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### **Hayek's *The Pure Theory of Capital***

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#### **Introduction**

In 1941, *The Pure Theory of Capital* was too late - and too obscure - to catch the attention of an economics profession that was fixated upon John Maynard Keynes. Although capital is central to issues of market coordination, capital theory held no broad interest, even prior to the developing era of Keynesian economics:

[i]n the Cambridge tradition that governed Keynes's brief study of economics, the Mill-Jevons theory of capital, later developed by Boehm-Bawerk and Wicksell was not seriously considered. By about 1930, these ideas had been largely forgotten in the English-speaking world (Hayek, 1983, p. 48).

By Hayek's own description, *The Pure Theory of Capital* is a 'highly abstract study of a problem of pure economic theory' that attempts to establish the 'fundamentals' that must serve 'more concrete work on the processes which we observe in the real world' (Hayek, 1941: v). In particular, Hayek wished to remedy earlier expositions of a monetary theory of business cycles (Hayek, 1933; 1935; 1939) and to respond to criticisms that arose primarily from 'the inadequacy of its presentation of the theory of capital which it presupposed' (Shackle, 1981: p. 242).

The protracted and interwoven development of Hayek's capital theory and business cycle theory was set against the background of an intense rivalry between Hayek and Keynes in the 1930s. Hayek had seen that 'an elaboration of the still inadequately developed theory of capital was a prerequisite for a thorough disposal of Keynes' argument' (Hayek, 1983, p. 46); and, in retrospect, he considered it an error of judgement that he had given no time to an immediate and studious critique of Keynes's *General Theory*. So, in addition to serving Hayek's own exposition of a monetary theory of business cycles, *The Pure Theory of Capital* serves to expose the fallacy of the central tenet of Keynes's *General Theory* - one that sits firmly in the mainstream of modern economics - for a 'direct dependence of investment on final demand' (Hayek, 1983, p. 48). Yet, Hayek's *exposé* remains generally ignored, with the effect that Keynesian demand management (macroeconomics) together with marginal analysis (microeconomics) remain the dominant instruments of economic analysis. The issues could scarcely be more important. To understand *The Pure Theory of Capital* is to question the relevance of mainstream economics.

## Anglo-American and Austrian economics

Referenced by Hayek as the ‘Anglo-American approach’, the marginal analysis of modern microeconomics presents a theory of production such that, with given technology (a ‘production function’ that relates output to the input of capital and labour), factor productivities, hiring costs and the level of activity, there exists an optimum combination of capital and labour. Whenever the relative cost of hiring capital and labour changes, a simple substitution takes place until the new optimal combination for production is reached; that is, where the ratio of the marginal product of capital to its hiring cost is equal to the ratio of the marginal product of labour to its hiring cost. These are the familiar textbook details of neoclassical optimality, that derive from the implausible assumptions that inputs of capital and labour are unambiguously quantifiable, independently priced and readily substitutable. Although neoclassical theory sees capital as machinery, the time required to build machines is not discussed. Instead, there is either short-run analysis (where capital is immutably fixed) or long-run analysis, where the combination of capital and labour and the level of output are already optimally adjusted to the relative hiring costs and to the technical parameters of the production function.

The crucial over-sight is that capital plant (durable capital) is a produced means of production; that is, machines are themselves produced by labour, usually working with other machines. The implication is that, when the cost of hiring labour increases so, too, does the cost of producing machines; and the neoclassical notion of a simple economically efficient substitution between capital and labour is no longer obvious. The oversight is a corollary of abstracting from the requirement ‘for time to elapse between effort and result in production’ (Shackle, 1981, p. 253); from the practical issue that some production methods require more time than others; and from the idea that capital is destroyed in the process of producing goods and services.

