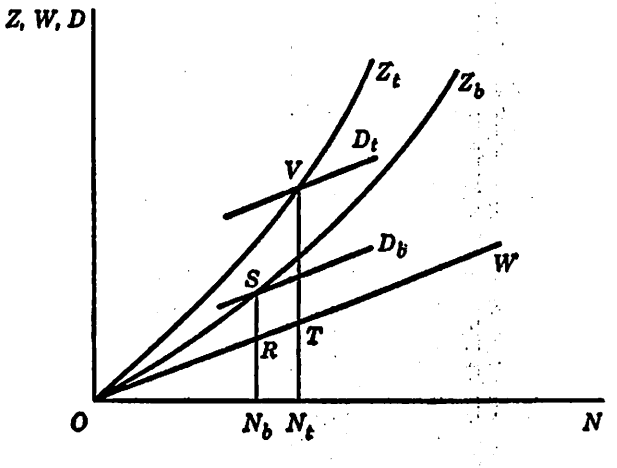

FIG. 14.1. The Effects of Trade on Aggregate Demand and Supply.

In Fig. 14.1, Z_b represents the pre-trade aggregate supply function, while D_b represents the pre-trade aggregate demand function. If the money-wage rate is assumed to be constant (w), then OW is the wage bill line, and in equilibrium, N_b is the level of domestic employment and the wage share is equal to N_bR/N_bS.

For any given ratio of factor prices, the wage share will be greater in the labor intensive industry (X) than in the capital intensive industry (Y). The aggregate wage share at any level of employment is, as indicated in Chapter 9, equal to the weighted average of the M/A-ratios of the individual industries, i.e.,

$$\frac{W}{Z} = \left(\frac{M_x}{A_x}\right)\frac{Z_x}{Z} + \left(\frac{M_y}{A_y}\right)\frac{Z_y}{Z}, \qquad (14.1)$$

where W is the total wage bill, Z is the gross income, Z_x is total income (sales) in industry X, Z_y is total income (sales) in industry Y, M, and A with their respective subscripts representing the marginal and average products of labor in the appropriate industry. The assumption of linear and homogeneous production functions implies that the M/A-ratio in each industry is independent of the output of the industry and will either be a constant (if the production function is of the Cobb-Douglas type) or will decline if the labor/capital ratio increases.[4] With the introduction of trade, therefore, the importance of industry Y increases relative to X, i.e., Z_y/Z increases while Z_x/Z decreases at each level of employment. Thus, even if the M/A-ratio (and therefore the wage share in each industry) is unchanged, (14.1) indicates that the wage share in the gross income of the economy will decline at any level of employment as trade induces a change in the composition of output.

As we have demonstrated in Chapter 9, the wage share depends on the position of the aggregate supply function relative to the wage bill line. The assumption of a constant money-wage rate[5] fixes the position of the OW line in Fig. 14.1, and implies that the aggregate supply function shifts upward to Z_t after trade is established.

Given the income and price elasticities of the various buyers, the aggregate demand curve for home production can be derived. This post-trade demand function would have to be built up through an

[4] See Appendix.

[5] A constant money-wage rate before and after trade is not inconsistent with labor becoming cheaper relative to capital, since the money price of capital can rise. Since the relative wage share depends only on the position of the Z function relative to the wage bill line, a fall in the money-wage rate can also be handled by the analysis. The assumption of a constant money-wage rate, however, simplifies the diagrammatic analysis.

analysis of the propensities to consume and import of the various buying groups in the domestic and foreign economies, and an analysis of the post-trade commodity price ratios. For the present, assume that the post-trade aggregate demand function will be D_t in Fig. 14.1, where D_t includes foreign demand for exports, but excludes domestic demand for imports. After trade, the level of employment will increase[6] to N_t, the money wage bill rises to N_tT and the relative wage share declines to TN_t/VN_t.

The marginal product of labor in each industry is lower (since the labor/capital ratio has increased), and therefore the real wage rate is lower. Since employment has increased, however, one cannot deduce the effect of labor's real absolute income. The possibility exists that labor as a group has improved its real income position, although previously employed workers will find that their real income has fallen.

