ECONOMIC STUDIES: CONTRIBUTIONS TO THE CRITIQUE OF ECONOMIC THEORY

CHAPTER 6

THE THEORY OF CAPITAL

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1974

THE THEORY OF CAPITAL

1. Introduction

Recent controversies in capital theory have centered around a number of related issues concerning, for instance, the meaning and measurement of "capital," the problem of "reswitching" of techniques of production and "capital reversal," the significance, if any, to be attached to the neo-classical propositions that the equilibrium rate of profit in a capitalist economy is equal to the "social rate of return to saving" or equal to the "marginal product of capital."[1] Some of those standing on the sidelines tend to dismiss this whole debate as a matter of meaningless formalism. Indeed, the terms in which the debate is conducted tend as often to obscure as to carlify underlying issues whose presence is more often felt than perceived. But to dismiss the substance of the recent debate as meaningless would be a serious mistake. Underlying it are deep and far-reaching issues in economic theory which have appeared at various times and in different forms going back to the era of Classical economics.[2]

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[1] G. C. Harcourt, Some Cambridge Controversies in the Theory of Capital, Cambridge: Cambridge University Press, 1972.

[2] As examples of these different forms reference might be made to the Hayek-Knight debate during the 1930's, Wicksell's struggle with the concept of an "average period of production," the nineteenth-century controversies on the problem of "maintaining capital intact," and Bohm-Bawerk's attack on what he called the "naive" and "motivated" productivity theories of interest. A relevant example from the work of the Classical economists is Ricardo's problem of an "invariable standard of value" and from Marxian economics the so-called "transformation problem." In the light of this long record of intense debate, it can be seen that the recent controversy is not at all new in substance.

Although debate over the nature of capital is virtually a defining characteristic of the development of economic analysis it has rarely been accepted that the uncertainty which continues to surround the theory of capital results from its problematic conceptual foundations. It is, nonetheless, hardly deniable that the problem of attributing some coherent meaning to the idea of "capital" remains to this day the source of continuing disorder within the generally impassive structure of modern economic theory. In order to sort out the confusions of current thinking on the topic of capital it is necessary to begin by posing directly the question of the peculiar status of the concept of capital within economic analysis. It is hardly an exaggeration to say that in the answer to this question lies the secret to the whole of the development of economic theory over the past two hundred years.

As we pointed out in Chapter 5, the category of exchange-value has been, since the original systematization of economics, the starting point for a theory which, in its full development, encompasses an integrated treatment of exchange, production, and distribution. Relations of exchange are peculiar in that they are pre-eminently relations of equality among commodity owners which later come only to be distinguished according to the peculiar characteristics of the commodities which they bring to the market and by the intensities of their desires for those commodities. Relations of production and distribution, on the other hand, are not evidently expressions of this same equality before the market. Relations of production and distribution would appear to go beyond the simple system of individual exchange and to bring into consideration the peculiar role played by distinctions of a social character which go beyond those of individual exchangers.

Relations of distribution concern the critical distinctions between commodity owners which derive from their locations within a determinate social order. These locations, implicitly, even within neo-classical analysis, are defined in terms of the peculiar role in production played by the distinct groups of which the social order is composed. Such distinctions between individuals relating to their social existence are bound up intimately with the conditions of the production of commodities. The analysis of production, which entails fundamental distinctions within the social world according, it would appear, to social criteria, conflicts with the analysis of exchange for which the only distinctions between members of the market economy are purely individual, relating to the specific "use-value" which individuals bring to the market.[1] Within the sphere of exchange all men are equals and are undifferentiated as to their social position. Within the sphere of production this equality is no longer apparent. Relations of production and distribution are relations within the social world which are not self-evidently of equality as regards access to ownership of the means of production and to the product of the production process.

It follows from this that the treatment, within economic theory, of the connection between the spheres of exchange and production represents a critical juncture in the presentation of a consistent standpoint on the character of the economic system as a whole. It is upon this point in the analysis that the dialectic of equalization and differentiation, of equivalent exchange and exploitation, converges. It is at this point also that the analysis confronts directly the problem of capital, for it is precisely

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[1] Cf. J. Robinson, Essays in the Theory of Economic Growth, New York: St. Martin's, 1962, p. 1.

the first role of capital to mediate the two spheres. By standing, it might be said, with one foot in each, capital expresses the dependence of the exploitation of labor (and ultimately of all class distinction) upon equality of right before the market just as it reveals the dependence of that equality of right upon a given configuration of production relations.

Within orthodox economic analysis, the problematic character of capital derives ultimately from the necessity that the concept of capital reconcile the analysis of exchange with that of production. The central question for analysis is: How does equivalent exchange express itself in the production of commodities and how does it come to appear as the exchange of products? Further, the analysis must discover within the sphere of production a simple extension of what was shown already in the analysis of exchange to be an arena of freedom and equality. More specifically, the problem of the original neo-classical theory of capital was to constitute the economic process as a whole as the systematic outward expression of the idea of exchange; as equally the "very Eden of the innate rights of man" where "alone rule Freedom, Equality, Property, and Bentham."[1]

At the most fundamental level, it is in the conception of capital as value that the contradictions of the neo-classical theory of capital are to be found. The particular form of these contradictions can therefore be grasped only by first establishing clearly the character of value as it is conceived within neo-classical thinking and thereby isolating the specific manner in which the capital relation emerges within that mode of thought.

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[1] K. Marx, Capital I, New York: International Publishers, 1967, p. 176.

In the previous chapter the specificity of the concept of value within the neo-classical theory of the exchange economy was considered. Within this theory the value of a commodity is ultimately grounded in and expressive of the manner in which that commodity relates to the consumption need of individuals. On this basis the derivation of capital must begin with the notion of consumption as the goal of the economic process as a whole. Where the circulation of commodities involves the circuit of capital it must be shown that the realization of the value of commodities in consumption is still the rationale of the peculiar circuit through which they run as elements of capital. What is crucial here is the difference between the "simple circulation of commodities" and the circulation of capital. In the former, commodities exchange for money in the market only in order that they may, via money, be transformed into other commodities more immediately fitting into the needs of the commodity owner. By contrast, in the circuit of capital the value advanced as capital passes through the commodity form only in order to expand into an increased fund of value. This is the most general conception of capital and is common in form to all theories of capital. The problem which is specific to the neo-classical conception is that, in the case of the circuit of capital, the expansion of value as such cannot itself be the goal. Rather, it is the realization of the expanded value in consumption which can alone serve as rationale for the capital process as a whole. There can be no independent movement of value, no self-development, no value process qua value process. All value relations are expressions of the external relation of commodities in consumption, their falling out of (and permanent exclusion from) the circuit and movement in order to realize themselves as objects of direct consumption.

Capital is precisely that circuit of commodities which does not, at least directly, have consumption as its end, which, furthermore, rather than terminating at a given point in order to reestablish its conditions outside of its own process, finds its conditions within its process of expansion. This characteristic of the circuit of capital appears to deny directly the concept of purposive activity upon which all modern social science is founded.[1] It is also this characteristic which confounds the ability of the neo-classical theory to deal with the capital relation.

For neo-classical thinking, all economic behavior is the adjustment of scarce means among competing but given ends. The end of all economic activity, the goal of the entire economic process, is consumption. This goal must, therefore, be revealed within the circulation of commodities which is a mediating process between means and ends. Furthermore, this goal must be revealed in such a way as not to deny the means-ends relation itself, conceived as a condition of <u>scarcity</u> of means in relation to ends. In the previous chapter we have seen how this condition of scarcity serves to ground the content of the exchange relation and how this conception governs the specific manner of integration of production with exchange in the neo-classical theory of the exchange economy. So now, this condition imposes a further requirement on the construction of the capital relation in neo-classical theory. Specifically, the capital relation itself, in order to be consistent with the basis upon which the exchange relation is constituted, must be shown to be consistent with the condition of scarcity and, indeed, to arise out of that condition, when the objects which satisfy

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[1] Cf. below, Chapter 8.

the consumption needs of individuals are not externally given but are themselves products. This condition thus dictates a specific conception of the nature of the capital relation in the sphere of production. It requires that the capital relation must be shown to be an attribute of the means of production themselves.

In sum, the problem of capital appears in neoclassical theory in the form of the need for the derivation of the capital relation in a way which denies the self-expansion of value as the basis of that relation and re-establishes that basis in the consumption of utilities. The problem is then one of the deduction of the capital relation within the theory of exchange in such a form as not to contradict the essential character of that theory. The concept of capital is required to spring out of the subjective value analysis. Within such a theory capital will only <u>appear</u> to be self-expanding. Instead, it is made to be, <u>in actuality</u>, the simple circuit of commodities <u>extended over time</u>. This construction then serves a dual role. First, it serves to establish a concept of capital consistent with the theory of exchange. Secondly, it serves to ground the introduction of production into the exchange economy in such a form as not only to fail to contradict the conditions of the exchange system but to be itself dependent upon those conditions. This is the task which the modern theory of capital, from J. B. Clark and Bohm-Bawerk to Samuelson and Hicks has set for itself.

2. The Concept of Capital

The Theory of the Exchange Economy in its simplest form entails only the direct exchange of utilities one against the other. The basis for the deduction of this exchange, as we have seen, is in the attribution of needs of a specific character to the individuals engaged in the exchange system. This specification of need is at once essential to the derivation of a consistent price system and at the same time incapable of any legitimate theoretical derivation--it is in the nature of an arbitrary assumption. Characteristically, the deduction of the capital relation rests upon a connected further specification of need rather than upon a deduction based upon the immediately given conditions of the exchange economy. This specification has to do with the intertemporal nature of need. To argue that time, taken in the abstract, alters the previously specified character of individual need requires an additional assumption which further specifies that need. Why this particular specification is the one invoked will become apparent in the course of the construction of the neo-classical concept of capital.

It may be mentioned in this connection that the introduction of time is not, in itself, the basis of the transformation of the theory of exchange into the theory of capital and production. The conditions of the original theory of exchange in no way exclude the passage of time and the temporal dimensions of the exchange process, since unspecified, may be of any magnitude. The introduction of time into this process would necessarily be redundant were it not that need is presumed to be specific to time. It is, therefore, not at all a question of time as such, but a question of the presumed relation of need to time.

Within neo-classical thought the problem of capital concerns the

allocation of scarce resources over time. The fundamental idea is that of the choice of an intertemporal consumption stream, of the maximization of intertemporal utility.[1] In formal terms, we have

$$\begin{array}{cccccc} \bar{c} & c_1^0 & c_2^0 & c_3^0 & \cdots & c_*^0 \\ \bar{c} & c_1^1 & c_2^1 & c_3^1 & \cdots & c_*^1 \\ \bar{c} & c_1^2 & c_2^2 & c_3^2 & \cdots & c_*^2 \end{array}$$

where c_j^i is consumption according to plan i in period j, $\bar{c}$ is the initial endowment or the base stream of income prior to any intertemporal adjustment (the income received per period by the individual from nature), and c_*^i is the income at the termination of the plan. In the choice of the desired stream the rate of interest appears as the proportion of gain in the future to current sacrifice. The amount of "capital" is the amount of consumption foregone in the present (therefore "invested"). Where the commodities consumed in the future are the same as the commodities given up in the present, or where there is only one object of need which is given up in the present in order to be consumed with interest in the future, the calculation of the amount of capital and its rate of return is straightforward. The actual physical quantity of the good invested can be directly opposed to the magnitude of the return and a direct calculation of the profitability of the change-over to the alternate stream is possible by comparing the net return on capital to the rate of time preference. On the other hand, where there exists more than one consumption good involved in

[1] Cf. F. P. Ramsey, "A Mathematical Theory of Saving," Economic Journal, (December 1928), pp. 543-59.

the exchange over time, or where the consumption foregone is consumption of a good different from that received in the future, the calculation must be in value. In this case a measure of the value of capital must be derived which leads to consistent conclusions regarding the relation of consumption foregone to the return on investment.

In the absence of production, the determination of the value of consumption foregone need only be consistent with the formation of price in the exchange economy as a whole via the interaction of a system of needy individuals. A complication is immediately introduced when production is allowed since the relation of value invested to value returned must now also be consistent with the externally given conditions of productivity. As we shall see, with the introduction of production the concept of capital undergoes an expansion of meaning so that it also becomes necessary to establish that capital as so much consumption foregone is synonymous with capital as "produced means of production" and as "intermediate product."

In the absence of production each individual receives an income stream of a given shape from nature. This is analogous to the initial endowment of the theory of exchange. Such an endowment is presumed to be adequate to sustain the individual throughout his lifetime as an isolated consumer. In this state the individual either combines his direct effort with nature (as in picking berries) or he simply receives, from nature, an income which is consumed. The theory of capital and interest considers the optimal rearrangement of that stream. Such a rearrangement, in order that it be made to yield a return on capital, must involve a change in the total value received and not simply in the form of that value; that is, not simply in the particular utilities consumed. In the absence of a difference in total

value the rearrangement of the consumption stream over time involves only an alteration in the particular useful objects consumed and not in total utility. In that case the phenomenon of intertemporal consumption and exchange would reduce to the simple exchange of commodities of the exchange economy without capital and interest. The distinguishing feature of exchange with capital formation and a rate of return is that the total value received depends upon the time shape of the receipt of consumption. Individuals, then, must be sufficiently eager to change their time shape of consumption that the time pattern becomes itself a source of utility over and above direct consumption. The date of consumption becomes a characteristics which affects the utility gained in consumption. This is the first and most general condition which is introduced for the deduction of capital and interest.