The use of labour to produce items of capital that are then employed, together with labour, to produce consumption goods is described (in the Austrian approach to economics) as an indirect, or ‘roundabout’, method of production. Working capital is also required. To illustrate: in the manufacture of bread, wheat and yeast are separately cultured (using chemical nutrients and water) to reproduce themselves; the wheat is milled to produce flour; yeast and water are added, the mix is kneaded, allowed to prove and then baked to produce bread. This process involves durable capital (tractor, plough, grindstone and oven) and working capital (the ‘intermediate products’ of seed, yeast, nutrients, and a ‘wage fund’ from which to remunerate labourers in the period before their contribution to the production of bread can be sold at market). Such considerations are lost to neoclassical economics, where labour is set alongside durable capital to the exclusion of working capital and the consideration of time.

The more revealing Austrian approach to production has its origins in the work of David Ricardo. In the early nineteenth century, Ricardo had shown that the labour theory of value - according to which relative product prices are determined by the amounts of labour required to produce each product - could not be true when capital is used. The nub of his explanation is that, if machine-X were capable of producing the same output as that produced by (say) 100 labour-years, machine-X must embody (that is, can be produced by) fewer than 100 labour-years of work. Otherwise, there would have been no point in building that machine. It follows that a rise in the cost of hiring labour must increase the cost of 100 labour-years by more than it increases the cost of machine-X. So, a rise in the cost of labour *would* trigger the substitution of machines for labour, but not in the simplistic manner of the neoclassical approach. In the development of this idea, William Stanley Jevons is credited with the first explicit introduction of time into the theory of production (see Hayek, 1941, p. 113), following upon which Austrian capital theory

emerged in the work of Eugen von Böhm-Bawerk, Knut Wicksell (honorary Austrian!) Ludwig von Mises and Friedrich Hayek.

Roundaboutness comes both in the time taken to produce capital, and in the productive life of capital. Although Jevons focused upon continuous inputs, other possibilities present themselves given that resources may be committed as investments over varying periods of time. Similarly, corresponding returns may also be obtained over varying periods of times. At one extreme, a product may require inputs over an extended time-scale to give virtually instantaneous consumption (continuous input/point output); for example, a firework display. At the other extreme, a product that is produced virtually instantaneously may give service over many years (point input/continuous output); for example, a walking stick that is cut from a tree. Most cases are hybrids in varying degree (continuous input/continuous output). Whatever the profile, the expenditures necessary to purchase inputs are most commonly incurred in advance of the revenues received from the sale of outputs. This is the perspective of the Austrian theory of capital.

In the Austrian approach, capital is presented as ‘equivalent to a “fund” out of which incomes, and particularly wages’ (Hayek, 1941, p. 325) are paid. For example, Robinson Crusoe might set aside fish (thereby saving from current production to accumulate a wage fund) to sustain himself during the period necessary to build a boat (durable capital). A successful investment would see all of his circulating capital - the fund of fish and, *via* Crusoe’s effort, their transformation into felled trees and vine and, still further, into a boat - finally ‘turned over’ as fish are finally caught by this roundabout method. In combining his direct with his indirect labour efforts, Crusoe’s investment increases his capacity to catch fish.

Now, even by the simple illustrations of baking bread and catching fish, relationships are shown to be sufficiently ‘complex’ to render it ‘seriously misleading’ to ‘treat one part of capital as being permanent, and the other part as involving no waiting whatever’ (Hayek, 1941, p. 330). Indeed, while capital stock (tractor, plough and Crusoe’s boat) may have the appearance of permanence, even the most durable item of capital will depreciate in use, through natural deterioration and with obsolescence. In stressing this impermanence, Hayek places the greater emphasis upon circulating (rather than durable) capital. Circulating capital

possesses the characteristics of capital in a higher degree than fixed capital, and ... those theories which tend to stress the importance of goods in process rather than of durable goods have contributed more to the understanding of the important problems in this field (Hayek, 1941, p. 330).

The reasons are: that inputs are necessary to produce outputs; that inputs are used up (however slowly) in their contribution to production; and that time is required both to apply inputs and to obtain outputs. At some stage, all elements of capital (tractor, plough, Crusoe’s boat, wheat grindstone, yeast, water, oven and the wage fund) become transformed into final consumption goods (bread and fish). At the end of its period of circulation - as final consumption goods are eventually sold at market - capital is ‘turned over’ and released in ‘free form’ (as income) and becomes available either for re-investment or for commitment elsewhere. Changes in the deployment of capital stock are achieved through this release of capital in free form as income together with the application of new saving from income.

