

# **The Capital Idea and the Scope of Economics**

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# The Capital Idea and the Scope of Economics

## *The idea of Capital is central but lacks clarity*

Capital (I am not the first to discover) is a very large subject, with many aspects; wherever one starts, it is hard to bring more than a few of them into view. It is just as if one were making pictures of a building; though it is the same building, it looks quite different from different angles. As I now realize, I have been walking round my subject, taking different view of it. (Hicks 1973: v).

The idea of Capital<sup>1</sup> is surely central to the study of economics. Its centrality, however, has not prevented the development and persistence of substantial disagreement concerning its meaning and significance. It seems as if each generation of economists has invented its own notion of Capital and its own “capital controversy.” The Classical economists thought of capital in the context of a surplus fund for the sustaining of labor in the process of production. Ricardo and Marx provide frameworks that encouraged us to think of Capital as a social class – the class of owners of productive facilities and equipment. The Austrians introduced the role of time in the production process. In Neoclassical economic theory we think of capital as a quantifiable factor of production. In financial contexts we think of it as a sum of money.

Different views of capital have, in large part, mirrored different approaches to the study of economics. We can see this in the revealing case of John Hicks. Hicks was perhaps the most eclectic of modern economists to examine capital theory. He was preoccupied with it over his long and productive career. He wrote three significant full length works (Hicks 1946, 1965, 1973) and numerous articles on the subject of capital over a period of three decades. He provided many insights into this complex area, but, in the final analysis even he was limited by the formalistic, quantitative methodological framework from which he was unable (or unwilling) to break.<sup>2</sup>

That the subject of capital theory is difficult is perhaps not to be doubted. But difficulty alone is surely insufficient to explain the apparently elusive nature of its central concept and the disagreements that have emerged as a result of this lack of clarity. I shall argue that this ambiguity is a direct result of the chosen methods of analysis, and that these methods, because of their restrictive nature, have necessarily limited the scope of economics.

In this paper I will trace the idea of Capital from Adam Smith to the present and show how it has evolved in complexity and subtlety, containing within it many potential areas of fruitful investigation, only to be simplified and narrowed by mainstream economics in the service of “scientific precision.” I will suggest that one of those fruitful areas is the economics of organization generally and the organization of production in the modern firm more specifically. Economists taking this tack may thus contribute much to the area of business studies and it would not be surprising to see the economics profession of the future splinter along these lines. Let’s begin with Adam Smith.

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<sup>1</sup> To emphasize the notion of Capital “as an idea” I will mostly capitalize the first letter, no pun intended.

<sup>2</sup> For a discussion of Hicks’s work on capital theory see Lewin 1999, chapter 6 and Lewin 1997a.

***Capital is an expression of the connection between time and value – some historic themes.***

**Adam Smith – the important connections between capital accumulation, economic growth, the division of labor and the organization of production.**

Capital is about value over extended time. The idea of Capital arises when we contemplate the connection between value and time. The reason why we have different understandings of, and approaches to, Capital is because of differences in the way that time and value are understood and expressed in economic discourse. Adam Smith has a rich understanding of the complex and varied elements of a nation's "capitals." The creation of value, through various activities that we know of as production, always takes time. Access to created value often follows productive activity by a significant interval. Workmen may have to work a whole year before they are able to reap the fruits of their agricultural harvest. In this interval they have to be sustained. Thus, if the productive activity is to be undertaken, someone must *advance* the sustenance (payment) to the workmen. This advance was conceived of as a capital sum that facilitated production, and in Smith's world it was easy to think of it as a stock of corn saved over from a previous harvest for this very purpose. In this way, the activity of saving was connected to the idea of Capital and Capital was the facilitator of time-consuming productive activities.<sup>3</sup>

The annual produce of the land and labor of any nation can be increased in its value by no other means, but by increasing either the number of its productive laborers, or the productive powers of those laborers who had before been employed. The number of productive laborers, it is evident, *can never be much increased, but in consequence of an increase of capital, or of the funds destined for maintaining them.* The productive powers of the same number of laborers cannot be increased, but in consequence either of some addition and improvement to those machines and instruments which facilitate and

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<sup>3</sup> For an extended examination of Smith's "corn economy" see Lewin 1999: 49-52. This is based on the treatment from Hicks 1965: 36-42 interpreting Smith 1982: book II, chapter III, "Of the Accumulation of Capital, or of Productive and Unproductive Labor." See also the appendix to this paper. I have come to think that a characterization of Smith's understanding of Capital exclusively in terms of a corn economy does not do him adequate justice. Smith discusses at length different kinds of accumulation. He has a taxonomy in which a nation's "stock" can find expression either in a stock of items for consumption or as part of its productive "capitals" – the latter being divided into fixed "capitals" (productive equipment) and circulating "capitals" (raw materials, stored agricultural produce). Only the last mentioned is analogous to the corn economy. Nevertheless, it is true, that he, in common with the other classical economists, thought of Capital in terms of a fund of value (that takes on a suitable physical form) necessary to sustain productive activity.

[In a specialized economy a worker's] purchase cannot be made till such time as the produce of his own labor has not only been completed but sold. A stock of goods of different kinds, therefore, must be stored up somewhere sufficient to maintain him, and to supply him with the materials and tools of his work till such time, at least, as both these events can be brought about. (Smith 1982: 276).

Smith is perhaps to be distinguished by his very rich incorporation of the 'dynamic' aspects of economic progress like continued technological development and improvements in economic organization that link the division of labor to the accumulation of capital – phenomena that motivate this paper. As the editors of the bi-centenary edition of the *Wealth of Nations* tell us:

It is worth emphasizing ... that Smith's concern with economic growth takes us back in a sense to the oldest part of the edifice, namely his treatment of the division of labor, the point being that the increasing size of the market gives greater scope to this institution, thus enhancing the possibilities for expansion, which are further stimulated by technical change in the shape of the flow of invention.' (General Introduction in Smith 1982: 31, see Smith's discussion on pages 276-277).

abridge labor; or of a more proper division and distribution of employment. In either case the additional capital is almost always required. It is by means of an additional capital only that the undertaker of any work can either provide his workmen with better machinery, or make a more proper distribution of employment among them (Smith 1982: 343, italics added).

In addition to regarding saving as necessary for the achievement of economic growth, Smith considers the earning of profit to be consequent, not simply upon the accumulation of capital, but, significantly, also upon the fruits of the division of labor. In modern terms, Smith sees *capital accumulation, technical progress and economic organization as being tied together*. The availability of capital is necessary (though apparently not sufficient) for the adoption of new and more productive methods of production. And though he seems to identify a type of diminishing returns, this is clearly not in the form of a declining rate of return to investment in a given mode of production, but rather refers to the eventual possible exhaustion of investment opportunities for extending the division of labor, that is, for the *discovery* and introduction of new and improved production methods.

### **David Ricardo and the Ricardian Legacy**

Though David Ricardo clearly benefited greatly from Smith's work, his emphasis and focus changed significantly and this turn was responsible for a whole different approach to Capital. Ricardo's concerns reflected his preoccupation with the future of market economies. The advent of the Napoleonic blockade and the consequent rise in food prices, led him to wonder about the long-term trend of an economy in which the population was rising. How would the population get fed? He seemed to accept Malthus's idea that the population would grow in such a way as to keep the wage rate at the bare level of subsistence. But if the population was growing this would lead to the use of land of progressively inferior fertility. So with the wage rate fixed at subsistence level, and the margin of production being extended to inferior land, the earnings (rent) of the landowners on the infra marginal land would tend to rise. This meant that the residual, the rate of profit, was bound to fall. Pushed to its logical conclusion, the rate of profit would fall to zero, at which point capital accumulation would stop. A stationary-state would have been reached. There could be no such thing as permanent growth. The only possible exception to this result is in "improvements in machinery connected with the production of necessaries," "discoveries in the science of agriculture" and international trade (Ricardo 1973: 120; Kregel 1976: 24).