The second condition placed upon the theory is that the choice of an income stream express a preference for present over future consumption. Only if such a preference exists will a premium be paid for present goods, therefore will future goods be discounted. With the presence of such a premium and state of preferences, any shift in the lifetime stream of income cannot be a simple rearrangement of consumption from one period to another. Any shift of consumption from one period to another, from present to future, must involve the receipt of a greater amount of consumption in the future than is foregone in the present.

The questionable theoretical basis for this condition is well recognized within neo-classical economics. On one side the neo-classical treatment of capital seems clearly to require time preference which favors present over future consumption. Without this specification a positive rate of return would not arise. On the other side, the simple positing of needy

individuals hardly allows for any systematic deduction of needs with positive preference for present over future consumption, or, as we have suggested, for any preference whatever as related specifically to time. In order to shore up this difficulty the theory of capital provides a long list of ad hoc justifications for positive time preference (in the form of Bohm-Bawerk's "reasons" for interest, or in the more modern form of "life-cycle hypotheses" regarding the propensity to save). While these justifications cannot be considered in detail at this stage of our argument, it may be pointed out that the real basis of all arguments regarding preference for present over future consumption is in the phenomenon of production and in the social conditions of production. It becomes clear in the investigation of the neoclassical analysis of capital that it is predominantly within production that the rationale for a positive rate of interest emerges. This fact places the entire theory of capital and interest into a quandary since the derivation of production itself depends fundamentally upon the prior assumption of positive time preference.

If we are allowed simply to assume that time preference is positive, then, on the further assumption that the production of commodities allows for the expansion of consumption, that is, that the amount of the inputs into production is exceeded by the amount of output, it is possible to deduce production and to incorporate the latter into the exchange economy. Production becomes one mechanism for rearranging the intertemporal stream of consumption, a means for storing up utilities to be consumed at a later date, and is therefore subordinate to final consumption. Production thus becomes subordinate to the process of the exchange economy and conceivable within that process. Assuming that an individual possesses objects having

utility u and a time preference of one hundred percent then he would be willing to exchange u in period one for any bundle of utilities having utility greater than $2u$ in period 2. If, therefore, by entering commodities of value u into production he could receive in period 2, say, $2.3u$ as productive output then such an individual, if he were to act rationally, would engage in production.

Production fits logically into the Theory of the Exchange Economy only in this manner because production is, before anything else, the "refraining from" direct consumption of objects of need. So far as neo-classical thought is concerned, to employ utilities in production is to give up the possibility of realizing their value in the present, that is in immediate consumption. Production is, then, the antithesis of consumption and in that respect would appear to conflict directly with the underlying rationale of the exchange economy. Prima facie, production contradicts the theory of exchange. This result can only be denied by the subordination of production itself to individual need which requires first that the direct refraining from consumption be made reasonable in the light of individual preference. Without this, production would remain irrational when opposed to the possibility of consuming the commodities which go into production.

But the subordination of production to the conditions of the exchange economy requires yet another condition. While the elimination of immediate consumption is directly implied by the idea of production this elimination must be only a temporary displacement or postponement. To refrain from present consumption, therefore to engage in production, can only be rational if the act of refraining from consumption is motivated by consumption, in

this case future consumption. This means, in particular, that production must end in consumption.

What is important to note in all this is that production in the exchange economy is not simply assumed to take place but it is explicitly made rational according to the conditions of the exchange system. To that extent it is deduced within a definite line of argument employing a methodology which in one important respect is identical to that employed in the initial deduction of the system of exchange. In particular, the specification of need is made such as to lead individuals, on the basis of that need, to enter into production. Up to this point no greater harm has come to the conditions of the Theory of the Exchange Economy than that originally inflicted by the necessity of specifying need so as to deduce exchange itself. By this reasoning, the rate of return is easily grasped within the methodology of modern economics, and consistently so, as long as the arbitrary specification of need is allowed.

However, the deduction of production requires an additional assumption, different in kind from that which specifies need in such a way as to generate the system of exchange and to extend that system to include exchange over time. It is further necessary to assume that the "productivity of round-about methods of production" is given and diminishes with the intensity of application. On one side it must be assumed that production itself is "productive," that is, yields a surplus according to its own mode of organization, that it is productive viewed in a wholly material, or technical, manner. On the other side this productivity must diminish with the increased intensity of application of the production process (or with "the degree of roundaboutness"). These conditions while unnecessary

to the simple deduction of a rate of return on capital (as consumption foregone) are necessary to the treatment of production. It is of considerable importance to note that these conditions do not involve assumptions of the character employed in the construction of the exchange economy. The specification of need has nothing to do with the specification of the nature of production. It is therefore necessary to investigate more closely the nature of the special assumptions required in forming production into a process internally consistent with the exchange economy. These special conditions, in the specific form of the so-called "production function," will be considered in section 4 below.

Before going on to that discussion, a further clarification of the general relation of production to need is in order so that the basic presuppositions of the theory of capital relevant to the treatment of production can be placed in sharper focus.

3. Capital and Production

We hinted above that the conditions of positive time preference (the first two of Bohm-Bawerk's "reasons" for interest) can only be made compelling and intelligible on the basis of an analysis of the concrete conditions and social relations of production. Nonetheless, within neoclassical economics, the derivation of production logically presupposes the prior specification of time preference if it is to contribute to a theory of interest. Further, this specification must be independent of the conditions of the productivity of "round-about" methods of production. In other words it is illicit to argue that positive time preference emerges <u>because</u> of the possibility of engaging in round-about methods of production. Time

preference is the logical basis of the deduction, within neo-classical economics, both of the rate of interest and of production itself. While the latter is made possible by the conditions of technology, assumed given, it is made rational by the conditions of time preference.

This limitation of production in its relation to the discounting of future consumption was pointed out very early by Bortkiewicz. It can be readily grasped through the use of a simple example. Assume that production is a possibility but that the future consumption made possible by production is not discounted so that x units of a good consumed today have a value to the consumer equal to that of x units consumed at some future time. If it takes a time period p to transform x into $x+x'$ the person in possession of x at time zero is, in effect, in possession of $x+x'$ in period p (if he so chooses). It would appear that the person possessing x at period zero has an advantage over the person possessing x at period p since the former, in effect, possesses $x+x'$ in period p. Since $x+x'$ is greater than x consumption of $x+x'$ should yield greater utility than consumption of x. The result would seem to be that out of the difference in period of receipt of the consumption, of the original x, emerges a difference in utility consumed. Further, $x+x'$ in period p is also $x+x'+x^*$ in period $2p$. As a result even if the person endowed with x in period p were to invest it he would only receive $x+x'$ in period $2p$ and would remain behind now by the amount of x^*. However, once it is assumed that the individual with the greater initial endowment will eventually, after some finite time interval, consume the results of his investment, the individual who has received an initial endowment at a later period is immediately enabled to catch up with and

equal the consumption of the individual with the earlier endowment. If we assume the simplest case, for example, that investment is only productive for one period (because the productivity of round-about methods disappears for lengths of time greater than p) then both individuals are enabled to consume the same alternative consumption bundles (x or $x+x'$) the only difference being in the periods in which such consumption is possible. Since this difference has been assumed to be, from the point of view of the calculation of utility, no difference at all, it follows that even with the possibility of production there will be no preference for present consumption unless such a preference is already posited outside of the conditions of and possibility of production.

It also follows, from this example, that x units in period zero are, in the absence of time preference, equal <u>in value</u> to $x+x'$ units <u>in period zero</u> since, by waiting, the owner of x can transform them into $x+x'$ in period p, the only difference in consumption being the time in which it takes place. This result is of special importance since it reveals concretely the manner in which the production of commodities denies to those commodities the character of scarce resources and thereby removes them from the category of objects of economic action, from the category of commodities.

If we assume more generally that any given bundle of consumption goods X may be transformed, given sufficient time, into any other conceivable bundle Y via production then X and Y must be conceived, from the point of view of the Theory of the Exchange Economy as equal in <u>value</u>. More precisely, all rational basis for exchange between commodities at fixed rates disappears. No meaning can be attached to the exchange of commodity

x for commodity y where x can be transformed into 2x , or into y , or into 3y , or into some combination of x and y . Since x can be so transformed over time it is, from the point of view of utility equal to 2x and to y and to 3y so that the owner of x is indifferent (so long as he remains indifferent to time of consumption) to possession of x , of 2x , of y , of 3y , etc. Clearly, under such conditions it would be absurd to conceive of x , y , or any combination thereof as either scarce or as having a rate of exchange determined by their scarcity. This is to be expected when it is borne in mind that the foundation of the neo-classical conception of scarcity is in the givenness of the objects of need. This givenness is directly denied by the phenomenon of production which makes the objects of need also products. Since there is no scarcity (in the absence of discounting of future consumption) there can be no rational basis either for possession or for exchange. Furthermore, to the extent that inputs into production differ physically from the products, the round-about methods cease to be "more productive" in any clearly intelligible sense. The absence of the value relation means the absence of any utility among the diverse objects of consumption ("utilities") so that the product ceases to be quantitatively comparable to the means of production. Any concept of surplus-product drops away.

At this point the conditions of positive time preference, diminishing productivity of round-about methods of production, and termination of the circuit of capital, take on their real importance to the Theory of the Exchange Economy. It is on the basis of these conditions taken together that the circuit of capital becomes the simple circulation of commodities extended over time and that production may be incorporated into the theory

of exchange without contradicting that theory. The latter is possible so long as time is scarce and so long as there is diminishing marginal productivity to cut off the expansion of value via production.

On the presupposition that present consumption is preferred to future consumption it becomes possible to incorporate production into the exchange economy without immediately denying the conditions of exchange. Nonetheless the introduction of production into such a framework requires that production adopt a particular form. Production must be intrinsically "productive." That is, regardless of the system of value and exchange the act of production must yield a surplus product. Production exists only as a means to the end of the expansion of future consumption and not as a process which sustains itself. In other words, production has an irreducible existence which is independent of the market system and which can be taken up at the whim of that system. In this respect production possesses a character analogous to that of the original objects of need of the simple exchange economy: it is given, available for incorporation into exchange, but does not require within its own constitution the conditions of exchange. However, not only must production be present in this sense, as "surplus-production" but the productivity of available round-about methods must diminish with the intensity of their application. The greater productivity of round-about methods of production must diminish in order that production maintain future consumption as its goal. If the rate of return on investment were greater than the preference for present consumption and continued to be greater (or even increased) with capital deepening, therefore with continued application of production, then there would be no limit to such capital deepening and therefore to investment. Investment in the present

could only be for consumption in the indefinite future, investment for the purpose of future investment. In this case, the notion of scarcity would disappear altogether from both the spheres of exchange and production. The termination of the circuit of capital is the result of the condition of diminishing marginal productivity. This termination is synonymous with the circuit of capital finding itself subordinate to external conditions, subordinate to ends of consumption instead of being either self-sustaining or self-limiting.

On one side the original derivation of the circuit of capital and its construction as the simple circulation of commodities extended over time, as a relation of consumption (present to future), is predicated upon the condition of positive time preference. All conception of interest, capital, and production as determined by and limited in consumption begins with this notion of the discount of future consumption. The scarcity of products is the result of the time required in their production and of the relation of need to time posited within the neo-classical analysis. On the other side, the termination of the process of capital formation depends upon the condition of diminishing marginal productivity. Capital expands towards the goal of future consumption because the expansion of capital is made into the means of adjustment of present to future consumption. With production, this expansion is terminated, and therefore realized as adjustment to future consumption by the condition of diminishing marginal productivity. While time preference makes possible capital formation within the determination of the system of needy individuals oriented towards consumption of utilities, diminishing productivity realizes, within the conditions of production, this end-point of capital expansion in consumption.

To summarize the discussion up to this point, four essential conditions are necessary to the consistent integration of capital and production into the Theory of the Exchange Economy. The simple deduction of capital and interest, where capital is nothing more than deferred consumption, rests upon two conditions:

1. The specification of need in relation to time.
2. Preference for present over future consumption.

The conditions for the deduction of production within the exchange economy include the further requirements that

3. Round-about methods of production be "productive."
4. Diminishing marginal productivity of capital or diminishing return to extensions of the "degree of roundaboutness."

These four conditions make possible the treatment of capital and production within the Theory of the Exchange Economy.

So far as the critique of the theory is concerned this must vary in form according to which of the conditions, or pairs of conditions, are being considered. Those conditions dealing with the intertemporal specification of need can only be criticized in connection with their total lack of systematic foundation, with the fact that they are arbitrarily posited and can be as easily and correctly rejected as accepted. As regards this aspect of the theory of capital the neo-classical argument can claim no theoretical force. Beyond this, it can be shown that the specific assumptions, while arbitrary from the systematic standpoint, appear eminently plausible when viewed in terms of their real origin in the process of capital and in the specificity of capitalist production. Such an origin, of course, denies directly any possibility that they may serve to ground the

production of capital.

Leaving aside the conditions of intertemporal specification of need, the treatment of production needs separate analysis and criticism since the positing of production goes beyond the methodology employed in the derivation of the exchange system. It is necessary to consider somewhat more concretely the nature of production as it is conceived within neo-classical thought and to deduce the precise character of that production which alone is consistent with the Theory of the Exchange Economy. With the introduction of commodity production the elementary notion of capital as future consumption loses its transparency. Future consumption no longer is required to take the form of the refraining from the current use of objects of direct need. Capital appears in the form of produced means of production which may differ (as we will argue) in nature from the objects of direct consumption. In the light of this result (that consumption foregone is no longer of objects which are materially identical to those to be consumed in the future) the identification of produced means of production with "intermediate products" and with "consumption foregone" is no longer direct and must be established via argument. It is necessary, in particular, to show that produced means of production, even though not themselves consumable, still represent consumption foregone and that the relation of this foregone consumption, of "capital," to the return of future consumption is consistent with the original rationale for investment, that of preference for present consumption. It is this demonstration which has been brought into question in the recent discussion. In the light of this work the special and arbitrary conditions placed upon the character of production in order that it may be made consistent with the idea of scarcity of capital as the origin

of interest have been clearly exposed.