Changes in the deployment of capital over time ‘mainly depend on the foresight of the entrepreneur capitalist’ whose main function is ‘to attempt to maintain his capital so that it will yield the greatest possible return’ (Hayek, 1941, p. 332). Entrepreneurs with the greatest perception gain at the expense of others but, in the uncertain world, new capital may be financed

as much from unanticipated windfall capital gains as from income generated by normal business success. With poor entrepreneurship and business losses, investments are unlikely to be repeated in those areas where yields were low. Contrariwise, the gains to successful entrepreneurship release funds for further investments in areas of high yield,

which means not only that new capital is formed in place of that lost elsewhere, but that it is formed exactly where it is most needed, and placed in the hands of those most qualified to use it (Hayek, 1941, p. 333).

Capital is heterogeneous, existing in many different forms and the incentives to invest are equally diverse; but, since every investment has some impact upon the market valuation of output across *all* stages of production, investments are necessarily inter-dependent.

Investment delivers consumption goods across a wide range of near and distant future periods. For example, current investments might be directed to provide a new ferry for next year and a bridge five years hence, when the ferry may (or may not) be rendered obsolete. Against a limitless range of possibilities, the most important consideration concerns the compatibility of components within a capitalistic structure of production as it is developed continuously in the face of changing incentives and new opportunities. Hayek points to the narrower confines for a coherent configuration of capital goods than for consumption goods. Whereas price adjustments make it relatively easy to sell any consumption good that is brought to market, in regard to capital goods

there are definite proportionalities between the different parts of the capitalistic structure of production, which must be preserved if those parts are not to become completely useless (Hayek, 1941, p. 25).

For example, however much the price of a railway locomotive is reduced, an absence of rail track leaves that investment with a very low yield. Only in a static world might it be possible to link a given stock of capital uniquely to a given constant stream of income. If a unit of input were relocated from a shorter to a longer period of investment, this would raise the stream of output forthcoming at a later date and reduce the stream of output at an earlier date. The value of those two output streams would be correspondingly affected; and so, too, would the respective yields on the shorter (less roundabout) and the longer (more roundabout) investments. This is a general feature and the context for two related and important issues. How is the productivity of capital explained; and how might the aggregate stock of capital be quantified?

### **How capital is productive**

Capital is used because roundabout methods raise production above the capacity of direct labour methods. So, where lies the source by which machine-X has a greater productive capacity than the 100 labour-years that it takes to build:

why should the more time-consuming methods of production yield a greater return? Ever since the time when it was first put forward, this proposition has been the source of endless confusion (Hayek, 1941, p. 60).

(It still is!) The advantages that might be gained from a roundabout method of production are often confused with those that can arise from the division of labour or from technical progress. Technical progress is separate and distinct from the application of a roundabout method. The yield from a roundabout method *per se* is not derived from superior technology. Indeed, the choice of a method of production might be taken in the context of a given state of knowledge.

The introduction of capital *lengthens* the period of production. While greater efficiency might derive from the division of labour - the performance of a given set of operations by a larger number of men - this would *shorten* the period of production. Even so (and this may explain the confusion), the division of labour might accompany the introduction of a more roundabout production process, since 'it becomes possible to use certain capacities, materials and tools which could not have been used if all the labour had to be applied in the way that would give the final result by the shortest possible route' (Hayek, 1941, p. 71). Here a distinction is drawn between the vertical division of labour (through a series of *successive* processes) and the horizontal division of labour (which involves the *simultaneous* application of different skills). Only the former would necessitate an extension to the period of production and, thereby, contribute to the yield attributable to capital *per se*.

In principle, a new technique or a more effective division of labour should be discounted as explanations of a positive yield from the use of a roundabout method; each of these would as readily apply to a direct labour method. In practical terms, however, capital might be essential to facilitate those gains (in which case the contribution of capital would be inseparable from that of technology or skill specialisation).