Ricardo, like Smith, thus recognizes the possibility and perhaps the importance of technological progress. But it is not part of his basic scheme. Capital accumulation and technological progress are no longer closely linked. Ricardo's preoccupation with the laws of distribution – so very different from Smith's focus on economic progress – logically lead him to the now traditional tripartite division of factors of production into land, labor and capital – and these become identified with social classes. This perspective requires quantification at an aggregate level. If Ricardo's story is to make sense then Capital must earn a rate of return – like the wages of labor and the rent of land – and for this to be coherent it must be possible to speak of a quantifiable stock of capital (the denominator in the rate of return calculation).

The labor theory of value served to bring *all* economic goods within a common denominator. Ricardo used the 'labor-hour' as a unit of measurement, labor-time is the common standard of comparison. Machines, corn and cattle all cost labor and are seen to

be comparable in those terms. If we have a stock of circulating capital (for example, a stock of corn), we can ask how many hours of labor it took to produce it and get a value for the input. But if we have a machine lasting fifteen years, although we can say its production took  $x$  labor-hours, the total input is not used up in one year and enters successively into the output of fifteen years. Ricardo deals with this by regarding fixed capital, like machinery, as circulating capital that circulates more slowly. Some part of the machine gets used up in each of the fifteen years. Fundamentally there is no difference. All capital stocks rotate, it is only a matter of degree. It thus becomes possible to calculate the value of the inputs of any capital item that matures in any given year and to compare it with the value of its output in that year, thus being able to calculate a rate of return.

In sum, to repeat, Ricardo's main concern was with the distribution of income between the various categories of inputs and their owners. It was in order to give an account of the earnings of capital that he had to find some way to reduce the heterogeneous capital items to some common measure. His basic argument concerns the tendency for rates of return on various capital investments to become equal. This tendency provides a mechanism for determining flows of capital to various types of production. In long run equilibrium a capitalistic economy establishes *a uniform rate of profit*. This is what explains the distribution of wealth. In equilibrium all capital ventures earn the same rate of profit. Ricardo thus started the now common practice of using what would be the state of affairs in a hypothetical situation of long run equilibrium, a situation that is the end-state of an indefinite number of interactions in an essentially unchanging environment, as if it were the real-world everyday state of affairs. This is the equilibrium method of explanation. We speak of *the* rate of profit on capital as though it were a parameter.

Two important and interrelated restraining elements thus emerge from the Ricardian frame of mind.

1. One is the necessity to reduce the components of Capital to commensurable terms. Capital must be seen to be quantifiable in some dimension so that we can talk unambiguously about capital accumulation – let us call this element quantification.
2. And secondly, and related, one way to do this is by expressing the value of the heterogeneous items that we now think of as capital in terms of the inputs used to produce them. More specifically, since everything is ultimately reducible primarily to labor-inputs, labor is seen to be the most logical common denominator – hence the labor theory of value. This second element is more generically thought of as a cost-of-production approach to value that is so characteristic of the Ricardian way of thinking – call this cost-of-production valuation.

Cost-of-production valuation was abandoned with the advent of the marginalist revolution in 1871 and the arrival of Neoclassical economics. Indeed this, in some way constitutes the heart of the dispute between the Neo-Ricardians and the Neoclassical growth theorists. But the other element, quantification - the perceived need to construct a

notion of Capital as a homogenous aggregate of commensurable items, was decidedly not abandoned and, indeed, was carefully retained by devising another method of justifying the use of value as the homogenizing device by which otherwise incommensurable capital items were rendered commensurable. This method was the method of Neoclassical general-equilibrium analysis. Labor-value was abandoned but “equilibrium-value” was put in its place. As Ludwig Lachmann was to point out, heterogeneity matters only in disequilibrium, that is, when the value to be attributed to any productive resource was less than certain and differed as between appraisers of that resource.

It is this insight that prompts Lachmann to label both the Cambridge England Neo-Ricardians and the Neoclassical growth theorists as Ricardians (Lachmann 1973). They share the method of comparative-static equilibrium analysis that derives from Ricardo and his interest in accounting for the ‘laws’ of distribution. In this way the focus is clearly on the inexorable mechanisms of social development and away from aspects of human action and decision. If human planning features at all in the capital accumulation process, it is in a mechanical and implied way. Action is relied on implicitly to bring about the equilibrium that is assumed. If some capital venture were to become unprofitable capital would be withdrawn and invested elsewhere. But where capital is durable it can only be withdrawn very slowly. Thus, we must assume that no changes occur while capital is in the (long) process of being shifted from areas of low to areas of high profitability. And we are not permitted to ask how it is known which are the areas of low and high profitability. Somehow the economy is envisioned to grope its way soon enough to a configuration of capital items on which the rate of profit is uniform and the maximum possible. In a world of continuous unexpected change, of continuing technological, organizational, and product experimentation and innovation, flows of capital will not be able to keep up, and equalization will never occur. Prices of the various capital goods will be such that the original labor-value invested in them has no enduring meaning and the whole Ricardian basis would seem to be of dubious relevance. Relevance rather than realism is the key, but evidently relevance is often ‘in the eye of the beholder.’ Ricardo’s long run equilibrium method continues to command many adherents.

### **Carl Menger’s time structure of production**

Menger’s pioneering approach is responsible for our thinking of capital in terms of a *time structure* reflecting the structure of capital goods employed in the production process – it owes much to Smith and nothing to Ricardo. There is no attempt in Menger to reduce the variety of goods and services available at various dates to a single dimension. At any moment in time some goods are useful for immediate consumption, and some are only useful insofar as they contribute to the *production* of goods or services available for immediate consumption. And since production takes time, a time element is already implicit in the contemplation of a set of economic goods at any single moment in time.

Menger echoes Smith in envisaging durable heterogeneous productive equipment as the result of sacrificed earlier potential consumption in the interests of ‘providing for’ productive labor. He characterizes production as a sequential process in which *goods of higher order* become transformed into *goods of the first order* (consumption goods). The

former are capital goods. Capital goods are varied in nature but can be classified by where they fit, along a time continuum, into the production process. The lowest, or first, order goods, as noted, are consumption goods. The lowest order capital goods are second order. The next highest are third order and so on.

The transformation of goods of higher order into goods of lower order takes place, as does every other process of change, in time. The times at which men will obtain command of goods of first order from the goods of higher order in their present possession will be more distant the higher the order of these goods (Menger 1981: 152).

Menger, like Smith, considers the productivity of any productive structure to be intrinsically linked to its time structure.

[B]y making progress in the employment of goods of higher orders for the satisfaction of their needs, economizing men *can most assuredly increase the consumption goods available to them* accordingly - but *only* on condition that they lengthen the periods of time over which their activity is to extend in the same degree that they progress to goods of higher order. (Menger 1981: 153 italics added).

The rewards to saving result only if *more time-consuming methods* of production are adopted.

