Chapter Two
Capital Theory, Utility Theory, and Economic Equilibrium

In the 1870s a new attempt was made to explain how economic order results from individual exchanges. Out of the refinements, changes, and additions of this neoclassical revolution arose a systematic vision of economics, which is still dominant today. In writing about neoclassical economic theory, I am writing about the received theory which dominates the discipline.

Neoclassical economists regard the theory of exchange value as the cornerstone of economic theory. They agree with the classical economists that theorists must study prices to understand how economic order arises from self-interested individual action. To understand production and distribution and consumption, one must understand both price fluctuations and long-run equilibrium prices or exchange values. In this chapter I hope in an informal way to make the neo-classical approach intelligible. Later, in chapters 5–7, I shall develop neoclassical theory more rigorously. My goal in this chapter is to show clearly how the problems of capital and interest arise within the general neoclassical program.

1. Marginal Utilities and Exchange Values

In developing an alternative theory of exchange value, neoclassical theorists relied on further generalizations concerning individual choices to exchange commodities. When a rational and self-interested individual, A, exchanges one unit of commodity x for q units of commodity y voluntarily, A wants q units of y as much or more than 1 unit of x. Since the early neoclassical economists were influenced strongly by utilitarianism (e.g., Jevons 1871, chs. 2, 3), they found it natural to say that q units of y just then gives A as much or more utility as one unit

of x. Saying so, however, commits one neither to utilitarianism nor to the identification of utility with a mental state that is supposed to be the sole goal of action. One can stipulate rather innocuously that option 1 has more utility than option 2 for A if and only if A prefers 1 to 2. Obviously the above conditions depend on nothing peculiar to A; any rational and self-interested agent will engage voluntarily in an exchange only if doing so increases his or her utility thus defined. We can conclude that rational and mutually disinterested individuals are utility maximizers.

To say that individuals are utility maximizers is to say no more than that they do what they prefer. To coax more content out of this platitude, economists need to be able to discuss utility *functions*. These consistently relate options (which are identified with bundles of commodities) to levels of utility. Individuals can possess utility functions only if their preferences are complete and consistent. Moreover, economists suppose that agents are not satiated. A commodity bundle x possesses for all agents a greater utility than bundle y whenever x contains as much of each commodity as y does and more of at least one commodity. As utility maximizers, agents will always exchange a smaller bundle of commodities for a larger one if they can.

If economists are interested in how voluntary exchanges of informed, rational, mutually disinterested individuals can lead to an efficient and systematic organization of the economy, they can ignore the mistakes individuals make through irrationality, lack of information, or inadequacies in the assumption of mutual disinterest. As a first approximation, economists are thus perhaps justified in assuming away satiation. If one is interested in how an economy actually works, as opposed to how exchanges *can* lead to economic order, ignoring these complications is not obviously legitimate. Given these various strong assumptions, economists can specify for each individual a utility function which consistently relates larger bundles of commodities to higher levels of utility. As individuals grow and change, their utility functions will change, but we shall pass over these complications here.

I have not yet presented all the pieces of even a rudimentary theory of exchange. As Adam Smith noted long ago (1776, bk. I, ch. 4), exchange values are not proportional to utilities. All sane persons prefer lifetime supplies of water to lifetime supplies of diamonds, yet people regularly pay more for diamonds than for buckets of water. Neoclassical economists explain why by distinguishing the *total* utility that an agent's total stock of a commodity provides from the *marginal* or incremental utility which possessing another small unit of the commodity brings. Neoclassical economists offer the generalization that the marginal utility of a commodity is a decreasing function of the quantity of the commodity possessed. Unless people are satiated, consuming one more grain of rice will increase their total utility. One grain of rice will never make an enormous difference to people's total utility, but it will count more if they have almost no rice than if they have a great bowl of rice. The *disutility* of parting with a grain of rice will similarly be less if one has a great deal of rice than if one has very little. If utility functions are twice differentiable, one can simply say that their first partial derivatives with respect to the quantity of any commodity are positive and that their second partial derivatives are negative.[1]

Employing the principle of diminishing marginal utility, economists are much closer to being able to explain general properties of individual exchanging. If exchanging itself has no utility or disutility, individuals will agree to an exchange if and only if the marginal utility of what they are acquiring is equal to or greater than the marginal utility of

[1] If one graphs the utility function, one will have a surface in an $n + 1$ dimensional space (where n is the number of commodities). Each point on the surface represents a commodity bundle and its utility. The projection of any point on the surface onto n of the axes indicates how many of each of the n commodities are included in the given commodity bundle. The projection of the point on the remaining axis specifies the utility of the bundle. Moving away from the origin in any positive direction perpendicular to the utility axis, the curve will have a positive slope, but the magnitude of the slope will be smaller the further one is from the origin. If one holds the quantities of all commodities in a bundle except one constant, one can draw the graph in Fig. 2.1.