EPILOGUE TO THE FOREIGN TRADE ANALYSIS

There are many other possible interrelationships between income, employment, prices, wages, and foreign trade which could be elaborated upon.[7] With the growing importance of international trade and the emergence of trading blocs, an understanding of all the possible interrelationships is becoming increasingly important. The detailed analysis, however, must be left to works wholly devoted to these complex international trade problems.

APPENDIX

Proposition: To demonstrate that when a production function is linear and homogeneous, an increase in the labor capital ratio cannot induce an increase in the ratio of the marginal product to the average product of labor.

[6] Whether or not the introduction of trade really increases the real effective demand for home production will, as suggested above, depend on the actual demand elasticities of the various domestic and foreign buyers.

[7] For example, differential growth rates among trading nations may, because of income elasticities of demand for imports, differ among nations. These differences may lead to important complications in the balance of payments and the level of economic activity. See K. Kurihara, "The International Compatibility of Growth and Trade," *Economia Internazionale*, 13, 1960, pp. 3–8.

Assume that in the pretrade position, the labor intensive industry (X) is operating at point R on its isoquant map (Fig. 14.2a). After trade, the output of X is contracted to point S. Erect a line from S, perpendicular to the ordinate axis, which intersects the vector OR at point T. Since the production

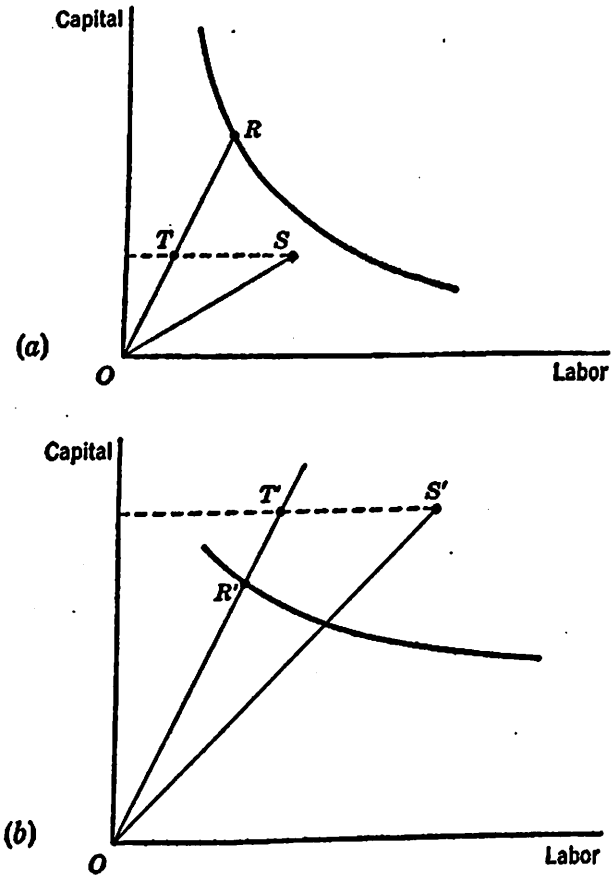

FIGURE 14.2.

function is linear and homogeneous, the M/A-ratio will be a constant along any given straight line emanating from the origin. Thus, the M/A-ratio at R is equal to the M/A-ratio at T. If starting from T, labor inputs are added to reach S (by moving along TS), then the marginal and average products will

fall (because of diminishing returns). It can be demonstrated, however, that with diminishing returns, the M/A-ratio will either be a constant (if the function is of the Cobb-Douglas type) or it will decline.[8] Hence the M/A-ratio at point S is equal to, or less than, the M/A-ratio at points T and R. Thus, with an increase in the labor capital-ratio, the M/A-ratio either remains constant or declines in industry X.

In a similar manner, it can be demonstrated that the M/A-ratio in industry Y cannot increase as the labor-capital ratio rises. In Fig. 14.2b, point R' is the pre-trade output position of industry Y, while the post-trade position is represented by S'. By erecting lines similar to Fig. 14.2a, it can be shown that the M/A-ratio at R' is equal to the M/A-ratio at T', which, in turn, is equal to or greater than the M/A-ratio at S'.

[8] See Appendix B, Chapter 9.