Menger first introduces these ideas in connection with processes in nature. Men find the fruits of nature valuable. But at an early stage in the development of civilization they learn that they can do more than simply “gather those goods of lowest order that happen to be offered by nature” (Menger 1981: 75). By intervening in the natural processes, individuals can have an effect on the quantity and quality of the subsequent yield. To understand the objectives of the ‘producers’ is to understand that the earlier a producer intervenes, *the greater are the opportunities to tailor the production process to suit his own purposes*. This provides an intuitive basis for the notion that the more “roundabout processes” tend to have a greater yield in value terms” (Garrison 1985: 165).<sup>4</sup>

Thus Menger goes much deeper than Smith into the role of time in production. Smith understands the need to provide for labor while value is being created, and that the more generous this provision, the more extensive the division of labor will be and the more productive. In Menger we have the suggestion that the greater the provision for productive labor, the ‘more time’ can be taken in the production process and, therefore, the more productive (if done properly) it will be. In addition, he marries this to the nature of value. The value attributed to any capital good is *prospective* not backward looking as with Ricardo. “There is no necessary and direct connection between the value of a good and whether or in what quantities, labor and other goods of higher order were applied to its production” (Menger 1981: 146). At any point in time there is a capital structure

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<sup>4</sup> This idea of the value of ‘roundabout’ approaches towards the achievement of ultimate goals has fascinating and broad application. Consider:

All cultural work, be it technical or purely intellectual, proceeds by the gradual shift from the direct relation between man and his environment to an indirect relation. In the beginning, sensual impulse is followed immediately by its gratification; but gradually more and more mediating terms intervene between the will and its object. It is as though the will, in order to gain its end, had to move away from the goal instead of toward it; instead of a simple reaction, almost in the nature of a reflex, to bring the object into reach, it requires a differentiation of behavior, covering a wider class of objects, so that finally the sum total of all these acts, by the use of various ‘means,’ may realize the desired end. (Cassirer 1946:58-59)

(I owe this quote to Gene Callahan who kindly suggest it. See also Callahan 2002: 136).

characterized by capital goods of various orders whose value is determined by the values attributed by consumers to the consumption goods the capital goods are expected to produce. “The value of goods of higher order is always and without exception determined by the prospective value of the goods of lower order in whose production they serve” (Menger 1981: 150 ). This is “*Menger’s Law.*” It implies the present value arithmetic that underlies the pricing of all durable assets – an asset being something that has value to the asset holder (owner) – according to which the *present* value of a capital asset (resource) is the flow of its (expected) future earnings suitably discounted. (Later Böhm-Bawerk addressed at great length the principles governing the determination of discount rates, the central principle being that of *time preference.*)

Menger’s vision thus incorporates a complex world. It is a world of diverse productive items that contribute to the creation of value over time that, without exception, are valued according to Menger’s Law by their prospective earnings. These values manifest in the market as prices. As long as these prices remain (and are expected to remain) constant and as long as there are no technical changes in methods of production, the capital structure will remain constant. But if there should be a permanent change in the price of even one consumption good, this will almost always imply the need to change the capital structure in some way. Substitutions will occur in response to the perceived changes in prospective output values.

The level and pattern of the employment of resources (including labor) and their earnings is determined and thus depends on *the strong link between the structure of consumption and the structure of production.* Changes in the demand for one (or some) consumption good(s) (*relative to others*) cause changes in the evaluation and use of *particular* capital goods and in employment. The implication in Menger is that the market can accomplish this smoothly.

Time is inevitably involved in the notion of capital. As explained, Menger recognizes the role of time as providing for greater productive possibilities. More time implies the ability, the flexibility, to find and adopt better suited, perhaps more time-consuming, production methods. But time, in this context, has two contrasting sides. More time taken implies more things can happen – providing the possibility of greater productivity but also greater uncertainty. Since the value of higher order (capital) goods depends on the prospective value of the consumer goods they are expected to produce, the elapse of time, and with it the arrival of unexpected events, implies that some production plans are bound to be disappointed and thus the value of specific capital goods will be affected. The economic consequences of human error are implicit in Menger's view of capital.

Adopting Menger’s perspective one cannot lose sight of the variety of goods and services and individual activities and choices. There is no suggestion of a uniform rate of profit at any point in time. Yet there is an inescapable order within the variety provided by our understanding of the purposes of individuals. “The process of transforming goods of higher order into goods of lower order, ... must always be planned and conducted, with some economic purpose in view, by an economizing individual” (Menger 1981: 159-60). Capital and the conscious organization of production and inextricably linked.

## Eugene von Böhm Bawerk and the average period of production

Böhm-Bawerk is probably the economist most often cited in connection with the development of capital theory. He is thought of as the ‘father’ of Austrian capital theory and credited with being the first to clearly introduce the element of time and its implications into considerations of capital (Hennings 1987: 233). This conception neglects the contribution of Menger. Böhm-Bawerk’s work on capital was a conscious extension of Menger’s. His departures from Menger are not seen universally as being an advance.<sup>5</sup> Whereas Menger produced hardly more than twenty or so pages on capital theory (in spite of which it may be said that he laid the groundwork for a comprehensive theory of capital), Böhm-Bawerk produced three large volumes. It was a major part of his life’s work. It is to be expected then that the scope for various and differing interpretations might be quite large. Austrian, Ricardian and Neoclassical capital theorists all find much with which they can agree in Böhm-Bawerk, albeit much also to disagree with. A reading of Böhm-Bawerk reveals an uneasy amalgam of the ideas of Menger and Ricardo.<sup>6</sup> Capital theorists in general have chosen to emphasize the Ricardian elements.<sup>7</sup> The Mengerian elements might just as easily have been emphasized had capital theory developed differently. As it is, modern capital theory, with its reliance on ‘production function’ reasoning can, with some justification, be traced back to Böhm-Bawerk (along with Wicksteed and some others – see the appendix to this paper). Much of the ambiguity surrounding the assessment of his contributions relates to his use of a theoretical device designed to provide a physical measure of the capital stock - the average period of production. In this he incorporated both of the Ricardian elements identified above, namely, quantification and cost-of-production valuation.

Böhm-Bawerk’s characterization of a capital using economy is very similar to Menger’s. Production is a process involving time. Original factors are transformed, with the aid of produced means of production, into consumption goods. Like Menger he too conceived of capital goods as being related to one another in terms of the stage of the production process that they occupy. And like Menger he conceived an increase in capital to involve a change in the time structure of production (not his term) in some way. It is not simply an augmenting of each type of capital good at each level of maturity (each stage of production), but a change in the internal structural relationships. Like Menger he

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<sup>5</sup>This statement relates to Böhm-Bawerk’s work on capital. His work on interest theory was clearly an advance and marks the beginning of the pure time preference theory of interest.

<sup>6</sup>My discussion in this subsection draws on Lewin 1999.

<sup>7</sup>“However much he denied any adherence to classical cost theories of value, his view of production and the role of capital and time bear the mark of the Ricardian tradition” (Hennings 1987a: 104; also Hennings 1987c). See also Hennings 1987b: 114-15 and Hennings 1997, chapter 8. Yet consider this same theorist’s capsule assessment:

A leading member of the Austrian School, he was one of the main propagators of *Neoclassical* economic theory and did much to help it attain its dominance over classical economic theory. His name is primarily associated with the *Austrian* theory of capital and a particular theory of interest. But his prime achievement is the formulation of an intertemporal theory of value .. (Hennings 1987a: 97, italics added).

Says Kregel (1976: 28-29), “Böhm-Bawerk’s role in the Austrian theory was to combine the Ricardian approach to capital in terms of labor and time with the ‘new’ marginal approach to pricing through utility.”

held that capital goods derived their value from their usefulness in the production of consumption goods, their value was to be derived from the value to consumers of the goods they produced. All durable capital goods are valued by the present value of their services using a subjective rate of discount. He emphasized the heterogeneity and specificity of individual capital goods and denied that they could be aggregated into some physical measure of the capital stock. Hennings quotes Böhm-Bawerk as follows:

A nation's capital is the sum of heterogeneous concrete capital goods. To aggregate them one needs a common denominator. This common denominator cannot be found in the number of capital goods ... nor their length or width or volume or weight or any other physical unit of measurement .... The only measuring rod that does not lead to contradictions ... is the value [of these capital goods] (Hennings 1997: 132, his translation of Böhm-Bawerk 1959 [1921] III 105).