4. The Neo-Classical Parable

The recurrence of debate at this time over the neo-classical theory of capital reflects the fact that the internal contradictions involved in the introduction of production into the exchange economy have never been effectively resolved, despite the considerable elaboration of the modern theory of value and production into a complex formal system. In other words, it reflects the fact that there continue to exist inherent logical weaknesses in certain aspects of the neo-classical approach to the problem. One of these aspects, the one which has been seized upon in the recent debate, involves the application of the marginal productivity theory of pricing of factors (or of the services of such factors) to the quantitative problem of explaining aggregate income distribution (so-called "factor-shares") in a capitalist economy. It is in the specific form of the marginal productivity theory that the conception of different factor returns as reflecting relative factor scarcities and technical conditions of production is embodied. It was thought that this conception would carry over to an interpretation of "capital" as a factor of production, on the same footing as labor, and of profits as a return to such a factor. Indeed it was felt that this transition could be made logically and without hitch from one situation to the other and back again, because the interpretation of "capital" as a factor of production was presumed to be merely a special and convenient case of a more general case involving production with many different capital goods, or many factors of production, as many as one wished to assume.[1]

The particular construction that was developed for this purpose, that is, as a vehicle for conveying the neo-classical conception of profits as reflecting the relative scarcity and technical productivity of the factor "capital," was that of an aggregate production function. In recent times it has been reconstituted by Samuelson in the form of a "parable" utilizing the concept of a "Surrogate Production Function."[2] The

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[1]The confusion involved in this transition was very early pointed out by Bohm-Bawerk. At a later date, Schumpeter again called attention to it when he wrote:

> For the votaries of the triad scheme and of the theory that incomes are essentially prices (times quantities) of productive services, the natural thing to do was to interpret the yield of capital goods...as a price for the productive services of those capital goods. This again may be done in several ways, though, unfortunately, all of them meet with this fatal objection: nothing is easier than to show that capital goods or their services, being both requisite and scarce, will have value and fetch prices; nor is it difficult to show that their ownership will often yield temporary net returns; but all the more difficult is it to show that--and, if so, why--these values and prices are normally higher than is necessary in order to enable their owners to replace them, in other words, why there should be a permanent net return attached to their ownership. This point was not fully brought home to the profession at large until the publication of Bohm-Bawerk's history of interest theories.... Until that time (perhaps in some cases even now) people thought (or think) that the easy proof of the proposition that capital goods must yield a return establishes ipso facto that they must yield an income to their owners. This confusion of two different things vitiates all the pure productivity theories of interest...both the primitive ones...and the more elaborate ones....

History of Economic Analysis, New York: Oxford University Press, 1954, pp. 655-66.

[2]See P. Samuelson, "Parable and Realism in Capital Theory: The Surrogate Production Function," Review of Economic Studies, June 1962.

outcome of the recent debate has been to show that this construction is based on very weak foundations. Indeed, it is possible to go so far as to suggest that the whole analytical structure of marginal productivity theory, insofar as it purports to provide a theory of relative shares and of the rate of profit in a capitalist economy, has come crashing down.[1]

The import of this recent criticism of the neo-classical theory of capital is two-pronged. It has been shown, on one side, that it is logically necessary that the central theme of the theory of capital be expressed in terms of a "simple parable" and, on the other side, it has been shown how simple the parable really is, that is to say, the true character of the simplification involved. It follows that the importance of the parable to the construction of neo-classical theory is considerable, since the parable reveals directly the central features and limitations of that theory.

Neo-classical economists consider their most abstract models to be parables for the reason that it has been clearly established that such models are not adequate either to grasp an actual system of economic relations or to found a more complex "model" of those relationships. Since the simple construct cannot be conceived to possess any scientific status it is considered to be a parable. The whole point of such terminological sleight of hand is to prevent the untruth of the simple models from reflecting upon the status of "neo-classical economics" itself. This intentionally ignores the fact, to be brought out below, that recent criticism not only discredits the parables but at the same time establishes the necessity of

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[1] Cf. P. Garegnani, "Hetergeneous Capital, The Production Function, and the Theory of Distribution," Review of Economic Studies, 37, 1970.

formulating the central propositions of neo-classical thought in terms of simple models, therefore in terms of precisely the parables whose validity is not considered defensible. Insofar as it is even possible to conceptualize the neo-classical view in a systematic manner it must be possible to do so within the simple models--this is precisely from whence their simple character derives. It is therefore incorrect from the outset to characterize the simple models as mere "parables." They are synonymous with neo-classical economics to the extent that the latter is expressible (i.e. in words).

It is appropriate to examine here, in some detail, the internal structure of the parable in order to demonstrate precisely how the parable embodies some of the central features and propositions of neo-classical theory and reveals thereby the limitations of that theory.

The neo-classical parable is set out in terms of an economy which produces a single good, say, corn, using labor and stocks of corn as means of production. At the center of the parable is the production function for corn or the "surrogate production function":

$$Y = F(K,L) \tag{1}$$

which relates output of corn Y to inputs of corn-as-capital-good K and labor L. Production is assumed to be subject to constant returns to scale (F is linear homogenous). Because of this we can rewrite (1) per unit of labor as

$$y = f(k) \; ; \quad y = \frac{Y}{L} , \quad k = \frac{K}{L} . \tag{2}$$

The function $f(\cdot)$ is continuously differentiable with positive and

diminishing marginal products of the factors. In particular, a "well-behaved" production function satisfies the "Inada conditions"[1]

$$
\begin{aligned}
& f(0) = 0 \quad ; \quad f(\infty) = \infty \\
& f'(k) > 0 \quad ; \quad f''(k) < 0 \\
& \lim_{k \to 0} f'(k) = \infty \; ; \quad \lim_{k \to \infty} f'(k) = 0 \; .
\end{aligned} \tag{3}
$$

The full significance of these conditions appear subsequently. For the moment their meaning should be clear: it is always possible to find techniques for producing more (or less) output of corn per man by adding to (or reducing) the stock of corn relative to labor (the corn-labor ratio) no matter what the size of that stock is, short of infinity.

In a one good production system "capital" is that part of output which is not directly "consumed." It is piled up and enters into production to be realized in consumption in the future. The advantage of the assumption of only one good produced rests first upon the fact that capital appears within such a system in its pristine form as pure deferred consumption. It is at once deferred consumption, produced means of production, and intermediate product. All the senses of capital are directly merged. With more than one product capital may still appear as intermediate product (insofar as consumption is still the end of the process as a whole) but the extent to which it is "deferred consumption" does not emerge directly from the production system itself, from the act of production as intrinsically deferred consumption. Since capital is a good which is not directly

[1] See K. Inada, "On Neo-classical Models of Economic Growth," Review of Economic Studies, April 1965. All that is said here applies with equal force to the neo-classical notion of a production function which shifts over time in accordance with technical change.

consumable it is not directly deferred consumption. If its physical character precludes its immediate consumption then its use in production is not physical evidence that its owner has forsaken consumption. It becomes necessary to provide a further demonstration that the capital good represents or embodies future consumption, which demonstration will not spring directly from the material process of production itself. Formally it would be equally legitimate to view the consumption good as future production and investment.[1] Directly, the production of capital is the result of the existence of a rate of return on its value since consumption of the means of production is excluded.

The preceding describes the available "technology."[2] Given this technology and facing competitive markets with given price of output, wage rate of labor w, and rental rate of the capital good r (which, in this context, is the same as the rate of profit), the individual producer

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[1]This would appear to be the logical implication of J. von Neumann's treatment of the problem of expansion in "A Model of General Economic Equilibrium," Review of Economic Studies, 1945. The idea that consumption is future production and investment also makes sense within the Classical or Marxian frameworks to the extent that capital is seen as "self-expanding value" and subordinates consumption to its process of expansion. Capital accumulation as consumption on the part of productive labor in Smith's treatment of capital accumulation is a revealing instance of this opposition between Classical (and to a greater extent Marxian) modes of thought and neo-classical thinking.

[2]The modern conception of the economy requires that "technology" be taken to be given and therefore be considered as essentially external to the economic process, as influencing that process but not as influenced by it. To be sure a choice of technique is assumed to be made but this is a choice from among a given set of alternatives. As we shall see further on, the fact that the neo-classical theory conceives of capital as deferred consumption requires that it adopt a special conception of the production process which attempts to grasp it as a purely technical, therefore, material, interchange with no necessary social grounding.

chooses that technique of production (a corn-labor ratio corresponding to a point on the production function) which maximizes his return (minimizes costs). This requires that in equilibrium that technique is chosen at which the marginal product of each input equals its price. We therefore have the equilibrium conditions

$$(4) \qquad r = \frac{\partial Y}{\partial K} = f'(k)$$

$$(5) \qquad w = \frac{\partial Y}{\partial L} = f(k) - f'(k)k \ .$$

By combining (2), (4) and (5), we get

$$(6) \qquad y = f(k) = w + rk \ .$$

Thus, payment to the factors according to their marginal products automatically exhausts the total product, which is in keeping with Euler's Theorem.

The marginal product conditions (4) and (5) express in this context the profit maximizing (or cost minimizing) criterion for choice of technique that would be observed by each and every producer operating in competitive markets. Of course, under competitive conditions, the prices w and r are <u>given</u> to the producers. But, from the point of view of the economy as a whole, there is still a question of how these variables are determined. We may express this point another way by saying that the equations (4) and (5) by themselves are sufficient to determine only two of the three variables, w , r , k . One of these variables (or a ratio of two of them, say, the "wage-rental ratio" w/r) must be given independently in terms of additional equation(s).

Note that it is at this point that certain analytical complications are being suppressed due to the assumption that there is only one good which serves simultaneously as means of production and output. In a model of production with many "capital goods,"[1] if we continue to maintain the neo-classical assumption of a well-behaved production function with the different capital goods as inputs, then there is a marginal product for each of the capital goods taken separately in each line of production. The competitive equilibrium condition expressing the profit-maximizing choice of technique is that the money value of the marginal product (which is the marginal product times the price of output) of each type of capital good is equal to the money rental of the capital good (which is the price of the capital good times the rate of profit) and is the same in all lines. Thus the connection between the marginal product of the individual capital goods and the rate of profit is indirect: it goes by way of the prices which themselves depend on the rate of profit. When there is only one produced good which serves as capital good the situation becomes quite different. For then the relative price of this commodity is unity (it exchanges one to one against itself). Prices therefore drop out of the marginal product condition and, there being only one capital good, there is correspondingly only one such condition. A direction relation is

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[1] Means of production are characterized as "capital goods" only within the neo-classical theory of production. The reason for this is that within the neo-classical conception production has a purely material character. Once entered into production the productive inputs lose all trace of social determination in order to appear as the purely technical or material "factors of production," therefore, in the case of capital as "goods." What is lost in this category is nothing less than the social character of the production process as a process of the production value and surplus-value and particularly as a process of the production of capital where the latter is a social relation and not a different name for means of production materially defined.

thereby established between the marginal product of the capital good, which is a purely technological datum, and the rate of profit. The marginal product of the capital good is in turn uniquely related to the stock of the capital good per man due to the assumptions concerning the production function. It follows that there is a one-to-one correspondence between the stock of the capital good and the rate of profit.

At a given rate of profit, one technique is chosen. At a different rate of profit, corresponding to a different equilibrium position for the economy as a whole, the technique chosen, and hence the corn-labor ratio, would be different. We can derive from the production function and the marginal-product conditions the exact relations that would prevail among the wage rate, profit rate and quantity of the capital good per man in different equilibria. Specifically, by differentiating (4) and (5) we get

$$\frac{dr}{dk} = f''(k) < 0 \tag{7}$$

$$\frac{dw}{dk} = -f''(k)k > 0 \tag{8}$$

which give the slopes of the equilibrium relations, the signs of which reflect the assumptions governing the production function. These relations are graphed in Figure 1. Associated with any corn-labor ratio is a unique set of factor prices and vice versa. An increase (decrease) in the quantity of one factor relative to the other is associated with a lower (higher) relative price of that factor.