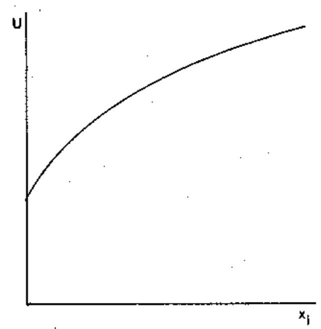

Figure 2.1

The quantity, x_i, of the variable commodity is represented by the horizontal distance from the origin. Total utility, U, holding the quantities of all other commodities constant, is represented by the vertical distance. The marginal utility of a commodity is in general a function of the quantities of all n commodities in a bundle. Holding the quantities of all but one commodity constant, one can represent marginal utility as a function of the quantity of that commodity alone. That function is the slope of the graph in Fig. 2.1.

what they are parting with. The exchange ratio between two bundles of commodities is not entirely determined by the utility functions of the exchangers. It also depends on the quantities of various commodities the exchangers already possess or expect to possess. If two people have almost no water and no expectations of having more soon, the first will have to offer a high price to induce the second to part with any water. Knowing *only* the utility functions or *only* the amount of water available, one could not explain why water could be exchanged for so large a bundle of commodities. One needs *both* bits of information. The "scarcity" of water is derived from these two pieces of information; it is not an independent fact. In neoclassical analysis, scarcity is not just a fact about quantities. Whether a good is scarce depends on the *relations* among its quantity, the quantities of other commodities, and preferences of individuals. Walras in fact identifies scarcity and marginal utility (1926, §22, §75). To make such an identification is reasonable since for a given agent (or in a given equilibrium state) x is scarcer than y if and only if the marginal utility of x is larger

One can draw the graph of this partial marginal utility function as in Fig. 2.2.

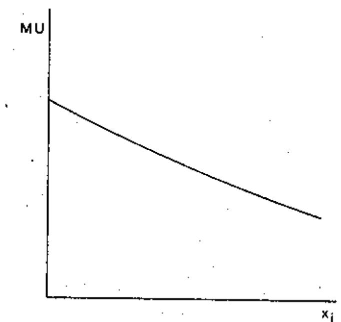

Figure 2.2

Here marginal utility, MU, not total utility, U, is measured in the vertical direction. The law of diminishing marginal utility asserts that the marginal utility curve will be downward sloping.

As is well known, economists can replace talk of marginal utilities with talk of marginal rates of substitution. The exposition here is intended to be simple and clear. Nothing of conceptual importance is lost by talking of marginal utilities. As recent work has shown, the use of calculus is avoidable. General equilibrium models can be formulated using weaker axioms than those in the calculus formulations I shall present. Calculus formulations are, however, historically significant, simple, and familiar. Given them, it is not necessary to go into the difference between marginal utility and marginal net utility. For an excellent discussion see Bliss 1975, part II, chs. 2–6.

than the marginal utility of y. Siamese cats (x) are scarcer than blind basset hounds (y).

Thinking in terms of utility functions suggests a different conception of cost. From the neoclassical perspective, the real cost in Adam Smith's parable of the deer and beaver is not a quantity of "exertion," but the disutility incurred in the effort to hunt deer or trap beaver. J. B. Clark says simply, "Cost is, in the last analysis, pain inflicted, just as utility is pleasure conferred" (1902:202n). Suppose individuals in Smith's parable happen to enjoy hunting deer and to hate trapping beaver. Those individuals who for some reason want a beaver will be willing to exchange many deer for one beaver. Even though it takes twice as much "toil and trouble" (as measured perhaps by expenditure of calories) to kill a beaver as a deer, the exchange value of a beaver will be much more than two deer.

Given the principle of diminishing marginal utility, neoclassical economists can begin to understand how the compensation of inputs into production is determined. A person who supplies some input into production suffers a disutility.[2] The disutility of parting with the input increases with the amount supplied. Individuals will supply more resources or labor only if they are given a larger bundle of commodities in return. Individuals will supply additional resources or commodities or services until the marginal disutility incurred in doing so becomes as large as the marginal utility of the additional commodities they can acquire with their income. Laborers who prefer consumption to leisure will work more and receive more income. Individuals whose resources have large marginal utilities or are relatively scarce as inputs into production, will also receive higher incomes; individuals whose resources have low marginal utilities and are relatively abundant as inputs into production will be poorly paid.