Böhm-Bawerk denies that capital goods are individually or intrinsically productive and insisted that it is the production processes that they make possible that are the sources of any increase in value that arises. But since these processes can be characterized by a series of stages of production successively further back from the ultimate consumption goods in which they culminate, he perceived a connection between the number of such stages and the amount of value added. That is, there is a strong intuition connecting the length of production, indicated by the number of stages involved (the degree of 'roundaboutness') and the degree of productiveness that results.

There are two concomitants of the adoption of the capitalist methods of production, ... One is advantageous, the other disadvantageous. We are already familiar with the advantage. With an equal expenditure of the two ordinary productive forces, labor and valuable forces of nature, it is possible by well chosen roundabout capitalist methods to produce more or better goods than would have been possible by the direct noncapitalist method. It is a truism well corroborated by empirical evidence (Böhm-Bawerk 1959: Book II, 82-3, footnote references crediting Lauderdale and Jevons omitted).

...[O]ne thing that can be stated with a reasonable degree of certainty is the proposition ... that as a general rule a wisely selected extension of the roundabout way of production does result in an increase in the magnitude of the product. It can be confidently maintained that there is no area of production which could not materially increase its product over the result obtained by its present method (Böhm-Bawerk 1959: 84-85).

Böhm-Bawerk felt that a more 'time consuming' process of production would not be chosen unless it was more productive in this sense, unless it added sufficiently more value to compensate for the longer 'waiting' required.

The disadvantage which attends the capitalist method of production consists in a *sacrifice of time*. Capitalist roundaboutness is productive but time-consuming. It yields better consumption goods, but not until a later time (Böhm-Bawerk 1959: 82).

Thus by wisely selecting more roundabout methods of production, increases in value can be obtained and these have to be weighed against the 'cost' of waiting. In addition, however, it is apparent that the returns to greater degrees of roundaboutness must eventually diminish. In summary:

All consumption goods which man produces come into existence through the cooperation of human powers with the forces of nature, which are in part of economic character, in part free natural powers. Man can produce the consumption goods he desires through those elemental productive powers. He does so either directly, or indirectly through the agency of intermediate products which are called capital goods. The indirect method entails a sacrifice of time but gains the advantage of an increase in the quantity of the product. Successive prolongations of the roundabout method of production yield further quantitative increases though in diminishing proportions (Böhm-Bawerk 1959: 88).

Böhm-Bawerk's lengthy exposition is generally imprecise. His discussions can be read as suggesting informal general properties of real capitalist economies. Capital accumulation involves judicious changes in the time structure of production that furnish greater output value. And output value is increased not only by augmenting existing products, but also by producing 'better goods.' Both output and input undergo 'qualitative' change as opposed to simply quantitatively augmenting existing processes. And this interpretation is strengthened by his connecting the fruits of roundabout production to the division of labor.

Our modern system of specialized occupations does, of course, give the intrinsically unified process of production the extrinsic appearance of a heterogeneous mass of apparently independent units. But the theorist who makes any pretensions to understanding the extrinsic workings of the production process in all its vital relationships must not be deceived by appearances. His mind must restore the unity of the production process which has had its true picture obscured by the division of labor (Böhm-Bawerk 1959: 85).

Yet, perhaps in order to deal with a variety of criticisms, for example as to the precise meaning of roundaboutness, in the very next paragraph Böhm-Bawerk now attempts to make his observations more formal and precise. An attempt to capture the degree of roundaboutness by measuring a period of production from the original factors to the emergent consumption good would be impossible and misleading in the modern world with its vast array of inherited capital goods. One could not, as it were, trace production back "to the moment when the first finger is stirred in the making of the first intermediate product that was later used in the production of the good in question, and as continuing until its final completion (Böhm-Bawerk 1959: 86)." And so he introduces the *average* period of production.

It is more important, as well as correct, to consider the *average* time interval occurring between each expenditure of originary productive forces and the final completion of the ultimate consumption good. A production method evinces a higher or lower degree of capitalist character, according to whether, *on the average*, there is a longer or shorter period of waiting for the remuneration of the expenditure of the originary productive forces, labor and uses of land (Böhm-Bawerk 1959: 86).

And he proceeds to arithmetically define the average period of production, which we may succinctly express as:

$$T = \frac{\sum_{t=1}^n (n-t)l_t}{\sum_{t=1}^n l_t} = n - \left( \frac{\sum_{t=1}^n tl_t}{N} \right)$$

where  $T$  is the average period of production for a production process lasting  $n$  calendar periods,  $t$ , going from 1 to  $n$ , is an index of each sub period,  $l_t$  is the amount of labor

expended in subperiod  $t$  and  $N = \sum_{t=1}^n l_t$  is the unweighted labor sum (the total amount of

labor-time expended). Thus  $T$  is a weighted average that measures the time on average that a unit of labor  $l$  is 'locked up' in the production process. The weights  $(n-t)$  are the distances from final output.  $T$  depends positively on  $n$ , the calendar length of the project, and on the relation of the time pattern of labor applied (the points in time  $t$  at which labor

inputs occur) to the total amount of labor invested  $N$ .<sup>8</sup> Since this formula is in units of time it may be added across various process to yield an overall measure of roundaboutness. In this way Böhm-Bawerk hoped to have solved the problem of measuring roundaboutness.

It is highly probable ... that some fraction of a working day will have been expended centuries ago. But because of its minuteness it would be a magnitude which would influence the average so little, that it can almost always simply and safely be disregarded (Böhm-Bawerk 1959: 87).

And he seemed to place a high reliance on this formulation.

Wherever I have spoken in this or preceding chapters of a prolonging of the roundabout method of production, and of the degree of capitalist character, I would have it understood that I mean this in the sense just set forth [the average period of production]... [T]he measure must be the mean duration of the process, and that mean must be computed by averaging units, each of which represents a period of time... For want of a better term, I shall use 'average period of production' to distinguish it from the absolute production period (Böhm-Bawerk 1959: 87).

In this way Böhm-Bawerk's lengthy, intuitive discussion of the nature of capitalist production as an increasing reliance on produced means of production in specialized production processes, became associated with this rather specific and limited formula. Though, in actuality a small part of his work as a whole, and arguably an aberration in his breadth of vision, it became the focus for many prolonged and energetic debates in capital theory. In the process, the concept of Capital became further transformed to the point where, in the hands of J. B. Clark and Frank Knight, the time element was removed completely.

Böhm-Bawerk had attempted to incorporate Menger's vision of time in the production process using a quantifiable concept. Clark (1893) (and later Knight) attacked this concept as meaningless and indefensible and, in the process, suggested a view of capital in which time as we know it seemed to play no real part at all. The average period of production can only be calculated when the production process is describable in a very particular way. A favorite example in the literature is the case of wood production from a forest in which a fixed number of young trees is planted while the same number of trees is cut down each period. It should be clear that it is possible to say, that since production<sup>9</sup>

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<sup>8</sup>In the special case where there is an even flow on inputs so that the same amount of labor-time,  $l_0$ , is applied in each period,  $\sum_{t=1}^n (n-t)l_t = 1/2 n(n+1)l_0$  and  $\sum_{t=1}^n l_t = nl_0$ , and therefore  $T = n/2 + 1/2$  or simply  $n/2$

(when  $n$  is large enough so that the  $1/2$  can be ignored, or when  $T$  is expressed in continuous time where it is absent). So, when inputs occur at the same rate over time, each unit is 'locked up' on average for half the length of the production period.