Beyond the role of capital as a vehicle for new techniques or in allowing a greater division of labour and skill specialisation, Hayek points to 'one general fact' to explain the productivity gain from roundabout methods; namely, that

there will almost always exist potential but unused resources which could be made to yield a useful return, but only after some time; and that the exploitation of such resources will usually require that either resources, which could yield a return immediately or in the near future, have to be used in order to make these other resources yield any return at all. This simple fact fully suffices to explain why there will always be possibilities of increasing the output obtained from the available resources by investing some of them for longer periods (Hayek, 1941, p. 60).

So, for Hayek, the greater productive capacity of machine-X derives from the latent resources (whose use would otherwise be non-viable) that are drawn into the production process. Capital investment *creates* economic resources out of non-economic 'resources'; and, from the released potential of the latter, further opportunities to enhance productive capacity may arise:

[t]here are always an infinite number of natural forces which are capable of being turned to some human use, and which are in this sense potential or latent resources ... the reason why resources which are capable of being turned to some useful purpose are not actually so used is that they would have to be combined with other resources which are more urgently needed elsewhere (Hayek, 1941, p. 60-1)

The absence of illustrative examples in a *Pure Theory* might have been expected. Waterpower is introduced here to serve that purpose. Even as a farming community chooses to set aside foodstuffs (as a wage fund) to support the construction of its first waterwheel and mill house, time must elapse before development raises riverbank sites to the status of economic resources. Once they are fully occupied, any further increase in demand would allow riverbank sites to command an economic rent.

In the earliest stage, the illustration shows how 'investments' constitute 'only the services of those resources which might also have given an immediate return' (Hayek, 1941, p. 63); that is, final consumption goods in the form of foodstuffs. Then, during the period of construction of

the waterwheel and mill house, the output of final consumption goods must fall as direct labour is diverted to work elsewhere; but, eventually, waterpower not only delivers an enhanced capacity to produce final consumption goods, it may also present further opportunities to draw other previously uneconomic resources into the productive process; and so,

as investment proceeds more and more of those natural resources which were only potential resources are utilised and gradually drawn into the circle of scarce goods, and have in their turn to be counted as investments (Hayek, 1941, p. 64).

More generally, the use of roundabout processes might also release the potential of latent techniques, latent specialization of labour and latent raw materials.

### **The stock of capital**

In physical terms, the overall capitalistic structure of production undergoes continuous change as entrepreneurs set their investments according to their expectations and anticipations of yield from different choices regarding future production/income. Since those decisions constantly redefine the values of the components that comprise the aggregate stock of capital, this brings into question the (neoclassical) notion of a measurable *quantum* of capital.

A roundabout method is defined by the requirement for time to produce plant and machinery, together with the time of its productive life. A simple *average* period of production (suggested by Böhm-Bawerk) is possible when inputs and outputs flow at a constant rate. The application of compound interest (suggested by Wicksell) brings some refinement to the concept. However, the measurement difficulties are intractable, and it remained for Hayek to show that the quest for an unambiguous *quantum* was futile:

there is no way in which the variety of technical periods during which we wait, either for the products of different kinds of input or for particular units of the product, can be combined into an aggregate or average which can be regarded as a technical datum. No matter what procedure we were to adopt, the same technical combination of different inputs would, under different conditions, appear to correspond to different aggregate or average periods, and from among the different combinations sometimes another would appear to be the “longer” (Hayek, 1941, p. 145).

Hayek’s elucidations show that the ‘supply of capital’ can be described only in ‘terms of the totality of all the alternative income streams between which the existence of a certain stock of non-permanent resources (together with the expected flow of input) enables us to choose’ (Hayek, 1941, p. 147). Together with various combinations of other resources, each constituent part of the stock of capital may be used in many different ways; but the sacrifice made in order to achieve any particular income stream can be stated only in terms of the potential income streams that might otherwise have been achieved.