If cost is disutility, neoclassical economists not only have an alternative theory of cost, but they also have shown that the same factor influences both supply and demand. They can thus make the appealing claim that all prices are determined by supply and demand. All they have to do is to find a way of equating the disutility incurred in procuring something with the utility in consuming it.

[2] Some neoclassical theorists prefer to conceive of costs in terms not of disutility, but of alternative uses (Stigler 1941: 34, 231). The differences between the two approaches are small (Knight 1921: 73) and not relevant to my concerns.

2. Equilibrium

In order to show how the voluntary exchanges of utility maximizers result in a systematic organization of production and distribution, neoclassical economists have greatly sharpened the notion of economic order. The concept of economic equilibrium is the result of this sharpening. It is a development of the belief that an economy is working systematically and well when there is a balance between supply and demand. A closed economy is in equilibrium when the demand for commodities as constrained by the income individuals receive as compensation for their role in production is just matched by the supply of produced commodities. A state of equilibrium obtains when no one wants to carry out any further exchanges at the prevailing prices. The choices of individuals are thus reconciled. The notion of equilibrium crudely defined here is described by economists as general equilibrium, because it is concerned with the entire economy (See Arrow 1968:376–89).

The idea of a general economic equilibrium faces two immediate difficulties, since it appears to ignore economic changes and the importance of time and expectations. Marshall (1930:323) speaks of a number of balls resting at the lowest point of a hemispherical container as in stable equilibrium. If they are displaced, the force of gravity damped by friction will act to restore them to a stable configuration at the bottom. But capitalist economies are not balls in cups; they are constantly changing. How can the notion of an equilibrium apply to a constantly changing system? Furthermore, the utility function of a rational agent must rank both future and present consumption states, since present choices affect our future well-being. For George, the utility of a hammer depends on his knowing what he will do with it and what utilities the outcomes of his actions will have. Notice that this future reference of utility functions does not require that the utility functions themselves change. George's preferences for wood furniture may be entirely fixed. Scarcities also depend on expectations. Economists must bring time and expectations into the analysis of equilibrium. They can introduce time explicitly via the notion of an intertemporal general equilibrium. That notion, however, is quite recent and raises special difficulties. I shall discuss it below in chapter 5. The more traditional concept of a general economic equilibrium, which provides the setting for traditional difficulties with the role of capital, is of a stationary equilibrium.

In a stationary equilibrium, the future is exactly like the present, and the present is exactly like the past. People will continue to behave in the future just as they have in the past and the present. Change and expectations thus have no role in the analysis of a stationary equilibrium. Of course, no economy is in stationary equilibrium. Traditional neoclassical theorists instead regarded economies as if they were constantly on the verge of reaching it, in the hope that economists could profitably employ stationary equilibrium analysis. "Exogenous" changes (changes in the givens of the analysis) keep economies from actually reaching such equilibria. Neoclassical economists have thus greatly simplified the analysis of how individual exchange leads to economic order. Actual properties of economies can be regarded as the composition of two different kinds of causal factors: disequilibrating exogenous "shocks" and adjustments of the system (which is ever seeking and always approaching equilibrium) to those shocks. Neoclassical economists have considered the effects of changes in tastes or taxation or of other givens by comparing stationary equilibria.

The problem of showing how economic order results from individual choice and voluntary exchange has thus been made precise. The economist needs to show (1) how prices are determined by the efforts of individual utility maximizers constrained by their original endowments of resources and the technological possibilities and (2) that when certain conditions obtain, these prices are exchange values and the economy is in stationary equilibrium. Finally, in conformity with the sketch of capitalist economies of chapter 1, neoclassical economists would like to demonstrate (3) that this stationary equilibrium is efficient or in some way optimal.

In practice the first two tasks of the general equilibrium theorist are performed simultaneously. The constraints on maximization may be expressed in mathematical equations. The maximization conditions yield other equations by means of calculus techniques. One then demonstrates that these equations solve for vectors (ordered lists) of prices, outputs, and inputs that satisfy the conditions for a stationary equilibrium.