<sup>9</sup>In this case, as in many others, 'production' consists in harnessing the processes of natural biological growth for economic purposes. These were the first and, in some ways are the most fundamental, capital processes. Consequently, much economic theorizing about capital proceeds from these first cases to argue by extension and, more often, by analogy to other, more complex cases.

and consumption go on steadily each period, they are in effect simultaneous.<sup>10</sup> Production and consumption are synchronized and occur together all the time (Clark 1893: 313, 1988 [1888]: 14-18; see also Hayek 1941: 114-45, 181, 195). In this case, it *is* possible to calculate the period of production. It is the time that it takes, on average, for a tree to grow from a seedling into a mature tree ready to be cut. If we assume that this time is the same for each tree, we have an even clearer measure. Clark's criticism can be understood to say that this time period is irrelevant since the forest is, after all, a permanent source of wood. Since production and consumption are in effect simultaneous, the relevant period of production is zero. This is the kind of vision one is offering in suggesting that capital should be thought of as a 'permanent' fund yielding a flow of income. A 'capitalist' economy is then one in which capital plays this role.

According to Knight (1936), the period of production, as applied to the economy as a whole, is always infinite or always zero, depending on the perspective one adopts. In the former case, there is no such thing as an origin to the period of production. The infrastructure of capital goods dates back to the origins of civilization. There must always have been production with the help of some capital goods and part of gross output was always used to maintain current capital goods and produce others. Output is a continuous flow that never ends. All social production is continuous. In the second case (where  $T = 0$ ), time intervals are seen as irrelevant. In other words, we can either think of the production process as stretching back from the beginnings of human history and forward into the unending future, or we can think of the production process as essentially timeless, since production occurs simultaneously with consumption. Thus, Clark and Knight argued that it is quite wrong to say that there are time intervals in production. Consumption and Investment take place *at the same time*, the two are concurrent, simultaneous. The whole thing is a misconception.

It is clear however that this view is valid only for an economy that has reached a state of stationary equilibrium - a situation in which the capital stock has been built up, is suitably maintained and yields a continuous income (net of maintenance cost). It is a world where unexpected change is absent and all production techniques are unambiguously known. This implies that all production plans are consistent with one another. In terms of the forest example the forest is already grown and yielding a steady output when our analysis begins. It tells us nothing about the decisions to grow the forest in the first place, when questions relating to the 'period of production' must have been important. Production and consumption only appear to be simultaneous to the observer who does not care about the production plans which gave rise to the production process in the first place. One plants seedlings today not in order to cut trees today but in order to cut trees some years from now. One cuts trees today only because one planted seedlings

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<sup>10</sup>In this example 'consumption' is equated with the harvesting of trees. Of course, in reality, trees are inputs for further production processes that result in consumption at a later date, for example the manufacture of pencils. The essential point, however, is that the woodlot example above provides a case of perfectly synchronized inputs and outputs that, in principle, could characterize other processes where inputs lead ultimately to consumption. Once such a process is completely established and becomes 'permanent,' an endless and unchanging succession of inputs and outputs results making it appear that production and consumption are indeed simultaneous. As explained in the text, however, this way of looking at the world is superficially valid only as long as there are no changes in the patterns of consumption and production. At any point of time, in any real capital-using economy, the capital structure that exists will be only partially adapted to the ever changing pattern of consumption.

some years ago. One cannot ignore the time element. Where the capital structure and the array of consumption goods is continually changing, production and consumption frequently do not even appear to be simultaneous. Even where we have a simultaneous and perfectly synchronized production process, considerations of the time structure and the decisions related to it must still enter. “The posited simultaneity of inputs and outputs literally leaves no time for an equilibrating process to take [or have taken] place” (Garrison 1985: 129).

Clark’s (and after him Knight’s) emphasis on the technical and logical aspects of ‘period of production’ concepts had the effect of making capital debates appear to be about abstract technical issues rather than about real economic issues. To concentrate on Böhm-Bawerk’s (and later Hayek’s) way of measuring production periods was to divert attention away from his (and Menger’s) vision of the capital structure as involving time in the *decisions made by producers*. It is these decisions that are the roots of the changes in the capital structure. The period of production that is relevant is that which is perceived by every producer-entrepreneur individually in the process of making a decision. Time enters into decisions through producers’ subjective evaluations of the constraints and possibilities. The period of production as an objective construct is inherently problematic, but this is irrelevant for understanding the importance of time, of the fact that different consumption goods are or were available at different times. The capital structure implies a time structure of production. Böhm-Bawerk, following Menger, understood this even though the Ricardian aspects of his work may have pointed in a different direction.

### **Quantity and Structure**

[T]he very idea of a ‘production function’ involves the astonishing analogy of the subject (the fabrication of things, about which it is appropriate to think in terms of ingenuity, discipline, and planning) with the modifier (a mathematical function) about which it is appropriate to think in terms of height, shape, and single valuedness’ (McCloskey 1985: 79).

One might say then, that there exist two broad, and exclusive, approaches to Capital. The first, tracing from Smith, but moreso from Menger, may be thought of as a *structural* (or compositive) approach. The second, tracing from Ricardo, having been incorporated into most modern economic approaches to Capital and economic growth (including the Neo-Ricardian and Neoclassical approaches), may be thought of as a *quantitative* approach. (This includes both Ricardian quantification and/or cost-of-production valuation.) Both approaches affirm that Capital is productive of value for the consumer, but

- the *quantitative* approach believes that it is possible and necessary to attach (unambiguously impute) this known and knowable value to the various items that make up the Capital stock and therefore to arrive at a meaningful aggregate measure of the that stock; while
- the *structural* approach believes not only that this is impossible, it also believes that the pretense that it *is* possible (that equilibrium is continuously maintained) has been responsible for both restricting economics from areas where it could make contributions, and inducing it (economics) to derive propositions that are of dubious value. The structuralists are a very small minority within economics, but there are signs that their number is growing – and they are working more and more in areas of inquiry once thought beyond the boundaries of economics.

The quantitative approach finds its most familiar and extreme expression in the work of the Neoclassical growth theorists beginning with Robert Solow (1956)<sup>11</sup> and continuing to the present. Growth theory makes use of the production function notion at the level of the economy. It is used primarily for the purpose of trying to account for the differences in measured economic growth (of final output values in real terms) across space and time.

The production function can be charitably understood as a metaphorical expression (McCloskey 1985) – an invitation to the discussion about what is conducive to economic progress and in what degree. As such its symbols can be expanded or contracted to imply almost any particular vision, for example, different constitutional systems (see Scully 1992) or rates of human capital accumulation and induced technical change (Romer 1990, 1994; see Barro 1998 for a fairly recent survey). As such it is subject to a variety of criticisms concerning the meaning and significance of the theoretical construction in the economy-wide production function and their correspondence to real-world entities.<sup>12</sup>

The production function is also the standard fare of the economics of the firm in microeconomics. Capital,  $K$  is seen as a homogeneous quantifiable input into the known production process of the firm. Neoclassical economic theory works with formal models of ‘representative firms,’ that is, firms that are, in all essential respects, identical. These essentials are captured by the elements of the production function. Though perhaps some important insights (concerning the pure logic of choice faced by firms as decision-makers) have been derived from this approach, it falls short in one very crucial respect. It is unable to explain why some firms do better than others, and indeed how it is that any kind of sustainable competitive advantage is ever possible. The production function is, to all intents and purposes, the firm. In fact, Neoclassical microeconomics has no real theory of the firm. It is really a theory of the industry and, as such, it is a theory that forswears any opportunity to explore or explain anything about the economics of real firms. The Neoclassical firm is a black box into which (Capital and Labor) resource-flows enter and out of which output-flows emerge in a basically inexplicable manner. If we really want to understand the workings of the firm, hypothetically, or in real world historical firms, we have to investigate the very processes ignored by Neoclassical economics, namely, the processes whereby resources get selected, combined, evaluated, organized, maintained, etc. as part of dynamic production processes. We cannot simply take for granted that these tasks just get done in the most economical way, and are, in any case, a matter for business or management studies and not for economics. In short, *any real attempt to understand the inner workings of the firm must take us away from the quantitative approach and bring us to the structural approach to Capital.*

Those most responsible for developing the structural view of Capital, namely, Joseph Schumpeter (1954), Friedrich Hayek (1941) and Ludwig Lachmann (1978 [1956]), were not fully aware of this implication and it is only very recently that their work has come to be seen to be relevant to the inquiry of the economics of the organization of production.