As the output stream at an earlier date falls when resources are re-allocated to a longer term project, ‘the value of the marginal products of units of input invested for that earlier date increases, with the result that it becomes profitable to invest more for that date’ (Hayek, 1941, pp. 190-1). However, this is as far as it is possible to take the notion of a marginal productivity of capital, because capital is only periodically available in a free form, to be applied readily in an endless variety of different uses. Entrepreneurs optimise their aggregate yield by equating yields at the margin; but the valuation of their capital (and, hence, the *quantum* of capital; or, in Hayek’s original terminology, the ‘aggregate figure of the amount of waiting’) is an *outcome* of their deliberation, rather than a datum against which to make their decision:

[i]n order to arrive at an aggregate figure of the amount of waiting involved in each process we have to assign different weights to the different units of input, and these weights must necessarily be expressed in terms of value. But the relative values of the different kinds of input will inevitably depend on the rate of interest, so that such an aggregate cannot be regarded as something that is independent of, or as a datum determining the rate of interest (Hayek, 1941, p. 143).

However, those comments were unheeded by the participants in a long needless dispute that extended beyond a decade into the early 1970s.

### **The capital theory controversy**

Capital was central from the earliest stages in the development of ‘classical economics’; to the analysis of the distribution, accumulation and growth processes of a capitalist economy. The respective shares of wages and profits were regarded as the outcome of historical social class relationships. This contrasts sharply with neoclassical economics, where the application of marginal analysis to factor markets drives the conclusion that, as more of a factor is hired, its marginal productivity falls as its marginal hire cost rises. If the former exceeds the latter, factors are hired; and if the latter exceeds the former, factors are fired. Hence the neoclassical conclusion: the real value of the hire cost of a factor tends to reflect the marginal productive contribution of the last factor hired/fired.

In pointing to the result that the aggregate amount of heterogeneous capital is quantifiable only by the discounted present *value* of its prospective future product, Joan Robinson initiated the capital theory controversy (see Robinson, 1953). Equilibrium within the neoclassical paradigm requires the marginal product of capital to be known; which requires the *quantum* of capital to be known; which requires the remuneration of capital to be known; which requires the marginal product of capital to be known. In short: the *quantum* of capital employed is decided by its marginal productivity; but its marginal productivity is decided by the *quantum* of capital employed. This was not new. Frank Knight had indicated the problem in 1936 -

[d]ifficulty and complexity arise because the relation between capital and interest take different forms and especially because of the danger of circular reasoning. On the one hand, capital is usually and properly defined as ‘income’ capitalized at some ‘rate of return’. But the interest rate is usually thought of as the ratio between the net annual yield and a quantity of capital. On the face of this is a vicious circle; interest cannot be a rate of return; i.e. a ratio to a principal, unless the terms of the ratio are definable independently of the rate return itself; yet in the same units of both numerator and denominator (Knight, 1936, pp. 434-5).

- and, thereafter, the feature had been incorporated (as indicated by the citation above) into Hayek’s subsequent work. Yet, Knight and Hayek feature neither in the debates nor in the definitive summary (see Harcourt, 1972) of the futile and protracted Cambridge controversies in the theory of capital.

The attack (from Cambridge, England) upon the ‘profound truths’ of the neoclassical ‘parables’ (see Harcourt, 1972: p. 122) was an attack upon an easy but inappropriate opponent, whose own defence (from Cambridge, Massachusetts) was predicted upon the simplistic timeless notion of constrained optimisation. The respective paradigms have little common ground. Indeed, the neoclassical concept of a factor’s marginal product is irretrievably lost, once production is acknowledged to be a series of outputs following upon a series of inputs. Within the Austrian framework, many of the issues raised in the controversies have little relevance;

these include the distribution of income between homogeneous factors of production and the quantification of capital. Many other issues, relating to the admission of capital as a factor of production, to the ideological stances taken in respect of capitalism, to the incentives for capital accumulation, to the array of choice requiring investment decisions and to the causes and consequences of economic growth, were already adequately addressed within the Austrian framework.