We can combine the two relations (4) and (5) to get a relation between the wage and profit rates that would prevail in different equilibria. By virtue of the Inada conditions, $r = f'(k)$ is a single valued function

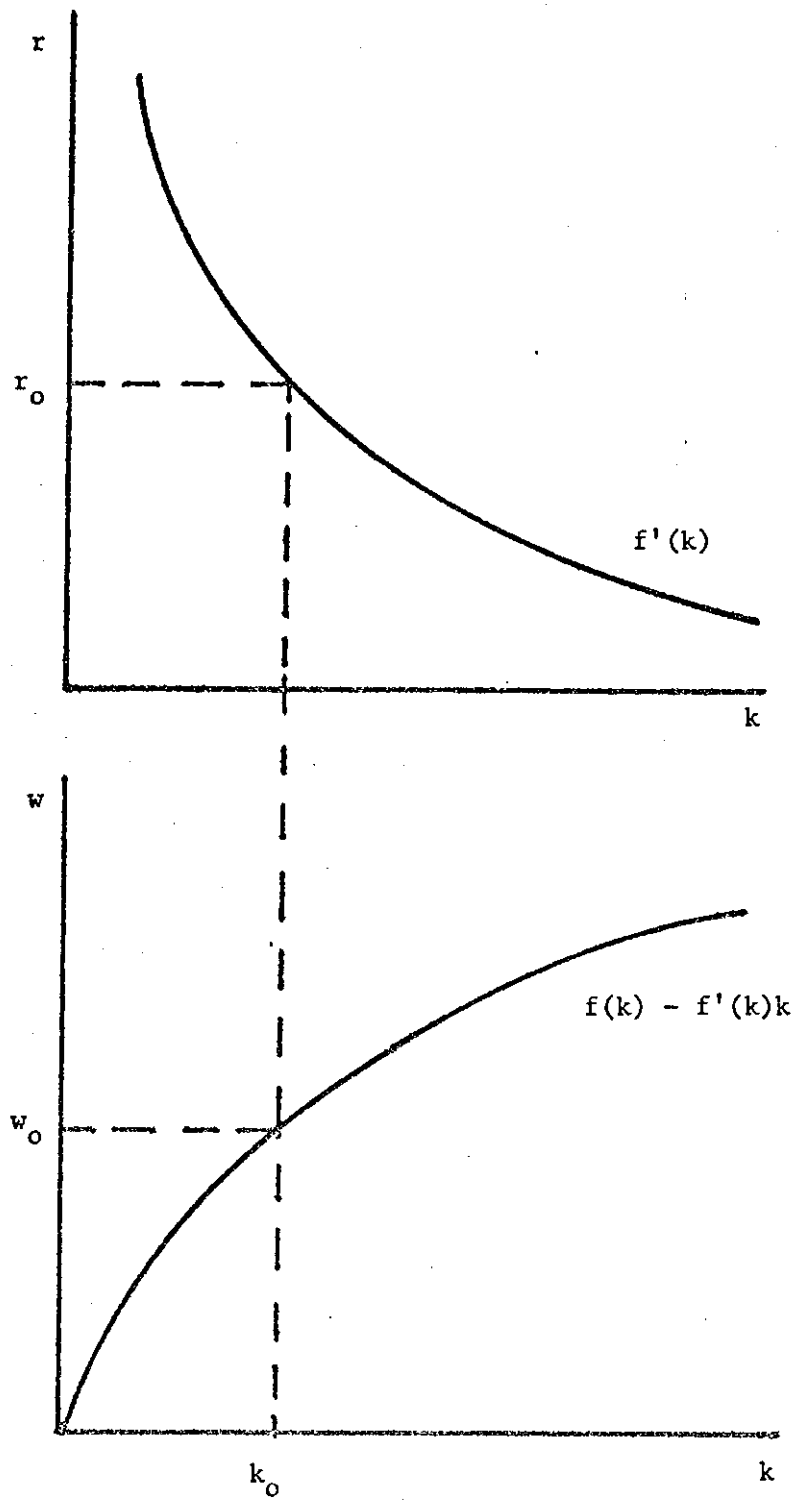

Figure 1.

and therefore has an inverse such that

(9) $k = k(r) \; ; \quad k' < 0 \; .$

Substituting (9) and (4) into (5) gives

(10) $w = f[k(r)] - rk(r) \; .$

This is the wage-profit frontier corresponding to the given technical conditions. A frontier such as this, giving the wage and profit rates consistent with the given technology under competitive conditions, could be computed from any technology in which any number of goods (not just one) are produced by themselves and labor.[1] Because of the special conditions underlying this particular frontier, however, certain special results follow. Specifically, from differentiation of (10) (or from dividing (8) by (7)) it follows that

(11) $$-\frac{dw}{dr} = k \; ,$$

so that the absolute value of the slope of the frontier at any point on that frontier is equal to the quantity of the capital good per man. Furthermore, after multiplying (11) by r/w we get

(12) $$-\frac{r}{w}\frac{dw}{dr} = \frac{rk}{w} = \pi$$

which says that the elasticity of the frontier at any point is equal to

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[1] Cf. P. Sraffa, The Production of Commodities by Means of Commodities, Cambridge: Cambridge University Press, 1960. This relation was named the "factor price frontier" by Samuelson. Names are, of course, important. The importance of this particular name is that is expresses the neo-classical conception of profit as the price or reward of a "factor."

the ratio of total profits per man and wages per man or the relative share π of profits and wages in the net product.

Thus the parable tells us that, knowing only the quantity of the capital good per man and the technology, we can find from the frontier the corresponding wage and profit rates that would rule under competitive conditions. The elasticity of the frontier at that point gives the relative share of profits and wages. The distribution of income is therefore completely determined by technology and relative factor "endowments." An increase (decrease) in the quantity of one factor relative to the other lowers (raises) its price. The distribution of income varies accordingly, depending on the particular form of the technology, that is, depending on the "elasticity of substitution." In this way, the analysis incorporates the argument that relative factor prices reflect relative "scarcity" of the different factors and the amount which each factor gets from the national product is determined by technology and relative factor endowments.

All of this story is formally consistent for a "one-commodity" world, that is, a world in which only one good is "produced." Beyond this, it is claimed that this story can be used as a "parable," or a stand-in, for a more complex world in which many goods are produced and there are many different capital goods. The production function, it is argued, can serve as a "surrogate" for the relations which prevail in this sort of world.[1]

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[1] To quote Samuelson, op.cit., 1962: "...we can sometimes predict exactly how certain quite complicated heterogeneous capital models will behave by treating them as if they had come from a simple generating production function (even when we know they did not really come from such a function)." And again (p. 201): "...simple neoclassical models in a rigorous and specifiable sense can be regarded as the stylized version of a certain quasi-realistic...model of diverse heterogeneous capital goods processes."

The extent to which this is, in fact, the case has been the subject of considerable controversy within economic theory. The implications of introducing some of the "complications" associated with a system of commodity production forms the chief basis of the recent critique of the neo-classical parable. The main elements of this critique are presented in Section 6. Before going on to that, we show in the next section how the parable fits into the context of the neo-classical theory of growth and distribution.

5. Capital Formation and Economic Growth

Capital appears, within the model of production, as a product, therefore as "produced." To account for its existence requires, at this stage, introduction of the act (or acts) of "capital formation." It is this consideration which ties the problem of capital to that of economic growth.

In the essential neo-classical conception saving has nothing to do with capital accumulation and economic growth properly considered (although capital is "accumulated" and the economy may "grow"). Saving governs the "endowment" of capital relative to labor, and, in particular, the relative capital intensity. This conception is most sharply distinguished where it is assumed that the population is stationary (and without a special argument there is no reason to assume otherwise). In this case there will be an approach to the stationary state which involves capital formation up to the desired capital stock but there is no accumulation of capital properly considered. This conception does not include any necessary process of sustained growth but only of growth which terminates when it runs up against the limits defined by the intertemporal consumption decisions of individuals, the available resources, and the schedule of the productivity

of capital. Growth must, therefore, be stimulated by special conditions placed upon the nature of capital. Such special conditions are of two kinds: First, it is assumed that the labor supply is expanding at a given rate. If this is the case, then, simply in order to preserve the capital endowment per man of the original stationary state it is necessary to expand capital. Capital is always running after the expanding supply of labor in an effort to maintain the optimal capital-labor ratio. The result is economic growth. However, the simple expansion of the labor supply is insufficient to sustain the growth process. It is further required that the recipients of income in each period be encouraged to save a portion of it appropriate to the preservation of a rate of expansion sufficient to maintain the capital-labor ratio in the face of the increasing supply of labor.

It is important in this connection to draw clearly the distinction between the expansion of the labor supply and the growth of population. The total population is the sum of individuals capable of holding factors and of defining a system of consumption preferences. Labor, on the other hand, is a factor endowment which individuals may or may not possess and which they may possess in varying amounts and in varying forms. The simple expansion of population can have no effect either on the capital stock or on the growth of the economy. It is only the expansion of the supply of the factor labor which can stimulate and make possible growth. Thus, sustained growth depends on the expansion of factor endowment. Factor endowment depends in the case of labor on the supply of labor and in the case of capital on the intertemporal consumption preferences of individual holders of factors. Growth can take place in the form of capital deepening even

in the absence of a growing labor supply so long as individuals are willing to increase without limit their stock of capital, to put off farther and farther into the future the realization in consumption of their investment. This notion of capital deepening was typical of the original theories of capital within the neo-classical tradition which focus consistently upon that aspect of expansion which is the object of individual decision. Such a focus was not, as we have pointed out, capable of expanding sustained growth. For the latter the additional assumption was needed that the supply of a particular factor--labor--was expanding independently. This assumption is not only wholly arbitrary but inconsistent with the construction of the exchange economy. As we have seen the process of capital formation may be subsumed within the exchange economy as the product of choice. The supply of capital, therefore the endowment of the factor capital, is itself produced, given the conditions of scarcity of time and of the productivity of round-about methods of production. The determination of the labor endowment, on the other hand, is simply given outside altogether of subjective consumption decisions expressed within the exchange system.[1] For a consistent conception of labor as a factor it is necessary to make the supply of labor also the product of individual decision, to recognize explicitly that individuals make consumption decisions and that labor is a factor about whose consumption individuals decide. It has, however, generally been considered simpler and less problematic to derive sustained growth upon the basis that the supply of labor and

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[1] Recent attempts to go beyond this and articulate a neo-classical theory of population increase have only borne out the wisdom of sticking with the ad hoc assumptions of the theory of economic growth on the question of the labor supply.

its rate of increase are simply given. This assumption is the essential foundation for the idea of economic growth within the Theory of the Exchange Economy. Clearly if such an assumption were disallowed on general methodological grounds and the growth of the labor factor made the product of individual decision-making it would be difficult to account for sustained growth. In fact the process of economic growth itself would fall outside of the theory of exchange and production unless special and hardly justifiable assumptions were introduced to the effect that the supply of labor does undergo a given rate of expansion. Easier, it would seem, is the direct approach which simply posits without any claims for justification that the supply of labor expands at the rate n.

The essential core of the neo-classical theory of growth, starting with the contribution of Solow[1] was set out utilizing the concept of a production function as described in the previous section. Its contents can be sketched as follows.

Let there be given quantities of corn-as-capital-good K_0 and of labor L_0 available for employment. At any moment the available supply of factors is thrown inelastically upon the market. Factor markets can clear if factor prices settle at a level such that firms are willing to choose, in accordance with the profit maximizing criterion expressed in equations (4) and (5), the particular combination of factors consistent with the available supply (K_0, L_0). In this sense there can always be full employment of available labor and "capital" provided that wage and rental rates in real terms (that is, in terms of corn as numeraire) are free to settle at the appropriate level. Unemployment can occur only if,

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[1] See R. M. Solow, "A Contribution to the Theory of Economic Growth," Quarterly Journal of Economics, February 1956, pp. 65-94.

for some unexplained reason, the wage rate (or rental rate) is too high. In formal terms, what this means is that the procedure described in the previous section for obtaining the profit maximizing choice of technique is now reversed. Instead of finding the corn-labor ratio appropriate to given wage and profit rates we now find the wage and profit rates appropriate to given quantities of the factors. The assumed properties of the production function ensure the existence of a unique solution at positive levels of w and r for any arbitrary quantities K_0, L_0.

On the side of demand it is required for equilibrium that saving equals investment. Of course, in the parable world, whatever is not consumed (saved) from the total output of corn must be invested. This is because corn is the only form in which wealth can be accumulated and its investment in production always yields the going rate of profit. Thus there can never by any discrepancy between saving and investment decisions. The Keynesian problem of unemployment due to shortage of "effective demand" is thereby ruled out.

The one-good model is in this respect analogous with the construction employed by Ricardo in opposition to the Malthusian claim regarding the possibility of a "general glut."[1] For Ricardo the issue has nothing to do with effective demand, and, therefore, with the level of consumption demand, but only with what social group does the consuming. The problem of consumption is simply a problem of whether capitalists choose to allow "unproductive workers" or "productive workers" to consume the output of the production of society. With only one commodity produced the system of production made up of distinct and interrelated producing units each

[1] Cf. Chapter 3, above.

producing inputs of others through the use of products of the others gives way completely to the self-sufficient individual unit of production which is not dependent upon other units. The production of corn is directly and without any mediation the consumption of corn by productive workers. Production and consumption are the same. With one good produced the necessity of realizing its value in money disappears and the necessity of a distinction between money and real wages is eliminated. The "circulation of capital" takes the simple form of the purchase of labor with corn. The possibility of disturbance of equilibrium, of uncertainty, of dynamic processes, is left wholly out of account. Since labor is not itself the product of a production process there is only one true unit of production so that there can be no process of circulation of commodities among individual units of production.

The Keynesian theory of the "monetary economy" can have no relevance to a world in which there is only one exchange possible, labor for corn, so that the idea of a distinct mechanism for the expression of general purchasing power (money) is redundant. It is worth mentioning that this characteristic of the one-good model results not from the absence of money per se. Rather, it is the assumption of a one-good economy that excludes any real monetary relation. To introduce a monetary commodity into the one-good model is only to compound the confusion without making any real change in the basic process. The meaningful introduction of money, and therefore of the possibility of dynamic process and Keynesian problems, requires the introduction of a system of commodity production in place of the one-good model.[1]

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[1] Cf. below, Chapter 9.