A. *Simple Exchange Equilibrium*

To solve for such a general equilibrium is a complex task which requires further theoretical assumptions. Let us follow the early equilibrium theorists (Jevons 1871; Walras 1926, Wicksell 1911 for example) and simplify the problem by assuming away production(!). Individuals are just exchanging commodities already in existence. Even in this

simplified problem, no equilibrium solution can generally be determined unless we assume that commodities are infinitely divisible and that individuals must take prices as given. It is possible to have an equilibrium solution with indivisibilities and without perfect competition, but one will usually be unable to prove that such a solution exists. Economists have been concerned with sufficient conditions for the existence of economic equilibrium, not with necessary conditions.

Given these assumptions, one can set up a system of equations in which the unknowns are prices and the quantities of each commodity that individuals wind up with by exchanging their initial endowments. We know how much of each commodity each individual begins with and each individual's utility function. Depending on the mathematical form of the utility functions, these may be sufficient to solve for all the unknowns. A simple example may make this claim clearer.

Suppose we have two groups of agents, A and B, with 100 members each and only two commodities, x and y. All members of A begin with the same initial endowment and have the same utility functions. The same goes for the members of B. (I am not considering the apparently simpler case of only two individuals, because with so few traders, exchange ratios would be influenced by the bargaining powers of the traders.) Initially each member of A has $x_a/100$ and $y_a/100$ and each member of B has $x_b/100$ and $y_b/100$. After exchanging they have respectively $(x_A/100,\ y_A/100)$ and $(x_B/100,\ y_B/100)$. We have six unknowns; the final quantities of commodities each possesses and the two prices. Since no one profits we have the two equations:

(2.1) $$p_x x_a + p_y y_a = p_x x_A + p_y y_A$$

(2.2) $$p_x x_b + p_y y_b = p_x x_B + p_y y_B$$

Since utility is maximized we have two more equations:

(2.3) $$\frac{U_x{}^A(x_A, y_A)}{U_y{}^A(x_A, y_A)} = \frac{p_x}{p_y}$$

(2.4) $$\frac{U_x{}^B(x_B, y_B)}{U_y{}^B(x_B, y_B)} = \frac{p_x}{p_y}$$

$U_x{}^A(x_A, y_A)$ is the partial derivative with respect to x of the "A" utility function evaluated at (x_A, y_A).

Since no goods are lost in the process of exchange:

$$x_B + x_A = x_b + x_a \tag{2.5}$$

$$y_B + y_A = y_b + y_a \tag{2.6}$$

Among the four equations (2.1), (2.2), (2.5), and (2.6), only three are independent. If we set p_x or p_y equal to 1 we can apparently solve for the other price, x_A, x_B, y_A, and y_B. Equations (2.3) and (2.4) can be derived easily from the calculus conditions for maximizing a function, but they also possess an economic meaning. If the ratio of the marginal utilities of the two commodities is not for both agents equal to the price ratio, the economy is not in equilibrium. Someone will want to exchange. If, for example, the ratio of the marginal utility of x to the marginal utility of y for A is greater than the price ratio, then trading away some y for some x brings about a net gain in utility. In equilibrium both price ratios and marginal utility ratios must have adjusted themselves until (2.3) and (2.4) hold.

The analysis of a situation of a simple exchange economy is an extreme simplification of the problem of demonstrating the existence of an equilibrium for a capitalist economy. In this analysis economists have scarcely described an economy, since they are analyzing only a single exchange event. The notion of an equilibrium is greatly simplified here, since there seems to be no future at all. Actually one could consider the above "economy" as in stationary equilibrium—in each period the endowments simply appear and are exchanged. The example illustrates how little past and future there is to stationary equilibrium. In this simple exercise in equilibrium analysis, the theory of exchange value is simultaneously a theory of consumption and a trivial theory of the distribution of income. It thus promises to carry out completely the general program for economics. Notice that goods which are scarcer (i.e., have a higher marginal utility) will have higher prices.

B. *Noncapitalist Production Equilibrium*

To extend the neoclassical theory of exchange value to a capitalist economy, it is usual to make a theoretical detour. For examples of such detours see Wicksell (1911, vol. 1) or Walras (1926). Consider first an economy, unlike any real economy, in which none of the inputs into production are themselves produced and in which there is no interest (and in equilibrium no profits). We can think of the equations

in this case as describing a single production-exchange event or a series of repeated events that constitutes a monotonous history of this hypothetical economy. Each year the same quantities of resources and unproduced factors of production are available at the same prices. Output and prices of output are constant. The only way in which to study the effects of a change, let us say an increase in population, is by comparing the stationary equilibrium that can be derived from the new system of equations with the original stationary equilibrium.