### **Hayek's river analogy**

Whereas *The Pure Theory of Capital* is short on illustration, Hayek later employed a river analogy to deliver a revealing insight into the complex time-lapse relationships that may exist between investments and the output of final consumption goods (Hayek, 1983). Tributaries flowing into the upper reaches of a river deliver ever-changing volumes of water. These are analogous to flows of new and replacement investment that are determined by relative factor prices, technological change and the interest rate. Analogous to a constant rainfall (but changing dispersion) within the catchment of the river and its tributaries, are variations in the allocation of investment funds to diverse projects of different life duration. In the broadest perspective, the river represents the structure of capitalistic production that (given the dispersion of rainfall) delivers varying volumes of water (supply of final goods) quite independently of the level of the tide (demand for final goods) in the estuary. Of course, though independently determined, spontaneous adjustments to prices and supply volumes are expected where supply and demand are not in equilibrium.

Hayek's most important claim is his denial of a direct causal relationship between sales of consumption goods and changes in the upper reaches of the stream of capitalistic production; and between sales of consumption goods and the level of employment. So, Hayek rejects the Keynesian argument that the path to full employment might begin with general measures to boost consumers' expenditure; that a modest increase in consumption goods' prices would encourage new investments and employment. Both theoretically and empirically, there is no single correspondence between sales of final goods and changes in the upper reaches. Indeed, Hayek believed it to be more generally the case that a revival of final demand in a slump was 'an effect rather than a cause of a revival in the upper reaches of the stream of production' (Hayek, 1983, p. 46). That initial impetus is most likely to emerge through spontaneous entrepreneurship - alertness to opportunities and anticipation of change - in the widest sense:

if entrepreneurs ... never altered their plans until after a change in final demand (or any other change) had actually occurred ... the adaptation of production to change would be so expensive as to make it in many cases impossible ... because the capital available for investment in new forms would be so scarce (Hayek, 1941, p. 330).

### **Capital investment, monetary disequilibrium and the business cycle**

Inter-temporal preferences determine the pace of capital investment and the extent of capital accumulation. Only by sacrificing the production of final consumption goods are resources diverted (as saving) to investment projects. The vital need for any community to maintain minimum levels of sustenance determines: (1) the maximum rate of input into a wage fund (that is, saving in order to provide the resources to undertake investment) and, by implication, (2) the lowest value to which positive time preference (that is, the discount rate) might fall; and (3) the maximum rate of economic growth (that is, the increase in productive capacity through capital accumulation). All are inextricably tied. Where consumers' choices set the discount rate above the minimum vital level, saving is below the maximum attainable level and capital accumulates at less than the maximum rate. Choice determines the rate of capital accumulation: if more jam is



consumed today, less jam can be produced tomorrow. Yet, capital's inherent productivity can influence that choice: the more enticing is the jam promised for to-morrow, the greater the amount of to-day's consumption that is likely to be postponed.

The decision to lengthen the process of roundabout methods of production makes it possible to obtain a *greater* volume of final goods from a given outlay; but these goods reach the market at a *later* date than the *lesser* volume of goods from a shorter process. Whether it is more profitable to maintain or to alter the structure of production depends upon the balance between the prices received for final output at different dates and the cost of providing capital. In a setting of diverse capital stock of different life duration, the situation is complex in that a redirection of investments may lead different outcomes at different dates in terms of stock of capital and the level of output.

The ultimate yield of any particular investment is determined by many factors including a multitude of unrelated decisions taken by many individuals. In general, the success of any particular investment depends upon how well each production plan fits within a structure to which every plan contributes. Machines are potentially commercially viable when their productive capacity is greater than that of the labour needed to build them. In using capital, time is required both to build and to realise the potential of machines; so, their commercial viability rests upon the time discount factor. When roundabout methods are used, resources are committed (in early stages of production) some time before final consumption goods (from late stages of production) are ready for market. This implies that 'backing' (someone's saving) is needed for the enterprise. The alternative source of finance - bank credit - gives the lineage to Hayek's monetary theory of the business cycle.