We have seen that whereas the classical (Ricardian) theory of capital had become concerned with explaining the determination of the rate of profit earned on an abstract

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<sup>11</sup> Early growth theory of a Keynesian (fixed production coefficients) variety goes back to works by Roy Harrod and Eversy Domar.

<sup>12</sup> For a critique see Lewin 1999, chapter 5.

category of resources (or a fund) known as Capital, the Mengerian approach suggested paying attention to the *structure* of capital. Hayek's sympathies lie clearly with the latter.

Our main concern will be to discuss in general terms what type of equipment it will be most profitable to create under various conditions, and how the equipment existing at any moment will be used, rather than explain the factors which determined the value of a given stock of production equipment and the income that will be derived from it. (1941: 3)<sup>13</sup>

Hayek's *compositive (structuralist)* sympathies are clearly stated:

The problems that are raised by any attempt to analyze the dynamics of production are mainly problems connected with the interrelationships between the different parts of the *elaborate structure of productive equipment* which man has built to serve his needs. But all the essential differences between these parts were obscured by the general endeavor to subsume them under one comprehensive definition of the stock of capital. The fact that this stock of capital is not an amorphous mass<sup>14</sup> but possesses a *definite structure*, that it is *organized* in a definite way, and that its *composition of essentially different items* is much more important than its aggregate 'quantity,' was systematically disregarded (ibid.: 6, italics added).

This vision is directly applicable to the economics of the firm and has a particular affinity to the modern Resource Based approach in the business strategy literature (Lewin and Phelan 2001).<sup>15</sup> The basic problem that a firm faces is the choice of which products to produce and which methods to use to produce them. The latter includes the way productive resources are to be organized and monitored. This choice problem resists becoming trivial (as with the Neoclassical logic of choice) insofar as the firm is envisaged as an experimental environment (see Lachmann 1978:) in which learning is idiosyncratic and continuous. In such an environment the value placed on resources, in

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<sup>13</sup> It is a problem for the reader that, having stated this general objective, Hayek then turns to a protracted examination of capital under equilibrium conditions reminiscent of the classical approach, and never really fulfills his originally stated objective. It has been suggested (by Hayek among others) that Lachmann did just that (see Lewin 1997b).

<sup>14</sup> In this approach it is clear that both Lachmann and Hayek benefit from Schumpeter's pronouncements. In his lectures on capital theory Lachmann states, 'Schumpeter has a succinct statement of the compositive school approach. Whenever we are talking about a given situation - meaning given tastes, resources and technology - resources must exist in a certain stock of inherited goods i.e. goods provided in the past. They are simply there, like land. These resources are limited in the way that they can be used. The stock of existing goods constitutes a constraint on human action going forward. The stock of capital is neither homogeneous, nor is it an amorphous heap. Its components complement one another. Some goods must be available for the operation of others. The nature of the composition of the stock is vital - it constitutes a given 'structure.' (Lachmann 1996: 126-27, see also 144). This is an allusion to the words of Schumpeter. In a section entitled 'The Structure of Physical Capital,' Schumpeter seems to anticipate much that is relevant to Lachmann's (and Hayek's) viewpoint.

The initial stock of goods is neither homogeneous nor an amorphous heap. Its various parts complement each other in a way that we readily understand as soon as we hear of buildings, equipment, raw materials, and consumers' goods. Some of these parts must be available before we can operate others; and various sequences or lags between economic actions impose themselves and further restrict our choices; and they do this in ways that differ greatly according to the composition of the stock we have to work with. We express this by saying that the stock of goods existing at any instant of time is a *structured quantity or a quantity that displays structural relations within itself*, that shape, in part, the subsequent course of the economic process (Schumpeter 1954, pp. 631-632, italics original).

<sup>15</sup> For a very recent work that draws a direct link between aspects of the Resource Based view and Lachmann's approach to capital see Mathews 2002.

the market, or within the firm reflects subjective individual opinions regarding what can be done and what can be sold.

All resources may be seen as a type of “capital.” Their prices are the capitalized values of their expected future earnings (rents). Value gets created by entrepreneurial decision-makers who form new *capital combinations* (Lachmann, 1978). From this perspective, the particular organizational-form in which the capital combination exists may be seen as a resource if it adds value to the productive process. That is, since organization matters for productive value it, and the routines it embodies, are resources. Resources in general may thus be seen as part of an intricate capital structure composed of heterogeneous capital items. It is in combination with other resources that any single resource is seen to have value. This is the essence of complementarity (synergy).

As Lachmann explains, the notion of a capital *structure* is a much more realistic way to think about capital inputs than the notion of capital *stock*.<sup>16</sup> The capital structure is characterized by (intentional and unintentional) capital complementarity and *multiple specificity*. Multiple specificity means that resources are characterized by degrees of specificity, that is, they have a wider or narrower range of alternative uses. A completely specific resource has no value in any alternative combination.

Like Schumpeter, Lachmann envisages production as a process driven by the entrepreneur who forms new and continually changing *capital combinations*. Within these combinations the individual capital items (resources) stand in complementary relationship to each other. They are *joint inputs* into the achievement of a production plan in the broadest sense. When the plan fails in part or in whole the entrepreneur has to adapt by making *substitutions*. Thus substitutability and complementarity are not so much attributes of capital resource inputs (as in neoclassical economics with its emphasis on equilibrium) as they are of states of the world. Complementarity is a feature of *stability*, substitution is a feature of *change*. Together they describe two aspects of the capital structure (broadly understood), its resilience and its flexibility.

When substitutions have to be made, the entrepreneur must change the capital combination in a manner constrained by the physical and institutional constraints. Some resources will have only one use and will be rendered useless by the change. Their value will fall to zero. These, as explained, are completely specific resources. Most resources will have more than one use (they are characterized by multiple specificity). The more adaptable a resource the greater its value in alternative uses. A resource that has to be sold for scrap in the face of change has limited uses, while a resource that can be used in a variety of alternatives (an opera house can be turned into a movie theater) is more resilient.

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<sup>16</sup> “In a homogeneous aggregate each unit is a perfect substitute for every other unit, as drops of water are in a lake. Once we abandon the notion of capital as homogeneous, we should therefore be prepared to find less substitutability and more complementarity. There now emerges at the opposite pole, a conception of capital as a *structure*, in which each capital good has a definite function and in which all such goods are complements. It goes without saying that these two concepts of capital, one as a homogeneous fund, each unit being a perfect substitute for every other unit, the other as a complex structure, in which each unit is a complement to every other unit, are to be regarded as *ideal types*, pure equilibrium concepts neither of which can be found in actual experience.” (Lachmann 1947: 1999).

## Firm differences and the economics of organization

Heterogeneity, and the complementarity and multiple specificity that it implies, are relevant only in conditions of disequilibrium. In equilibrium where no unexpected changes occur the capital structure will be perfectly sustainable requiring no changes. In this way, heterogeneity and change are intimately related. Only if *ex ante* values (as seen by someone in the market) turn out to be different from *ex post* values, will heterogeneity matter. If the values of all resources turn out as expected their heterogeneity would have no strategic significance. But in the absence of equilibrium, the heterogeneous nature of resources significantly reflects the fallible decisions of the past as well as the possibilities and constraints of the future. And that is why firms are different.

So, in a fundamental sense, it is the *heterogeneity of expectations*, that matters more than the heterogeneity of resources as such. Heterogeneous resources give rise to differing expectations of their worth as conceived in various possible capital combinations. Those expectations that turn out to be correct give rise to profits.