With full employment thus assured the equilibrium level of income is obtained from the production function. Assume now that saving is a fixed proportion s of total income. For saving-investment equilibrium we have

(13) $$I = sY$$

and the warranted rate of growth of "capital" is then

(14) $$g = \frac{I}{K} = \frac{sf(k)}{k} .$$

Suppose that available labor grows over time at a constant rate n which is exogenously determined

(15) $$L = L_0 e^{nt} .$$

For steady full-employment growth at a constant corn-labor ratio it is required that the stock of corn grow at the same rate as labor, or

(16) $$g = n .$$

From (16) and (14) we see that what is required is that

(17) $$\frac{f(k)}{k} = \frac{n}{s} .$$

The assumptions concerning the production function ensure that there always exists a unique value of the corn-labor ratio which provides a solution to this equation. The solution is illustrated in Figure 2. Given the labor-force growth rate n, the saving proportion s (or their ratio n/s) and the technology represented by $f(k)$, we find a value of $k = k^*$

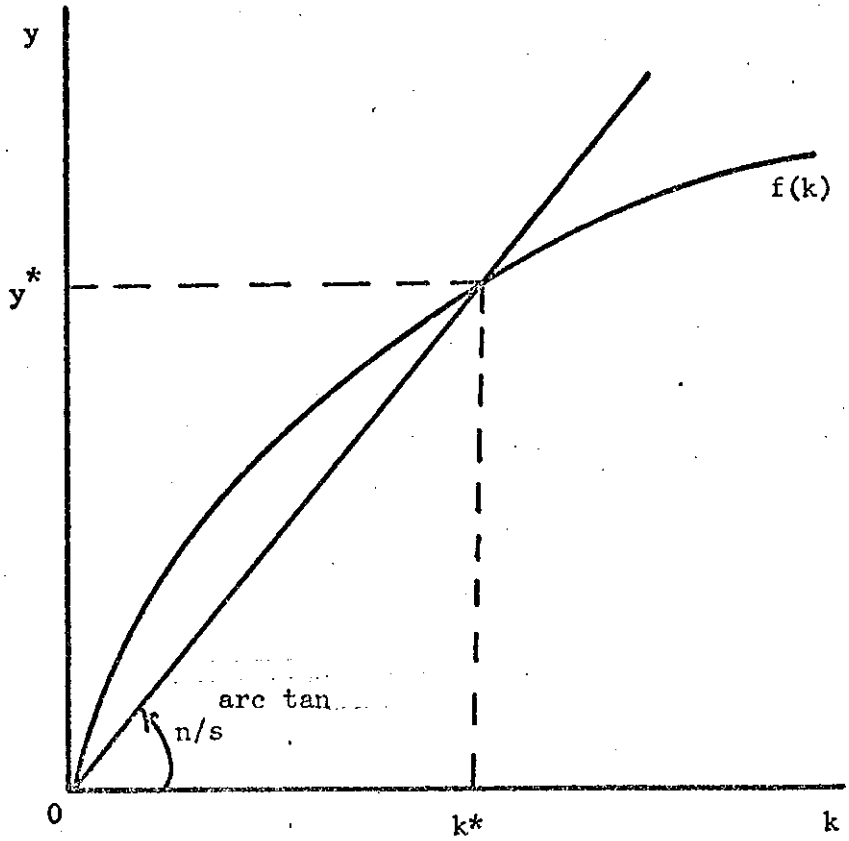

Figure 2.

such that $n/s = f(k^*)/k^*$ and it is unique.

It is easy to go on to show in this framework that, starting from any position which is different from that required for steady growth (implying that $k_0 \neq k^*$), the economy will undergo an adjustment process leading eventually to attainment of steady growth. Suppose that, by historical accident as it were, the economy starts out in a position where saving out of full employment income exceeds the investment required at the existing corn-labor ratio to provide employment for the increment in the labor force. The existing corn-labor ratio is, so to speak, too low. In Harrod's terms we have a situation where the warranted growth rate exceeds the natural rate.[1] Since the available saving is automatically invested, the total stock of corn per man rises by the amount of this saving. Once the investment has been made, it turns out that there is too much corn to employ the available labor with the existing production technique. Competition among firms[2] for the available labor drives up the wage rate and, correspondingly, the rate of profit falls. At a higher wage rate (lower profit rate) firms find it now profitable to adopt a technique with a higher corn-labor ratio. The wage rate rises to the point where that corn-labor ratio is selected at which all the available stock of corn is fully utilized and the excess demand for labor disappears.

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[1] See Harrod, R. F., Towards a Dynamic Economics, London: Macmillan, 1948.

[2] The idea that there can be many competing firms in a model such as this is one of its many paradoxes. It might be asked, in particular, what the basis for the division of the economy and of production among distinct units (let alone "firms") could possibly be, especially given the absence of division of labor and fixed capital.

If the warranted growth rate continues to exceed the natural rate in subsequent periods, these adjustments are repeated. As the process continues, the total stock of corn per man is rising all the time, the rate of profit is falling and the technique of production is being continually adjusted, a higher corn-labor ratio for a lower profit rate, so as to maintain full utilization of "capital" and labor. But, as the corn-labor ratio rises in this way, the same amount of saving provides less and less employment. Eventually, a point is reached where the corn-labor ratio is such that the available saving is just sufficient to employ the increment in the labor force. The gap between warranted and natural growth rates is then eliminated and the situation becomes consistent with a steady state.

When the warranted rate is less than the natural rate, a similar process operates in the opposite direction. In this case, the amount of saving is not enough to employ the increment in the labor force. The wage rate falls (the profit rate rises) and correspondingly the corn-labor ratio falls until a steady state is reached.

All of this shows that the system is <u>stable</u> in the sense that any departure from the steady state will bring into operation an adjustment process such as to induce a return to it.

The argument is illustrated in Figure 3 for the case of a uniform saving proportion. The curve $sf(k)$ represents the amount of saving at full employment for each level of the corn-labor ratio k. The curve nk represents the investment required to maintain full employment at each corn-labor ratio when the labor force grows at the rate n. If $sf(k)$ is above nk then k is rising; if below, then k is falling. The arrows

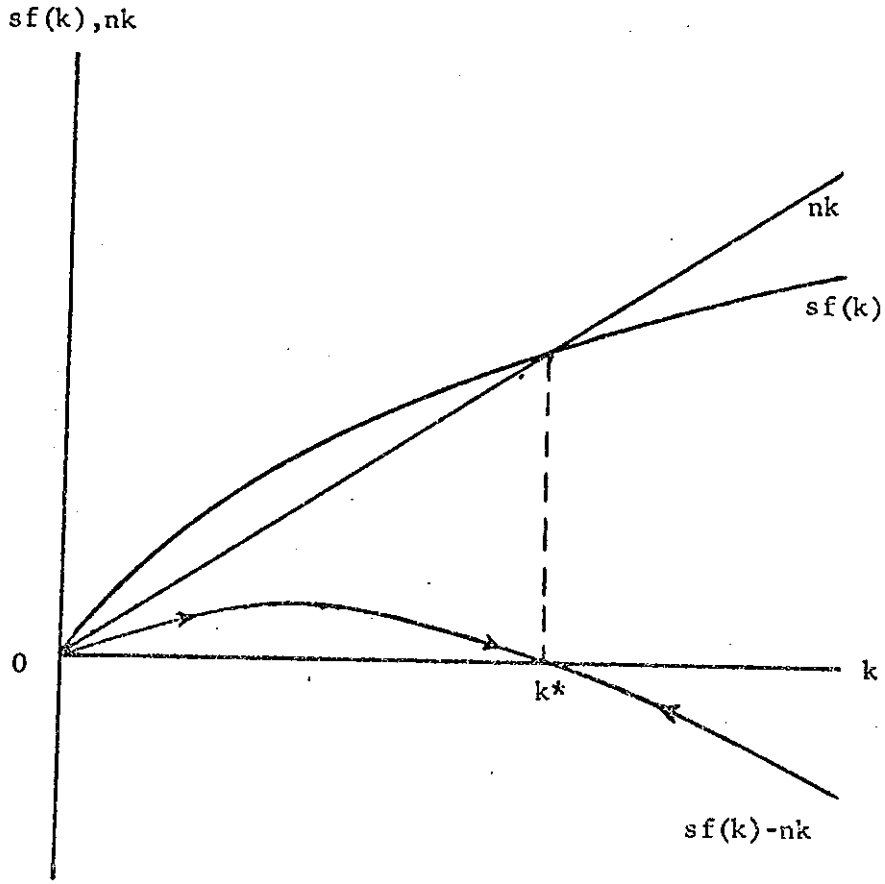

FIGURE 3.

indicate the direction of movement in each case. The appropriate steady-state value of k is k^*.

It should be noted that the argument is conducted throughout in terms of a process of movement "up" (or "down") the production function. Specifically, the economy is assumed to undergo a process of accumulation involving a continuous increase (decrease) in the stock of corn per man while the rate of profit falls (rises) and the technique of production is continually adjusted to each successive level of the profit rate. Here we see the significance of the assumptions concerning technology and production. In particular, accumulation consists of adding part of the output of corn to the stock of corn already in existence. A change in production technique for the entire stock of pre-existing and "new" corn can be implemented instantaneously and without cost in response to a change in "factor prices" simply by varying the quantity of corn per man employed. In this sense, there is direct substitution of "capital" for labor. Because of the assumptions concerning the production function, such substitution can be carried out indefinitely while continuing to yield positive wage and profit rates. Therefore, full employment of available labor and "capital" is always guaranteed whatever might be the size of the labor force and stock of "capital." Furthermore such substitution can always go on until the steady state is reached.

It should be readily apparent why the neo-classical analysis conceives of "growth" only as full employment growth. Both the rate of expansion of capital and the rate of change of the capital-labor ratio are products of individual decisions on the part of consumers taken together with the given rate of increase of the labor supply. The entire underlying

rationale for growth is either the approach to the desired capital stock, or, with continuous labor force expansion, the maintenance of a desired capital-labor ratio. Growth is the manner in which the economy adjusts to the supply of labor and to the intertemporal consumption decisions of individuals, the manner of adjustment to changed(or to changing) factor supply. Growth, being subordinate to such decisions, can possess no independent determination as is implied in the case of the Keynesian analysis. For the latter the expansion of capital is, at least tacitly, an independent force linked into "animal spirit." Since the pace of capital expansion is determined without specific regard to a rational decision-making process,[1] the expansion of the economy as a whole may be overdetermined in the sense that the varying forces (animal spirit, expansion of labor supply, saving rate out of income) may be inconsistent either with one another or with the abstract condition of full employment growth. This result is not possible in the neo-classical framework since expansion is completely determined by the interaction between rational decisions as to the employment of factors on the part of individuals and the endowment and rate of growth of endowment of those factors.

A striking feature of this analysis is that there is no need to distinguish between the comparison of different steady states and a process of change through which an economy moves. Every point on the production function corresponds to a particular steady state, each with a given set of conditions, as well as to a point on the path of movement of an economy towards a steady state. All of this is made possible by the assumption

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[1] Cf. Chapter 9 below.

of equivalence between the inputs and outputs of the production process. In such an economy there is no such thing as a given stock of means of production specific to particular uses. The stock of "capital" is assumed to be instantaneously adaptable to the employment of any quantity of labor and to produce any quantity of output. We shall return to a detailed consideration of this contention at a later stage of our argument. Meanwhile, it may be pointed out here that the contention that the stock of corn is capable of being productively employed with any amount of labor introduces a condition peculiar to a system of interdependent production and division of labor into the one-good economy. Typically differences in "factor proportions" are made possible by alterations in the physical specification of the means of production employed. This condition is however excluded in the one-good economy. The resulting picture is only reasonable so long as it remains wedded to the primitive, pre-capitalistic, agricultural form in which seeds combine with earth to produce corn and the amount of corn produced depends solely upon the amount of seed and the care with which it is planted. Even this analogy breaks down when it is borne in mind that one can normally expect one seed to produce no more than one plant and therefore no more than a fixed amount of output no matter what the labor input.

If we hold, however, to the paradoxical assumption that there is only one good and yet there is infinite flexibility of factor proportions there can be no problem of the degree of utilization of a given stock of capital equipment varying with the level of demand in the short run. Indeed, there can be no problem of demand at all since whatever is produced is either consumed or invested. Say's Law holds without exception. It

is assumed, moreover, that "factor prices" are free to respond appropriately in any given situation. In particular, the real wage rate moves up or down to the appropriate extent in response to any excess demand or supply of labor. The profit rate falls or rises as soon as there is any over-saving or undersaving.

There is an obvious question in all this as to whether and, if so, how the process of adjustment would work itself out in an economy in which means of production are specific to different uses and there is a (changing) structure of relative prices of the different commodities, in which firms make investment decisions in the light of expectations of future profits, wealth is held in the form of money and the wage rate (in terms of money) is set by bargaining between workers and employers. The preceding analysis is incapable of dealing with these matters by virtue of the assumptions on which it is based. In this connection, it may be noted that the process by which a capitalist economy is supposed to adjust from arbitrarily given initial conditions to a steady state raises a number of serious analytical problems for the neo-classical theory, once allowance is made for the existence of more than one type of means of production. These problems are effectively suppressed within the framework of assumptions of a "one-commodity" model. What is involved here, quite apart from the other matters discussed in this chapter, is the failure of the neo-classical theory to account for the process of change in a capitalist economy, except through the artificial device of a "sequence of momentary equilibria."[1]

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[1] Joan Robinson refers to the neo-classical conception of a process of accumulation with changing technique and falling rate of profit as a "Wicksell process," noting that "Wicksell himself gave it up in despair." She

We can now bring together the basic elements of the neo-classical scheme so as to exhibit the nature of the interdependencies and causal links that are involved. These relations are depicted in Figure 4. The production function is drawn in quadrant I. Quadrant II gives the equilibrium profit rate consistent with each corn-labor ratio. Quadrant III describes the wage-profit frontier corresponding to the given technology.

From the point of view of the problem of factor returns, it can be seen that the basic idea is that of a one-to-one correspondence between the relative size of factor endowments (the corn-labor ratio) and the price of those factors. Once we know the factor endowment k and the technology corresponding to the production function $f(k)$, we can find from the frontier the corresponding configuration of factor returns. When this notion is embedded in a treatment of capital formation a further explanation is provided, in the case of capital, for the determination of the factor endowment and on the assumption of a given expansion in the endowment of the labor factor, of the capital-labor ratio. Corresponding to a given saving proportion and growth rate of labor there is a unique corn-labor ratio consistent with steady growth, as in quadrant I. A higher saving rate is associated with a higher corn-labor ratio; a higher growth rate of labor with a lower corn-labor ratio. From quadrants II and III we see that the rates of return on the two factors differ according to the level of the corn-labor ratio. We conclude from this that these rates

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points out that "The difficulty of the problem arises...from attempting to rig up assumptions to make it seem plausible that a private-enterprise economy would continuously accumulate, under long-period equilibrium conditions, with continuous full employment..., without any cyclical disturbances, in face of a continuously falling rate of profit." Robinson, "Accumulation and the Production Function," Economic Journal, September 1959, p. 433.