To set up the conditions for an equilibrium, economists need some way of expressing in mathematical equations the motivation of producers and the technological possibilities of transforming inputs into outputs. Walras initially presented a general equilibrium system in which fixed quantities of inputs are needed in production (1926, sec. 204). Technological possibilities have, however, usually been expressed by introducing production functions with special properties. I shall follow this usual course. The additional motivation assumption almost always made is that producers maximize profits.

The special features of production functions are the following. If the quantity of all inputs except one is held constant, and the quantity of the remaining input is increased, the quantity of output is increased. As successive increments of the one variable input are added, after a point, output increases at a decreasing rate. The returns to the successive input increments, which economists call the "marginal (physical) products," are diminishing. Production also exhibits constant returns to scale; if *all* inputs are increased or decreased in the same proportion, output is increased or decreased in exactly that proportion. If one can apply calculus to the production functions (if they are twice differentiable), these conditions mean that the first partial derivatives are positive, the second (after a point) negative,[3] and that the functions are homogeneous of degree one.

From the properties of production functions and the assumption that producers maximize profits, it can be shown (1) that the ratio of the "marginal products" of different inputs to the same output must be equal to the price ratio of the inputs; (2) that the value of the marginal product of an input must be the same in all its applications and (3) that profits must be zero in all enterprises. The last result may seem surprising, but it is what one should expect, since "production" is instantaneous and requires only unproduced inputs. Given constant returns to scale, consumers could always buy the inputs and "produce"

[3] For many variables the second order conditions are actually more complicated. Footnote 1, which discusses utility functions, may be useful to those uncomfortable with the calculus terminology.

the outputs themselves. In equilibrium there can be no profits. These three conditions provide the additional equations needed to solve for a noncapitalist stationary equilibrium. The givens are utility functions (whose domain includes factors of or inputs into production[4]), the original endowment of commodities and of factors of production, the distribution of that endowment, and the production functions. Given all the various assumptions needed to formulate these givens and to derive mathematical equations from them, one can solve for a stationary equilibrium.

3. Exchange Value as Determined by the Constrained Balancing of Marginal Utilities.

We can now understand better the marginal utility theory of exchange value. Prices of commodities and of factors of production are jointly determined by all the givens in an equilibrium system. So are the marginal utilities experienced in consuming different commodities and the marginal disutilities incurred in surrendering inputs to production. These marginal utilities and disutilities depend, like prices, on utility and production functions, the initial endowment of resources and commodities, and the distribution of this endowment. It is thus misleading to say that prices are causally determined by marginal utilities (or to say that prices are causally determined by scarcities). Marginal utilities (or scarcities) and prices are simultaneously determined. Within the constraints of the production functions and the distribution of the initial endowments, equilibrium prices bring individual preferences into relation with one another.

Neoclassical economics thus presents what might be called a "constrained balancing of marginal utilities" or a "constrained maximization of utility" theory of exchange values. Notice that, if other parameters are held constant, the price of a factor of production is a decreasing function of its quantity relative to the quantities all other commodities and factors of production.

It seems that neoclassical economists have nearly everything they need for the presentation of a rich and systematic foundation for economic theory. They have a single model which may show how the

[4] In speaking of "factors of production," economists sometimes simply mean "inputs into production." Sometimes they mean only general *kinds* of inputs into production, like capital or land. Sometimes they mean only those inputs into production which are themselves unproduced, like labor or land. I shall use "factor of production" as a synomym for "input into production."

choices of informed rational self-interested individuals whose only interactions are voluntary exchanges can give rise to economic equilibrium and thus to a determinate system of exchange values, outputs, and distribution of income. All neoclassical economists need to do is to extend the theory to the real life case in which agents employ produced means of production.

4. Problems with Capital and Interest

Applying this model of constrained balancing of marginal utilities to a capitalist economy presents serious difficulties. How can one explain profits within the framework of general equilibrium models? Profit or interest is apparently the return to capital, but how is this possible? What is capital? Can one speak sensibly of its marginal product or of the marginal disutility of parting with it? How can one determine what the quantity of capital is? Should one look for some way of accounting for the phenomenon of profits or interest which avoids talking about capital? Like the classical theories of value, neoclassical theories face their sternest test when they confront the problem of incorporating interest into price theory and explaining how interest is determined.