This vision is also clearly related to the huge literature on the question of the nature and boundaries of the firm originating from the seminal work of Ronald Coase (1937).<sup>17</sup> Coase's examination of the nature of the firm draws attention to the costs of doing business among which, as developed primarily by Williamson, are the costs of coping with opportunistic behavior. Opportunistic behavior, or the potential for opportunistic behavior, has become a key ingredient of this transaction-cost approach to the theory of the firm (Klein, *et. al.*, 1978, Williamson 1985, for example). In particular, and this is the connection with Capital, opportunities for opportunism arise from the fact that productive assets, once constructed, exhibit specificity. Asset owners can thus demand advantageous modifications of existing contracts under threat of withdrawing complementary assets from production and rendering the specific assets valueless. This possibility provides an incentive to unify ownership. That is, it provides a rationale for the firm as an ownership-unifying and opportunism-avoiding organizational device. On the other hand, however, it raises the question of the limits of ownership, suggesting that in avoiding the costs of doing business through the market, the firm must face the costs of internal organization, the costs of governance.

It has been pointed out that among the costs of doing business through the market, coping with opportunism is only one type of cost, indeed one not at all emphasized or thought important by Coase. And, some controversy as to the ability of the market to cope with opportunism exists in this literature (see for example Williamson and Winter 1991). From Coase's perspective, transactions costs are primarily the information costs of finding suitable resources at competitive prices and having to strike an independent deal for each phase or element of the production process. As some have pointed out, however, (Dahlman 1979, Langlois 1991) from a broad perspective all transactions costs are a type of information cost. A capital-theoretic approach to the transactions costs suggested by opportunistic behavior underscores this perspective.

While the presumption of the potential for opportunistic behavior (shirking, hold ups, etc.) may shed considerable light on the existence of the firm as a vertically integrated productive unit, or on productive organizational arrangements more generally, this can

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<sup>17</sup> Though, of course, neither Hayek nor Lachmann are much cited sources in this literature – Schumpeter, who is often cited, appears to be the common ancestor.

never have any ‘strategic’ implications in the absence of disequilibrium. In other words, opportunism matters for organizational structure only if there is a divergence of expectations. It is true that this literature places some emphasis on the existence of *asymmetric information*, that is, the possession of different information by different trading parties. But this asymmetry is strategically irrelevant unless it gives rise to a divergence of expectations between the parties.

For example, if both the buyer and the seller confidently expect the buyer to appropriate the enhanced value of a constructed specific resource by ‘holding up’ the seller after the asset has been constructed, and if both believe that a contract to prevent this is unenforceable or insufficient (incomplete), then either integration (unified ownership) will occur or the transaction will be abandoned or the opportunism will be tolerated, whichever is conceived by the parties to be more economical. The point is, there is no disagreement on which alternative is the most economical (efficient) and, therefore, no real strategic questions arise, only potential ones. If, however, there are *asymmetric expectations*, one of the parties will turn out to be wrong and the value of the resource will turn out to be different from that expected by at least one party. That difference is economic profit (I have elsewhere, in joint work, called it a ‘strategic rent,’ see Lewin and Phelan 2002). For example, the buyer may have a ‘vision’ (Penrose, 1995 [1959]) of the potential use of a particular resource that the seller does not share because he has less or different information, or, more significantly, because he *interprets the same information differently*. If the buyer turns out to be correct, he will have earned a profit, a strategic rent, the difference between the *ex ante* price paid for the resource (built by the seller), his cost, and the *ex post* value to him of the resource, as reflected by its contribution to his revenue. Of course, the buyer too may be (pleasantly) surprised if the *ex post* value of the resource turns out to be even higher than he expected, but this has no strategic implications since, there being no expectation of this enhanced value, it could not have been an influence on his strategic behavior.<sup>18</sup>

Furthermore, there is an important sense in which the existence or absence of potentially profitable opportunistic behavior cannot, *in itself*, be an explanation for the existence of the firm. An insight from the Resource Based view of the firm is surely that businesses have their origins in the resources of the entrepreneur-manager (innate or otherwise) and the resources that the entrepreneurial team controls, creates, can potentially acquire and finally combines. All profitable business ventures must trace back to some differential insight or some unexpected event. *There must first be the perception of a potentially appropriable profit before the question of organizational arrangement can be relevant*. And this perception must signal the ‘discovery’ of some undervalued resource or resource *combination that was hitherto unperceived*. Once a potential profit is perceived by at least one person, the question then arises as to which organizational arrangement is best suited to its appropriation or renders it vulnerable to appropriation by others.

## **Conclusion: Quantification, structures and the scope of economics**

We may summarize as follows:

- all production occurs in real time and its fruits have to be anticipated

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<sup>18</sup> The important work of G. B. Richardson (1972, 1990 [1960]) who drew important inspiration from Hayek should also be mentioned.

- the elapse of time before the arrival of final value-added necessitates that provision be made for productive activity in the interim, a subsistence fund
- the taking of time also provides for opportunities to improve the process of adding value
- the anticipation of a value-to-be-added necessitates that production be driven by a *plan* and implies that uncertainty is involved
- all capital value is about ‘future’ value; the future is pregnant with possibilities, many more possibilities than can be actualized
- the market process is about the *selection* of plans with more realistic futures
- plans entail organizational forms, production methods, resource types, ...
- this means that capital value is multifaceted, broad in scope, and not ‘objectifiable’ – something that should hardly be controversial in the wake of recent high profile accounting revelations
- Capital is about structures, collections of productive items and practices that are part of individual plans to create value; it is these plans that give these collections a structure

Mainstream Neoclassical economics being confined to forms of explanation and examination that involve actual or symbolic *quantification*, rather than the broad explanation and examination of structural *qualities*, is thus seriously handicapped in its ability to say anything about the institutions of production. One response to this has been to suggest that this, in any case, is not within the scope of economics and is a matter for sociology or management studies. It could be argued further, however, that by confining itself to explanation in terms of formal or empirical quantification, such methods of inquiry are prone to adopt what Hayek termed, ‘a pretense of knowledge.’ In other words, a critical attitude toward the stance of Neoclassical economics in this context might argue both that it indefensibly eschews the possibility of investigating and describing areas of legitimate inquiry, like the organizing of economic activity consequent upon the division of labor, and that even in the confined space to which it restricts itself, it produces propositions of dubious relevance and meaning.

We can see this by more carefully considering the relationship between quantities and structures. A structure of things can be described by a list of items that stand in a certain orientation to one another. Complex structures are composed of many items with many possible interactions. A structure as opposed to a list (which could be unmanageably detailed and of dubious meaning) is distinguished by the fact that one can infer properties about the whole list from a description or observation of just a few component (or typical) parts together with an articulation of the principles of interaction.

Quantities are formed by aggregating commensurable items. Structures can be aggregated (quantified) if the elements of the structure and can be counted (valued) and if their orientation is constant, or, in other words, if substantial redundancy exists in the structure, so that similar principles of interaction are present in many different parts of the structure and these remain constant. Sometimes certain types of interaction are considered irrelevant and are ignored, while the focus is turned to interactions at other levels. If the latter are fixed while the former are irrelevant, aggregation may be facilitated. For example, if differences between firms (their internal structures as described by the interactions of their component parts) are considered to be irrelevant, while the interactions between firms is considered to be describable (hence quantifiable), as in the case of perfect competition or monopoly for example, then aggregating firms (or their estimated values) may provide a meaningful conceptual result. However, if such interaction is not describable, when neoclassical perfect-competition or monopoly is not a defensible or helpful description, and, by implication, the neglect of intra-firm interactions is not defensible, the result will have dubious meaning and relevance.