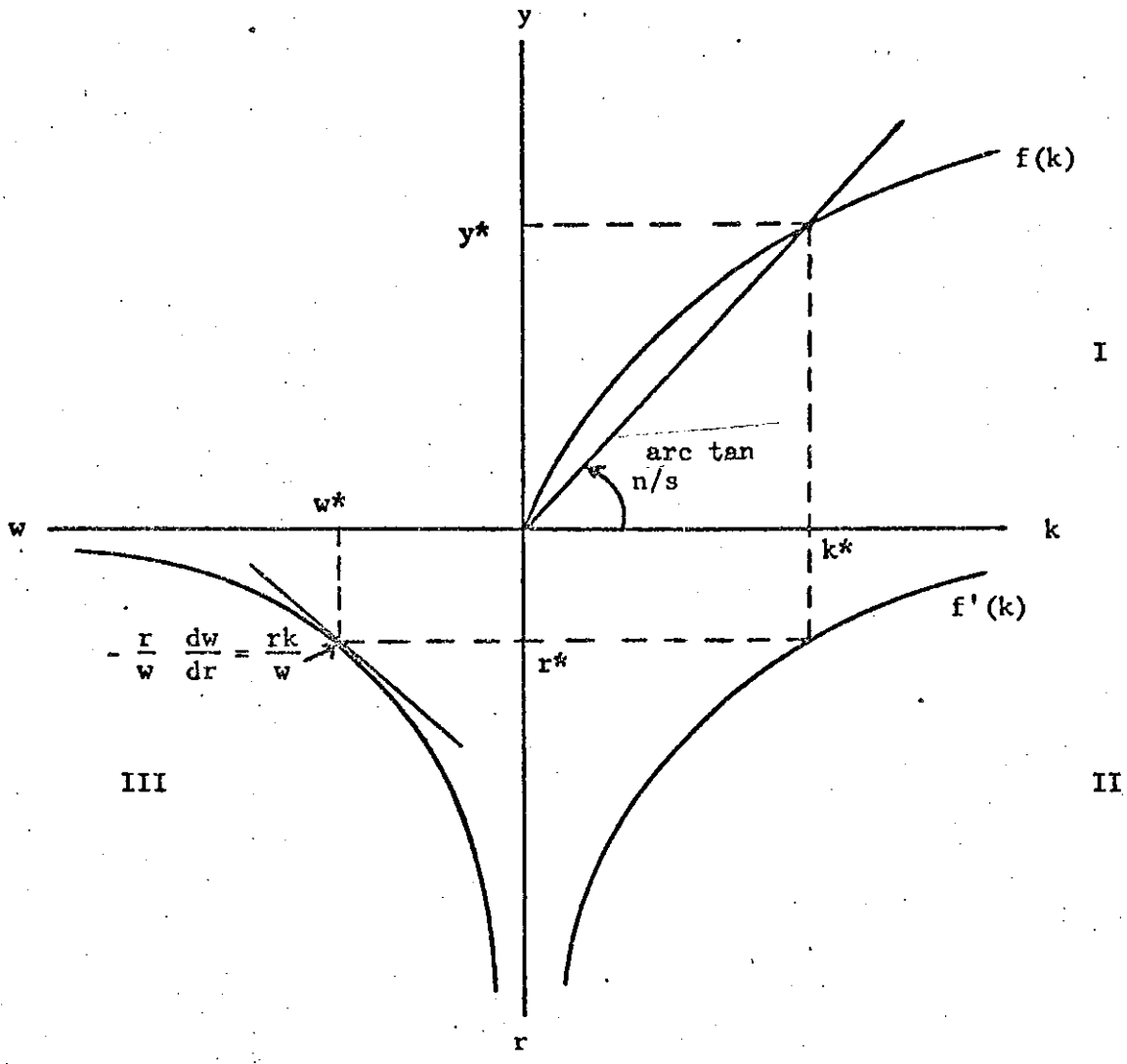

FIGURE 4.

of return depend upon factor endowment and technology. The factor endowments are themselves the result of intertemporal consumption preferences of individuals represented by the uniform saving propensity s and the forces underlying expansion of the labor force at the given rate n.[1]

It would seem the logical next step to conclude that this analysis succeeds in fixing the distribution of income between capital and labor in terms of relative scarcity of the factors and the given state of technical know-how. So long, however, as the framework is interpreted strictly, no special statement is being made with regard either to the distribution of income between "classes" or between individuals. There is no problem of the "distribution of the net product" between capital and labor or between owners of the means of production and the owners of "labor-power." Rather, the problem is one of the determination of that price of the factors which is consistent with their scarcity, therefore of the "rate of return" on "capital" and "labor" consistent with (1) technical conditions, (2) saving

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[1] Note that this interpretation hinges critically upon the assumption of a uniform saving proportion for all categories of income and all classes. When the overall rate of saving depends upon the distribution of income between profit and wages, the profit rate and corn-labor ratio are simultaneously determined. There is then no room for a one-way relationship between factor endowments, technology, and income distribution. Furthermore, if it is assumed that saving out of wages is zero, the profit rate is determined by the growth rate and the saving proportion for profits and is independent of technology and factor endowments. Within the Theory of the Exchange Economy there is, of course, no reason to assume that the propensity to save should depend upon the relation of wages to profit since that relation is understood to be one of factor returns and not of income distribution. It would be necessary, to sustain such a special condition, to make an assumption with regard to initial factor endowments of individuals. It would have to be assumed, in particular, that the endowment follows a special pattern, such as would be the case where ownership of one factor precluded ownership of another. There is no basis for any such assumption within the neo-classical conception of the economy.

decisions, and (3) the given rate of expansion of the labor supply. These rates of return on factors then determine the net income received by individuals according to their particular factor endowment, the amount of capital and labor which they own. But "capital" and "labor" are unrelated to classes, or to groups of individuals defined by their location within the social process as a whole, or even their relation to the means of production. The neo-classical theory of production and distribution resolves the problem of the "distribution of income" first by altering radically the terms in which the problem is posed in such a way as to shift interest from income-receiving classes, or classes reproduced within the totality of the economic process, to the pricing of factors of production. In this sense there is no longer any theory of income distribution at all since the pricing of factors does not itself account for the distribution of ownership of factors and the distribution of income between individuals is the result of their state of initial factor endowment which is regarded as outside the scope of economic analysis.

It is evident also that what sustains the growth of the economy in this scheme is the expansion of the labor force, the rate of which is presupposed as an unexplained datum. Given this growth rate and the savings habits represented by s, the rate of accumulation adjusts so as to provide the "capital" required to maintain full employment of the available labor force at the corn-labor ratio appropriate to a steady-state. Steady growth at full employment is guaranteed by the assumption of (1) producers which are willing to carry out investment corresponding to whatever saving is going on, (2) a technology which always allows for choice of the appropriate technique of production, and (3) factor markets for "labor"

and "capital" which ensure the wage and profits rates consistent with that technique. Thus, what is specific to the neo-classical theory of economic growth is the conception of growth as a form of adjustment to individual consumption decisions and factor supplies. What is specific to the neo-classical theory of production and distribution is the conception of production as a purely material interchange involving technically specified factors of production and of wage and profit rates as factor prices uniquely determined by technology and factor endowments.

In general terms, the conceptual structure of neo-classical theory is one which conceives of the distribution of income in a capitalist economy as emerging from the pricing of goods and factors of production in a general equilibrium of competitive markets, the outcome being determined by the quantity of available factor endowments, the technology of production and the preferences of individuals.[1] Using Euler's theorem it can be shown, under well-known conditions, that the value of the output produced with those factors and estimated at the prevailing market prices is exhausted by distribution back to the factors in accordance with their marginal productivities. The owners of the factors receive an amount of income corresponding to the specified amounts of the factors which each owns times their productivities.[2] This set of relations emerges in a particularly

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[1] As Solow puts it, "...the theory of capital is after all just a part of the fundamentally microeconomic theory of the allocation of resources, necessary to allow for the fact that commodities can be transformed into other commodities over time," Capital Theory and the Rate of Return, Amsterdam: North-Holland, 1963, p. 14.

[2] These conditions apply only to the market for factors. The formal statement of the theory is completed by addition of markets, in the "present" and in the "future," for the flow of goods which are produced with those factors, some or all of which goods, viewed as produced capital goods, may themselves constitute the stock of factors.

simple and straightforward way in the "one-commodity" model with two factors. Upon this set of formal relations, however simple or complex, neo-classical economists have sought to build a conception of factors of production as independently productive of value. Consistent with this conception, they have gone on to conceive of accumulation as a matter of the addition of new capital goods from the flow of current output to the pre-existing stock of capital goods, and hence as a matter of the time path of evolution of the stock of factors. The capitalist firm is seen merely as an intermediary between the individuals as suppliers of factors from their pre-determined "endowments" of those factors and the individuals as rentiers engaged in arranging the time path of their consumption by exchanging consumption "today" for consumption "tomorrow." The interest rate (or profit rate) is supposed to emerge from all this as a reflection on the one hand of the productivity of the capital goods and on the other of the presumed intertemporal preferences ("sacrifice") of the rentiers involved in refraining from consuming the current output of goods (or the existing stock).

6. The Specificity of the Simple Model

The necessity of formulating the neo-classical theory of capital and distribution in terms of the simple parable laid out in the preceding sections has come to the fore in the debate over the various attempts to formulate a consistent relation of capital to its rate of return along the neo-classical lines where production is allowed to take place within an advanced division of labor, as production of many distinct, productively interrelated commodities. We consider in this section some of the reasons

adduced for the failure of the parable and then go on to indicate the foundations of the general inability of the Theory of the Exchange Economy to grasp production of commodities outside of the confines of the simple model.

One may note in this connection that the central element of the parable is the idea of an inverse monotonic relation between the quantity of "capital" per man and the rate of profit. On this relation rests the conception that profits are the return to a factor of production, the rate of profits varying according to the scarcity of that factor relative to labor. On this relation rests also the notion that technical substitution between "capital" and labor as factor prices change can be relied upon to bring about a state of steady growth with full employment. For this relation to hold in a world of heterogeneous means of production the parable strictly requires that there exists some measure of the quantity of "capital," representing all of the different capital goods, which, when it is put into a production function of the form

$$y = f(k) \; ; \quad f'(k) > 0 \; , \quad f''(k) < 0 \; , \tag{2}$$

would satisfy the marginal product condition

$$r = f'(k) \tag{4}$$

and satisfy, in addition, the product-exhaustion condition

$$y = w + rk \; . \tag{6}$$

The relation (4) provides the linch-pin of this whole approach. It posits a single-valued relation between the quantity of "capital" per man and the rate of profit such that

$$r = \varphi(k) \ , \quad \varphi' < 0 \ ,$$

and

$$k = k(r) = \varphi^{-1}(k) \ .$$

If such a relation existed, it is argued, the parable would provide a "good" representation of the world of heterogeneous capital goods. With the production function, we could "predict" the unique value of r corresponding to any given value of k. In this sense we could say that technical conditions and relative factor endowments "explain" the rate of profit.

Outside of the conditions under which the parable itself is constructed, however, there is no justification for assuming in general that the overall quantity of "capital" per man should be inversely related to the profit rate, let alone that it should go from zero to infinity (with output per man increasing accordingly) through technical substitution of "capital" for labor and that the relation should be continuously differentiable. In general, the means of production consist of heterogeneous commodities. They can be expressed as a single quantity by valuing them at their respective prices, or exchange values, in terms of a chosen numeraire. There is a different set of prices for each level of the profit rate, the exact pattern of differences depending on the technical conditions of production of the different commodities.[1] The physical quantity of the capital

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[1]The reason for this is clear. In competitive equilibrium, prices equal money costs of production consisting of wages plus profits calculated at the ruling rate on the exchange value of the stock of capital goods employed. At a higher (lower) rate of profit the wage rate is lower (higher). The difference in total costs and price depends on the exact pattern of employment of labor and means of production throughout the whole interdependent production system. For a detailed analysis see Sraffa, op.cit.

goods and the methods by which they are produced may also be different from one equilibrium profit rate to another. The variation of the overall exchange-value of capital per man between different steady states can be viewed in terms of a price effect, a composition effect and a substitution effect.[1] But, conceived in this way, the ratio of capital to labor cannot be regarded as necessarily an inverse function of the profit rate.

The quantity of capital in this sense, that is, as a sum of exchange value obtained by valuing the different capital-goods at the ruling prices, depends on the rate of profit.[2] Therefore, one cannot argue that the quantity of this capital (or its "marginal product," whatever that might be supposed to mean in this context) determines the rate of profit without reasoning in a circle. For there is in general no one-way connection going from the quantity of capital in this sense to the rate of profit. To express the different capital goods in terms of a single number one could have recourse instead to a number such as their physical weight.[3] But

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[1] For an analysis of this relation in these terms, see D. Harris, "Capital Distribution, and the Aggregate Production Function," American Economic Review, March 1973.