The most straightforward approach to these difficulties is that of J. B. Clark (1902: viii, 123, 190, 363, and *passim*). He sharply distinguishes capital, as a permanent "fund of productive wealth" which is successively embodied in various capital goods, from capital goods themselves.[5] Capital goods are factors of production that, like all factors of production, earn rents. Capital, on the other hand, earns interest. This permanent "fund of productive wealth" is measured in value terms, but it is not just the value of capital goods. It is, according to Clark, a real factor of production (1902:29f). Interest, as the return to capital, is determined in exactly the same way that the returns to all other factors of production are determined; it is equal to the marginal product of capital and depends on the quantity of capital available relative to the demand for it and the availability of other factors of production.

There are various difficulties with Clark's treatment of capital. He

[5] Citing Clark, Frank Knight (1936a: 460) maintains "that the capital of an economic society or system is a continuous organic whole, a fund measured in value units, though at any moment it is largely (not entirely) embodied in things of a sort which more or less regularly wear out. . . . This view is in harmony with all ordinary thinking and procedure in connection with capital quantity. The quantity of capital represented by any existing thing is simply its value, the capitalization of its yield."

seems to be saying that interest is determined by the marginal product of capital; but, as mentioned previously, it is misleading to say that the price of any commodity or factor of production is determined by its marginal utility or its marginal product. From the perspective of general equilibrium theory, prices are determined by all of the givens of the system of equations. This criticism, however, misses the central flaw in Clark's proposal. He is suggesting in effect that capital, as a "fund of productive wealth," be included among the constraints on the equilibrium solution. The endowment of capital (since it is measured as a quantity of value) is, however, itself a function of the exchange values for which economists attempt to solve. If one takes capital to be a fund of "productive wealth," the explanation of interest as the return to capital cannot take the same form as the general explanation of the return to factors of production. The problems of incorporating capital and interest into neoclassical value theory remain.

Unless neoclassical economists can find some way of incorporating the phenomenon of interest into the constrained balancing of marginal utility theory of exchange value, that theory of value cannot be correct. The viability of the fundamental structure of neoclassical economics depends on the success of neoclassical capital theory. Neoclassical economists must explain what capital is and how the quantity and rate of interest are determined. Perhaps the only sensible theory of exchange value is based on physical cost and distribution between wages and profits. Perhaps the whole project of explaining exchange values on the basis of constrained preferences is a mistake. The project cannot succeed until the puzzles of capital and interest are solved.

The viability of the opposing theory of value based on physical cost and distribution depends on the demonstration that physical cost and distribution can determine exchange value without bringing in utilities. Whether interest is a cost to be explained in terms of some disutility or whether interest is merely a portion of the social surplus apparently has implications for both positive and normative theory. Notice that it has not yet been established that these supposedly alternative theories of value exclude one another; perhaps interest can be regarded as both a cost in terms of a balancing of marginal utilities theory and as a portion of the social surplus in terms of a physical cost cum distribution theory.

Capital theory thus rests at the foundations of economic theory. Let us now examine and assess specific neoclassical attempts to deal with the problems that capital and interest pose.

Chapter Three
Neoclassical Theories of Capital and Interest

In real economies reproducible inputs are used in production. Owners of these inputs earn interest. How, from a neoclassical perspective, is this income to be understood? Economists need to explain how the prices and rentals of capital goods are determined, what capital is, and how the interest on capital is determined. Within the neoclassical approach to economic theory there are two ways to tackle this complicated problem. Recently theorists have attempted to refine general equilibrium models until in principle they enable one to explain the rentals of all capital goods as well as all prices. Possessing such models one can then calculate the value of "capital" by adding up the value of all the capital goods. Adding up the rentals on all capital goods minus their depreciation, one would have the total amount of interest earned. Dividing the total amount of interest by the value of capital, one could say what the rate of interest was.

Such a general equilibrium approach to the problems of capital and interest has many virtues, but I shall focus first on earlier attempts to associate capital with some particular aspect of production and to interpret interest as the cost of this factor. The puzzles that capital and interest present are better understood if one follows their development in a roughly historical way. Associating capital with some aspect of production and interest with its cost, theorists attempted to explain the apparent productivity of capital and the existence of interest explicitly (see for example Wicksell 1911:149). Contemporary general equilibrium theories say nothing directly about capital or interest. In addition, those general equilibrium theories which have significant implications concerning capital and interest are too abstract to help with many important questions. When Robert Solow, for example, sought to discover how much of the growth of America's GNP in the twentieth century has been due to technological progress (1957:312–30), he could