On the other hand, by recognizing the importance of structure as a phenomenon to be investigated in and of itself, economists could indeed broaden and enhance the value of their investigations. A rich and growing literature on economic organization illustrates the unlimited insights to be mined. A recent example considers the question of interactions at various levels within structures. If interaction patterns are such that they occur more at some levels than at others, we may make use of the phenomenon known as *modularity* to gain a better understanding of the structure – its behavior and development (see Garud, Kumaraswamy and Langlois, 2003 for a general treatment). Modularity is a ubiquitous property of many types of structures like electronic systems, biological systems, social systems (like firm hierarchies) and, presumably, more traditional capital structures. But whereas mainstream economic investigators limit themselves to ‘data’ that are amenable to ‘rigorous’ statistical manipulation, the structural approach provides opportunities for empirical investigation in the form of ‘business history’ broadly conceived, substituting an ‘evolutionary’ orientation for an equilibrium one. It remains to be seen which path most economists of the future will take.

## Appendix: From Smith to Böhm-Bawerk to Solow.

1. Starting with Adam Smith we formalize his corn model in a rather simple way (Hicks 1965: 36-42, Lachmann 1996: 130-42). There is a crucial relationship between this year's harvest and next year's harvest. This year's output  $Y_t$  - our capital stock for this year - is divided up into seed corn, fodder and food production. In the simplest formulation, the whole of the corn that the laborer uses for his (and his animal's) consumption plus his planting may as well be counted as his 'wage.' The capital stock then comprises a 'wage fund' necessary to keep society going until the arrival of the next harvest. Then, if  $N$  is the number of laborers, the (average) wage rate

$$(1) w = Y_t/N$$

or:

$$(2) Y_t = Nw ; w = \text{real wages per worker.}$$

Growth in the corn economy will thus depend on the number of workers  $N$  and on productivity  $p$ , the amount of corn produced (on average) by each worker.

$$(3) Y_{t+1} = pN = pY_t/w \text{ or } Y_{t+1}/Y_t = p/w.$$

Thus the rate of growth is equal to

$$(4) g = p/w - 1.$$

This growth rate varies inversely with the wage rate and directly with average productivity. If  $p$  rises faster than population, the wage rate can rise.

This model neglects to account for all sections of the economy, for example, the towns and the land owners. If we assume that  $k < 1$  of any year's output is set aside each year to feed the non-agrarian classes, then the wage rate must be

$$(1') w = kY_t/N.$$

The capital stock is now not  $Y_t$  but rather

$$(2') kY_t = K_t = Nw.$$

So

$$(3') Y_{t+1} = (p/w)K_t = k(p/w)Y_t, \text{ or } Y_{t+1}/Y_t = k(p/w).$$

and the rate of growth is

$$(4') g = k(p/w) - 1.$$

Obviously, as formulated,  $k$  is a measure of the ‘drag’ on economic growth imposed by the ‘non productive’ elements of society. This conclusion is a result of formulating output as consisting solely of corn and gives rise to some obvious objections. This aspect of Smith’s model is of less concern to us though at this point than some others.

Smith did not think of  $p$ ,  $w$ , and  $k$  as constants. Economic growth means that the wage fund grows ahead of population. Smith believed that  $p$  would increase over time as result of the division of labor, thus causing a rise in  $w$ . Thus  $p$  and  $w$  would grow together, though not necessarily at the same rate. Economic growth and capital accumulation in turn made the division of labor possible.

2. Modern reformulations of Böhm-Bawerk, focusing on his average period of production, have shown how a connection can be made between his ‘model’ and a classical and Neoclassical approach (Dorfman 1959, see also Lachmann 1996:135-40). If a measure exists for the capital stock and the rate of flow of output, then the average period of production can be measured as

$$(5) T = K/f$$

where  $K$  is the capital stock and  $f$  is the output emerging from the production process in each period. (Alternatively, if the average period of production,  $T$ , is known or can be computed by reducing all inputs to labor-time, the value of the capital stock,  $K$ , can be calculated as we shall see below). Dorfman uses the example of a reservoir in a stationary situation, where the inflow = the outflow, implying a constant water level. Clearly the quantity of water can be expressed in terms of time. For example with 100 million gallons of water, two million per day flowing in and out, this would imply that the average drop of water was in the reservoir for five days. The ratio of stock to outflow is five, which is the period of retention of each drop. The same basic logic can then be applied to the capital stock.

Now, in terms of the labor theory of value  $f$  will be equal to the value of the labor expended to produce it. Using the same notation introduced for Smith’s corn model above, we have  $f = Nw$ , and the average period of production  $T = K/Nw$  or:

$$(6) K/N = Tw$$

According to Lutz, interpreting Böhm-Bawerk, “An increase in capital per worker in the process of production [is] identical with the adoption of a longer, more roundabout method” (Lutz 1967: 9). So, in modern terminology, the capital-labor ratio is very simply related to the average period of production and the wage rate.

In a *Neoclassical* framework, where capital and labor can be continuously substituted for one another, changes in  $r$  (the rate of return on capital) and  $T$  must be in opposite directions for any level of output.  $K$  is a direct function of  $T$  ( $T$  is a proxy for  $K$ ) and  $r$  diminishes with  $K$ . So

$$(7) K/N = \phi(w/r)$$

with the first derivative positive. Implicit in this approach is a ‘production function’ where output  $Q$  is a function of the average period of production  $T$ , with diminishing returns,

$$(8) Q = \varphi(T)$$

(see Hayek 1941: 140-1, 189, 208). So Böhm-Bawerk can be seen as part of the Neoclassical tradition leading directly to modern growth theory (see also Hennings 1997: 144-148).

Alternatively in a *classical* world, with a given capital stock and a given number of workers, if the wage rate rises the average period of production will fall. If  $w$  falls it becomes possible to extend the period of production. Given the subsistence fund  $K$  and given the technique of production, the shorter the period, the less productive it is. As long as  $K$  and  $N$  increase proportionately nothing will change.  $T$  and  $w$  will not be affected. But if  $K$ , for example, increases relatively to  $N$ ,  $T$  or  $w$ , or both will rise. Thus capital accumulation puts upward pressure on the level of wages and the average period of production. In this way, Böhm-Bawerk can be seen to have added a new dimension, a time dimension, to Ricardo’s theory of distribution. If  $T$  is taken to be constant (as with Smith and Ricardo), a datum of the constant technique of production, then the classical conclusion of an inverse variation between the wage and profit rates and the earnings of labor and capital follows. If wages are fixed at the subsistence level, then Ricardo’s conclusions follow.

3. In discussing his average period of production Böhm-Bawerk speaks of mean duration. His construction of the average period of production was the subject of much trenchant criticism (see Lewin 1999), and perhaps served to divert attention away from his more enduring contributions. However, there is no doubt that it contains some kernel of truth. Trying to construct a measure of magnitude for capital projects, based on the length of time that they take, raises important issues regarding the ambiguity of the results from such an exercise. Yet clearly, in actual real world decisions, the time prospectively involved in a project is a matter of concern for potential investors. It is not surprising therefore to find in the modern financial literature yet another attempt to capture in an unambiguous way the ‘length’ of the investment involved. It is not in terms of labor, or input-time, but, rather, in terms of value. The construct is known as duration and it measures roughly the ‘average time for which a dollar is tied up in the project.’ The formula  $D$  is as follows:

$$D = \frac{\sum_{t=1}^n [FV_t / (1+r)^t](t)}{\sum_{t=1}^n FV_t / (1+r)^t} = \frac{\sum_{t=1}^n [FV_t / (1+r)^t](t)}{\sum_{t=1}^n [FV_t / (1+r)^t]} / PV$$

where  $PV$  is the present value of the project, calculated by discounting the expected future values  $FV_i$  ( $i = 1 \dots n$ ) by the discount rate  $r$ . It bears a resemblance to Böhm-Bawerk’s average period of production, but without the standard objections. So,  $D$  is a weighted average of ‘value to be received,’ where the weights are the distance in time from the present. It is the time on average for which one has to wait for a dollars worth of future value.

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