[2] It would be of course possible to conceive of the exchange of commodities independently of the differences in organic compositions of capital involved in their production and therefore of a value of commodities distinct from their price where price is specific to a system of equal return on capital invested. This is the Marxian procedure which leaves aside consideration of the technical differences between commodities as "use-values" in order to focus upon their general characteristics as (1) commodities, (2) the products of capital, and (3) the products of a "labor process." In this case the value of capital can be estimated independently of the rate of profit, that is, in labor time.

[3] So far as prices are concerned it can be shown that, under fairly general conditions, these are uniquely determined in terms of technical conditions (the productivity of labor and the state of the division of labor and organic composition of capital) and the rate of profit and are independent of the composition of demand. This is the full significance of the well-known "non-substitution theorem" (see below, Chapter 7). For this result to hold, the rate of profit must be, so to speak, given in advance.

then there would be, in general, no unique relation between that number and the rate of profit. And, whether unique or not, it would be of no special interest from the point of view of the economic problems under consideration. By contrast, the number representing the price of the stock of means of production does have economic interest, though from a different standpoint. Namely, it represents the basis for the calculation of the distribution of the total profit among particular capitals and is therefore essential both to the conception of the competition of capitals and to the treatment of the expansion of capital as a whole.

In moving from the parable world of one good to a more complex world of production with heterogeneous commodities we find also that the neo-classical argument runs up against another difficulty which is related to, but analytically distinct from, the previous one. This takes the form of the reswitching of techniques of production, that is, the recurrence of the same technique at different levels of the profit rate even though that technique is dominated by others at intermediate levels of the profit rate.[1] It follows from this result that, in general, techniques cannot be uniquely ordered according to the rate of profit. The neo-classical production function is based on the assumption that such a unique ordering exists. It is on this basis, as we have seen, that an attempt is made to draw a direct and unique connection between technology and distribution. But this assumption is contradicted as soon as allowance is made for such a small complication as that the method of production of the capital good differs from one technique to another.[2] The presumed connection between

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[1] On this, see Sraffa, op.cit., 1960, Chapter 12.

technology and "distribution" is thereby effectively destroyed.

As a formal matter, the essential point in all this is that the neo-classical parable assumes that "capital" is a homogeneous substance measurable independently of the pricing system and of the determination of profits and wages, the quantity of which can therefore be made to "explain" the rate of profit. In this form capital is a scarce factor of production formally no different from "labor" and "land." It has been shown that in order for this equation to be sustained formally it is necessary that there be assumed to be a given price system for measuring the various commodity inputs and that this price system is invariant with respect to the rate of profit. This in turn implies that only one commodity is produced or that different commodities are perfect technical substitutes in production so that the price ratio between them is fixed. This is the special construction on which the neo-classical parable is initially based. When the scaffolding is removed, various assumptions have to be introduced if the initial structure is to be maintained. These assumptions are essentially of an ad hoc character. They therefore provide a weak foundation upon which to base a theory of distribution and growth.

The impossibility of conceiving of capital as a scarce factor once it is clearly situated within an economic process involving an average rate of profit and the production of commodities by means of commodities also extends to the interpretation of capital as "productive" in the sense that investment in more mechanized or more round-about methods of production

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[2] See, for instance, M. Bruno, E. Burmeister, and E. Sheshinski, "Nature and Implications of the Reswitching of Techniques," Quarterly Journal of Economics, November 1966.

yields greater consumption per man (up to a maximum). As Samuelson expresses it: "It is taken to be a technological fact of life that you can get more future consumption product by using indirect or round-about methods."[1] The increment in consumption is regarded as the return to the "sacrifice" of current consumption involved in investing in the more mechanized technique. The profit (interest) rate is supposed to reflect, on the one hand, the trade-off between the return of future consumption and the sacrifice of current consumption consistent with the prevailing preferences of the system of individual consumers. On the other it is supposed to reflect the "net productivity of capital" viewed as a technical characteristic of the roundabout methods.

Whatever might be thought of the presumption concerning time preference it can be seen that the logic of the argument requires, first, that the profit rate falls as the degree of capital intensity or roundaboutness increases in consequence of the sacrifice of present consumption. Here we have reliance being placed on the presumption of an inverse relation between the rate of profit and the capital-intensity of production as measured, for instance, by the quantity of capital per man. Now, however, it is required in addition that consumption per man rises as the profit rate falls and capital per man increases. On this basis, we should therefore expect to find in any production system that there exists an inverse relation between consumption per man and the profit rate (up to a maximum of consumption) within the range of available techniques. This is a relation

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[1] Economics, Ninth Edition, New York: McGraw-Hill Book Company, 1973, p. 598.

which is required to hold at the level of the production process conceived as a purely technical process.

It turns out, however, when we examine a given production system, that the very opposite relation may be found. In particular, as between different steady states, a lower rate of profit may be associated with either the same or a lower level of consumption per man.[1] This possibility is clearly demonstrated by the existence of reswitching of techniques of production. Specifically, reswitching means that the same technique is adopted at both a high and a low rate of profit though not at profit rates in between. With the same growth rate prevailing in the two situations, consumption per man would be the same. Thus it is possible for the profit rate to be lower without any alteration in technical conditions and in the associated stocks of capital goods and without any difference in consumption per man. It would seem, in this case, that the profit rate is divorced from any conception of the "net productivity of capital" and from anything to do with the "sacrifice" of consumption for future return.

The possibility of reswitching of techniques of production cannot be ruled out in general. Moreover, even in production systems where reswitching does not occur, it could happen that consumption per man is lower when the profit rate is lower.[2] All of this makes for the untenability of the neo-classical conception insofar as this particular element is concerned. Samuelson, in his summing up of the reswitching debate, acknowledges this. He seems to suggest[3] that there is some way in which it may

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[1] This was pointed out by Morishima, Equilibrium, Stability, and Growth, Oxford: Clarendon Press, 1964, p. 126.

[2] On this see for instance Bruno et al., op.cit., pp. 548-50.

[3] Quarterly Journal of Economics, November 1966, p. 582.

be possible to discover that situations which are incompatible with the neo-classical requirement are "empirically rare." But it is not at all clear what sort of empirical evidence could, in principle, be brought to bear on the matter at this level of analysis. The central issue is clearly a conceptual one and must therefore be considered prior to any appeal to "relevant data."

7. "Productivity" of Capital

The difficulty involved in the argument that roundabout methods are necessarily "more productive," far from being the result of mathematical perversity or a mere "curiosum," originates in the problematic conception of production with which the neo-classical theory attempts to constitute the theory of exchange as the basis for a treatment of capital. This goes back to the original introduction of production into the exchange economy. Production of commodities first becomes the object of rational choice due to the presumed existence of positive time preference on the part of commodity owners. This together with the given net productivity of capital invested in production allows for a comparison between the prevailing rate of time preference expressed in the rate of interest and the net productivity of roundabout methods. When those methods are more productive than the prevailing rate of preference for present goods it becomes rational to enter into production. In this sense it is argued that the extent of productive activity and the average period chosen (the degree of capital deepening or of mechanization) are determined by the time preference of the "community" as revealed in the market for credit. The subsequent analysis pursued on this basis contains an explanation not only for

the rate of profit but equally for the very fact of production. There is, here, an explanation, at least in part, for the entire process of "industrialization" which is deemed to typify the modern world.

At the center of the neo-classical theory of capital, then, there is a special conception of production and of the origins of the productive activity of individuals. The specificity of this conception is connected, we have argued, to the particular conception of capital upon which it is based and, ultimately to the theory of value which underlies the neo-classical concept of capital.

A central claim involved in this theory is that it is possible to speak of the physical productivity of capital as a characteristic of the capitalistic process of production. The contradictions which have served to undermine this claim from very early on place clearly into focus the intrinsic impossibility of conceptualizing the production process at the level of particular commodities as "productive," i.e. capable of producing a surplus. Insofar as the neo-classical conception requires that productivity of capital have a purely material base, that it be productivity in the sense of generating a "surplus-product," the possibility of relating this "surplus" to a difference in value between inputs and outputs of the production process cannot be invoked. It is essential, rather, that surplus-production be conceived independently of the "value form" as a property of the "technology" itself. What is required is a concept of "surplus product" in a material sense which is independent of the system of price formation. Since the production process must be productive in this material sense there must be a measure of the quantitative relation of inputs, physically specified, to outputs, also physically specified, which is different

from the value measure. Given this requirement the development of the "one commodity model" appears not as a simple parable but as the necessary manner of exposition of the neo-classical conception of surplus production. It is clear that the conditions of the neo-classical theory of capital and production can be met, in principle, only by equating the material character of the inputs with the material character of the product, therefore by eliminating all differences in useful form of commodities. Paradoxically, this reduction must leave aside all specification of the production process, all conception of the peculiarly technical features of that process. The equation of the useful forms of commodities is also the elimination of all specificity of those forms and, further, of the conditions which give rise to that specificity. The distinctions between use-values involve distinctions of their production processes, the specification of productive inputs.

Means of production, viewed technically, have certain determinate characteristics which can be described in mathematical, chemical, and mechanical terms. From the point of view of their technical aspect it is their specification in such terms which is central and which makes possible the physical production of objects. It is the fixing of labor into particular, technically distinguishable, useful forms which allows for the increased productivity of roundabout methods involving the activity of living labor upon past labor. In other words, production viewed as a technical process must be conceived in terms of the technical properties which distinguish it into the production of useful objects. Production as a technical process is intrinsically production of specific use-values distinguishable in form one from the other. For such a process, homogeneity

of inputs is not only extraneous but impossible in principle. Production of use-values is specific to the use-values produced. Only production of value (the labor process) can transcend this specification and equate inputs and outputs as values.

The specification of production in a technical sense as involving distinct and physically diverse objects is a condition for the idea of productivity of capital and for the associated idea of a "production function." The production function, even as conceived within neo-classical thought, requires both diversity of inputs and outputs and the application of capitalistic methods. It must be a function in labor and capital, in past and current labor. Different intensities of the cultivation of land, for example, require different means of production (intermediate products) and it is precisely the difference in technical specification of means of production which makes possible a difference in method of production. The underlying rationale for an association between productivity and capital intensity--the production function in corn and labor--is that the piling up of capital increases output per worker through the division of labor and therefore through the introduction of diverse equipment and means of production. The idea of a production function not only presupposes a division of labor but it equally presupposes a differentiation of labor taken in its physical specification.

Once this condition for the conception of the production function and the "productivity of capital" is recognized it becomes clear that productivity has no meaning, for neo-classical theory, with respect to the individual unit of production to the extent that the latter produces as one element in a system of interdependent reproduction. The inputs and

outputs are no longer quantitatively comparable in their material existence. A physical surplus only has meaning for the production system as a whole since only for the latter are the inputs and outputs materially comparable as vectors of particular commodities.[1] Even in this case the possibility of calculating a net rate of return as a pure number presupposes certain very restrictive conditions on the proportions in which particular commodities enter into the net product and are employed in its production.[2] More importantly, even assuming that the system as a whole is productive and that that productivity is calculable in terms of a single measure, it is invalid to assume that any individual unit of production is capable of making production decisions in terms of that net rate of productivity. Some rule is still required for the distribution of the total surplus-product among the particular production processes and, given that the surplus-product is only meaningful as the product of the system as a whole, there is no purely material condition which is able unambiguously to effect such a redistribution in terms of the particular physical productivity of the individual producing unit. The surplus product of the system _in toto_ is not visible or relevant to the particular production process except to the extent that it takes the form of the receipt of a surplus-value in the form of money. But this receipt, for example when calculated in terms

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[1] Cf. D. Harris, _Theory of Growth and Distribution_, unpublished 1973, Chapter 3.

[2] As in von Neumann, _op.cit._ It would also be possible to employ a construct such as Sraffa's "standard commodity" and the related "standard ratio" but while these have the property of physical measures they bear no necessary relation to the rate of profit which could be argued to fix the latter except insofar as they may be conceived to fix its upper limit.

of the value of capital invested, can be presumed to bear no special relation to the physical productivity of the individual unit since that unit is not conceivable as physically productive. The individual unit of production cannot be conceived to be productive in the Austrian sense and therefore production cannot be taken to arise out of the rational calculation of individual consumers or producers. The production of a surplus-product cannot be taken to be the rationale of the investment of capital in production since the surplus-product has a purely social existence.

It only becomes possible to constitute production as directly rational to the individual by severing production from the system of reproduction, of interdependent production of commodities by means of commodities. In this case the production of commodities collapses back into the conception of the individual producer-consumer and the conditions of aggregate production are equated with the conditions of individual production. The one commodity model constitutes the production system in toto as a particular production process. With one commodity produced, all rationale for the division of production among many competing producing units disappears. As such, the one commodity model is not so much a rigorous conception of a production system as it is a conception of the individual producer-consumer made directly consistent with the system of aggregate production. In this equation the aggregate production system loses its determination into many particular production units and the particular units lose their specificity in opposition one to the other. The production units all produce a single commodity using that same product as input. They are, therefore independent of any need to exchange among themselves and need only purchase labor in the market in order to engage in continued

production. To the extent that the producer himself possesses an endowment of labor it is unnecessary for him to have any recourse whatsoever to the market and production is severed entirely from dependence upon exchange. With the explicit introduction of production and capital the original rationale for exchange among individual producer-consumers disappears along with the elimination of differences among commodities and with the elimination of any scarcity of products.

The one commodity model of production and distribution is the logical result of the attempt to conceive of the individual production process as immediately the origin of a material surplus-product. The necessity of the latter conception is itself the result of the neo-classical treatment of the capital relation. The introduction of intertemporal preference together with the assumed material productivity of roundabout methods allowed for the incorporation of a concept of production into the Theory of the Exchange Economy. Since the givenness of objects was the basis of exchange the notion of the object as "product" could only be introduced in the most limited sense. The production of commodities could not serve to deny to commodities the characteristic of scarcity relative to need. But with the production of commodities it is clear that the commodities are not themselves scarce since they are not quantitatively given. More correctly, while the commodity may still be scarce that scarcity is no longer directly connected to the givenness of its supply. Since objects are now products and not given their scarcity must emerge as an element of their production. The entire burden of the conception of exchange as involving the allocation of scarce resources falls not on the givenness of objects of need but upon capital as a scarce factor, ultimately upon the fact that the production

of utilities takes time and proportionally more time the greater the amount of produced utilities desired. With the commodity constituted as a product it ceases to be the immediate object of rational decision-making within the conditions of resource constraint. All particular objects of need can be considered scarce only as embodiments of scarce factors, and particularly of capital. To the extent that production is itself the result of capital formation, of the preference for present consumption tied to the productivity of round-about methods, the effect of other scarce factors of production (i.e. "land" and "labor") is logically subordinate to the capital relation which accounts for all employment of other factors in production. The scarcity of commodity products is, then, in the first instance, an expression of the scarcity of capital.

As a result, capital must itself be conceived to be a substance which is scarce. This substance is no particular utility since it underlies, and is therefore common to, the production of all utilities. As products of capital all particular objects of need are distinguished only quantitatively--by the amount of capital embodied in them in their production. Capital, then, is that substance which remains once the equality of products is made explicit in their constitution as forms, or embodiments, of the factor capital. Since all commodities are now produced, they are equated by the indifference of the substance of their production to particular form, therefore by the ability of that substance to appear in different forms and to shift from one manifest form to another.[1] But what is this substance which is material and yet appears as indifferent to particular useful form?

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[1] Cf. J. B. Clark, The Distribution of Wealth, New York: Kelley, 1965.

Within Classical and Marxian economics the substance of the commodity which is indifferent to the useful form of that commodity is its value. This value is "intrinsic and not arbitrary" it is the abstract, universal, social substance of the commodity. This conception is meaningful, however, only to the extent that there is retained in the theory a distinction between value--this universal social substance--and use-value the particular relation to a given need. For the Theory of the Exchange Economy, however, there is no substantive distinction between "value" and "use-value." On the contrary, it is precisely the original underlying principle of that theory that value be equated to use-value so that both are suppressed and reappear as "utility." The value of the commodity is the relation of the commodity to individual need. Value as relation to need is an equation of value and use-value within which both lose their social character and appear as relations to individual preference. Since the neo-classical theory equates value and use-value it is incapable of conceiving of value as independent of use, of relation to need, therefore independent of particularity of the object of need. Abstraction from the particular use-form does not lead to constitution of the value substance but, rather, to the constitution of a universal material substance, universal use-value. When the notion of capital expresses its requirement for a specification of the universal substance of the commodity this can only be met, within the confines of the Theory of the Exchange Economy, by that universal substance which is also particular, a simple universalization of particular useful form. Where value is use-value the universality of value can only appear as the universal use-value. And this universal use-value is capital; capital as corn, as "leets," as "Meccano sets," as "putty," etc. The

fundamental significance of the one-commodity model for the theory of capital is precisely in the equation of value and use-value and therefore the constitution of value as the universal, the single, use-value. On this basis, and only on this basis, is it possible to conceptualize capital and the production of a surplus-product solely as determinations of individual need.[1]

8. Value and Capital

The idea that production can be conceptualized only by first leaving aside all specificity of useful form of the product in order to conceive of its capitalistic character in general is endemic to the history of economic analysis. This general treatment of production has, however, taken two opposing forms. Both of these forms appear at the origin of economic science in the works of Smith and Ricardo.[2] First, production in general is conceived as a purely material process, in the case of the Ricardian "corn model" as production of corn by means of corn and labor. This is also the basis of the neo-classical parable. Second, production in general has been conceived as a "labor process" in which the production process once abstracted from particular material object (from production of particular "use-value") appears as the process of the production of value and surplus-value. This is the basis of the Classical labor theory

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[1] "Hence, we see that behind all attempts to represent the circulation of commodities as a source of surplus-value, there lurks a quid pro quo, a mixing up of use-value and exchange-value," K. Marx, Capital I, p. 159.

[2] This duality of the Classical conception of value, capital, and production forms the central theme of Part I, above.

of value. In both cases production is conceived as surplus production, therefore as production based on capital. In the first case the surplus considered is a material surplus-product. Such surplus production as the application of capital is given its definitive expression in neo-classical capital theory which focuses from the outset, and as we have seen of necessity, upon the production of a physical surplus as the real nature of the capitalistic process.

In both cases it is the initial abstraction from particularity of useful form which makes possible the conception of productivity and it is the latter which sets the foundation for the analysis of profit and of price based upon profit-making calculation. But, so long as capital is deferred consumption, the productivity considered on this basis must be that of a material surplus-product and the measure of capital, independent of price, must be a measure based upon the elimination of all possibility of distinction in useful form among the products of capital. This is no longer an initial abstraction since in the absence of the specific assumptions employed in the construction of the simple model none of the essential conclusions derived on that basis can be presumed to remain valid. The Theory of the Exchange Economy, which is articulated on the basis of the absence of production, therefore of the givenness of the objects of need, once extended to the treatment of production becomes the neo-classical parable of production and capital formation in the absence of all exchange of commodities. The concept of capital, rather than providing the link between exchange and production provides an impenetrable barrier required by a conception of exchange value which cannot be reconciled with production and a conception of production which is equally irreconcilable

with any conception of exchange including that upon which it is itself founded.

The original claim of neo-classical economics was to a consistent account for the determination of equilibrium price which did not involve the contradictions of the Classical labor theory of value. This account was based on an initial shift in the conception of value from the Classical emphasis upon absolute value independent of particularity of individual need to value as the relation of scarce objects to the given needs of individuals. This shift was then argued to lead directly into a conception of capital and profit which did not suffer from the deficiencies of the Ricardian conception. Those deficiencies were traced back to the Ricardian pre-occupation with "labor" as the single scarce factor and to Ricardo's failure to recognize that with the introduction of time and of round-about methods of production it was necessary to also pay for the employment of capital out of the price of the commodity. Since with the presence of production based in capital it is no longer possible to argue that price is proportional to labor time it was concluded that the labor theory of value was in the nature of an unfortunate detour onto which Ricardo had shunted economic analysis for half a century.

These claims of the Theory of the Exchange Economy ring hollow indeed once the inability of that theory to conceptualize a system of relative price consistent with the production of commodities becomes apparent. But this inability is not of a solely negative character. To be sure the claims of neo-classical economics and of the Theory of the Exchange Economy have been conclusively overthrown by recent criticism. The nature of this criticism, once correctly understood, does not, however, reduce economic

analysis to a book of blank pages. The criticism also possesses a positive side in that the real conditions for the articulation of an adequate conception of value and capital remain implicit not only in the criticism of the theory of capital but equally in the central contradictions of the theory of exchange. The demise of the neo-classical theory of value and capital does, at the same time, indicate the essential requirements of an adequate conception of capitalist production. The concept of surplus-production which underlies the formation of an average rate of profit requires (1) a concept of surplus-value rather than surplus-product, and (2) a concept of surplus-value which remains independent of the system of exchanges among the products of capital as those emerge within the competitive process according to the principle of equal profit on equal capital advanced. Since the neo-classical concept of production is the necessary expression of the neo-classical theory of value and capital an adequate concept of production and of productivity must be established upon the basis of a conception of value and capital distinguished from and opposed to that of the Theory of the Exchange Economy.

In order to give a systematic account for the formation of capital and for the distribution of the net product between profits and wages it is essential, and has been recognized to be essential by all schools of economic analysis, that the conception of the production of a surplus be constituted as the theoretical basis for the determination of the system of prices and of profit-making enterprise.[1] We have seen that the material

[1] See below, Chapter 9 for a discussion of the way in which this necessity appears within the neo-Keynesian theory of capital and distribution.

conception of a surplus-product, while sustainable at the level of the reproduction system as a whole, is without meaning with regard to the direct production process. At the same time the conception of the determination of price through the interaction of profit-making individual enterprise cannot be founded directly upon the existence of a surplus-product for the production system taken as a whole. It follows that the concept of surplus-production can neither be that of physical productivity (at the level of the individual unit of production or at the level of the system as a whole) nor that of productivity measured in terms of equilibrium price. The formation of such prices, since they include the calculation of the normal rate of profit, presuppose surplus-production and cannot be directly capable of giving an account for that surplus. In order to determine that process of emergence of a surplus it is necessary to have recourse neither to the surplus-product of the system of production nor to the total profit of the system as a whole, but to surplus-value. Only in terms of the category of surplus-value is it possible to account for the greater productivity of roundabout methods of production without denying the real basis of that greater productivity in the division of labor and in the application of fixed capital. The phenomenon of surplus-production must be rooted in the process of capital as a value process. It must, therefore, be production of surplus-value and yet at the same time surplus-value must be considered independently of the total system of particular production units. Since no particular unit of production is capable of accounting for surplus-value and since the production system as a whole is equally incapable of giving such an account, the process of capital expansion and of the production of capital can only be grounded by considering

the analysis of production in terms of (1) the direct production process of capital as the process of the production of surplus-value which is (2) distinct from the profit and rate of profit (and related "prices of production") which emerge within a total system of particular units of capitalist production. It is necessary to arrive at the level of the general production process of capital based in the general exchange of capital for labor-power. It is necessary to conceive of the production of capital in terms of a concept of value distinct from that of equilibrium price, therefore in terms of a labor theory of value.

9. A Further Note

The peculiarity of the circuit of capital is precisely that it is self-contained, that it does not seek its conditions outside of itself in the direct consumption of the commodities which make up its elements. Neo-classical capital theory attempts to show that this characteristic of the circuit is mere appearance, that consumption is still the rationale and end of capital formation even where capital is understood as the denial of direct consumption. But capital, in its life process, rather than being subordinated to individual consumption subordinates consumption to the requirements of its own self-expansion. It is this fact which emerges, however distorted, in the ideas of impatience and productivity of round-about methods of production.

It is the process of capital which strips workers of the objective conditions of their labor and makes them of necessity "impatient," compelling them to exchange their labor-power at a discount on the future product of that labor. Preference for present consumption becomes a necessity inflicted

upon the individual by his absorption into the process of the expansion of capital. Furthermore, it is this same process which makes consumption in the present accountable for consumption in the future. For capital, consumption is always consumption in the future since consumption on the basis of capital is consumption within a process of expansion without limit. The aim of such consumption is not the shape of future consumption but the building up of an account for consumption in the future, an account which, for capital as a whole, must never be drawn upon.

In the circuit of capital simple exchange turns into its opposite, from exchange for consumption, whose end is use-value, into self-sustaining exchange, exchange for the sake of exchange, for the sake of the expansion of exchange-value. The circuit of capital contrasts with the simple circulation of commodities in that exchange which appears in the former to be subordinate to consumption is in the latter exchange which subordinates consumption. For the circuit of capital (money, M - commodities, C - more money, M') to be understood as the simple circulation of commodities extended over time it must be conceived as

$$)M\text{-}C\text{-}M'\text{-}C'(\ .$$

So far as consumption is concerned the individual is, in principle, indifferent to the time in which it occurs except to the extent that his social conditions require a particular consumption pattern; for example to the extent that the age structure of the labor market forces him to save for his old age. But these conditions are the products, not the origin, of capital. In the case of the "life cycle model" of saving the entire social condition of the individual within modern bourgeois society is taken to

be given independently of the process of capital formation and expansion so that it may then be employed to explain capital formation and expansion, so that the latter may be employed tautologically in order to give an account for itself.

Not only, however, is the notion of time preference the product rather than the origin of capital, equally the existence of round-about methods of production can only be taken to be given when they are abstracted from their origin in the production process of capital. It is the subordination of production to capital, therefore the creation of a capitalistic production process, which results in the production of surplus-value. The generation of a process of production adequate to the needs of capital (as self-expanding value rather than deferred consumption) is itself effected by capital through:

1. The lengthening of the working day, and
2. The revolutionizing of the means of production and creation of modern technology.

The origin of surplus-value is an eminently social one rather than a purely technological fact of life. This is particularly apparent in the case of what Marx calls "absolute surplus-value" (case 1). The existence of a surplus presupposes first that the wage does not absorb the entire product and this is assured, in the first instance, by extending the length of the working day beyond that period necessary for the maintenance of labor-power. To give an account for this creation of absolute surplus-value in purely technical terms would be to deny directly the conditions of the problem which rest not upon any given technological "fact of life" but upon the intervention of a particular social relation and of a set of mechanisms

which allow (1) for the increase of the length of the working day beyond the "necessary labor time" and (2) do so by at the same time allowing, and requiring, the appropriation of the surplus thus generated by capital.

Similarly the creation of that modern form of technology which involves the increasing productivity of round-about methods does not involve the serial adoption of given techniques of greater and greater capital intensity but the revolutionizing of the production process. The latter takes place not at the whim of consumers articulating an intertemporal preference in consumption but as a necessity of the expansion of capital which by transforming the production process seeks to increase its rate of expansion. The process of production is productive of a surplus not because of the technically given productivity of round-about methods but because of the subordination of production to capital and the mechanisms by which capital drives the wage down below the value of the net product, below the value newly produced in the production process.[1] It is the self-expansion of capital which not only allows for the application of round-about methods but which actually brings those methods into existence.

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[1] Failure to grasp the social ground of surplus-production is typical of bourgeois economic analysis beginning with Classical Political Economy. This weakness appears in its most vivid form in modern theories of production, especially in Sraffa, op.cit. This point has been considered above in Chapter 4; compare also E. von Bohm-Bawerk, Capital and Interest, Vol. II, The Positive Theory of Capital, South Holland, The Libertarian Press, 1959, p. 308.