Financial markets allow potential creditors (that is, savers who supply 'loanable funds') and debtors (that is, investors, who demand 'loanable funds') to trade to mutual advantage. The *natural* rate of interest is the price that equalises the demand for loans with the supply of credit. Whereas saving (that is, the non-consumption of current production) allows the *transfer* of purchasing power from income recipients to potential investors, the provision of bank credit involves no tangible resource transfer. Rather, bank credit *creates* purchasing power with no resource backing.

Although the *natural* rate of interest rises with any increased demand for loanable funds, an expansion of bank credit would hold the *market* rate below the level of the *natural* rate. As the amount of bank credit varies (both rising and falling) the *market* rate of interest diverges (both negatively and positively) from the *natural* rate of interest. So, if bankers apply set commercial criteria for extending credit, any bunching of investment opportunities (arising, say, from advances in technology or product development) could lead to a bunching of bank credit. In that circumstance, it would be likely for the market rate of interest to be forced below the natural rate. When the process of bank credit creation is terminated - as commercial banks hit the constraint of their finite reserve assets, or as the central bank restricts the supply of reserve assets in order to maintain their value and (hence) acceptability of high-powered money - the market rate of interest would be forced above the natural rate.

Variations in the process of bank credit creation disturb the *natural* state of equilibrium in the market for loanable funds. The application of capital theory in a context of monetary disequilibria is the key element in Hayek's business cycle theory, which views production as an inter-temporal sequence of stages: investment goods are produced at stages that are chronologically early in relation to the eventual emergence of consumption goods. Whenever there is an increased willingness to save, the *natural* rate of interest falls so raising the incentive to invest in early stages of production. New saving provides resources to create capitalistic

(roundabout) methods of production and to deliver sustainable economic growth (that is, permanently higher levels of output of consumption goods, when roundabout methods eventually come on-line).

The origins of inter-temporal economic instability (the business cycle of boom and slump) derive from the monetary instability that is associated with variations in bank credit creation. When new bank credit holds the *market* rate of interest below the *natural* rate, the monetary theory of business cycles shows there to be too much investment (over-investment) and the wrong type of investment (mal-investment). Over-investment occurs because ‘the case most frequently to be encountered’ (Hayek, 1967, p. 54) is where new bank credit primarily delivers additional purchasing power to investor-debtors. That increased demand for investment goods diverts resources from the production of consumption goods. Too few consumption goods are produced and there is too much investment. Mal-investment occurs because *un-naturally* low interest rates give an extra incentive to invest in the very earliest stages of production: too much investment is directed to early stages of production, and too much is directed to late stages of production. The forces setting the incentive to over-invest and to mal-invest are examined in the next section.

When new bank credit holds the *market* rate of interest below the *natural* rate, more resources are in demand for investment purposes, but the incentive to save is diminished. The corollary of that reduced saving is an increased demand for consumption goods. Initially, this is likely to be met both from stock, from the existing structure of production and from other practical considerations:

capital and labor can be employed more intensely than is possible on a sustainable basis. Routine maintenance of machinery can be postponed and the machinery can be kept running more hours per day or more days per week than usual. Additional workers can be drawn into the labor force, some workers can work overtime, and others can postpone retirement. These considerations allow for the production of both investment goods and consumption goods to increase simultaneously but, of course, not on a sustainable basis (Garrison, 2004).

It is because Hayek’s business cycle theory is built upon the assumption that factors of production are fully employed that simultaneous increases in demand for investment goods and consumption goods *are* incompatible, so that something must give. Ultimately the attempts to save less and to consume more are thwarted (as ‘forced saving’) by the diversion of resources from the (late stage) production of consumption goods to the (early stage) production of investment goods. ‘Forced saving’ delivers the necessary real resources for the capital investments that are encouraged by new bank credit and, thereby, create deficiencies in the supply of consumption goods.

The overall effect is inter-temporal disequilibria; that is, inconsistent patterns between the implied schedules of supply and demand for consumption goods, with excessive demands in the present and excessive supplies in the future. In this scenario, the general tendency is for current prices of consumption goods to rise, with subsequent consequences for incentives to invest such that, even with the diversion of real resources to the production of investment goods, the growth that is stimulated is unsustainable.

### **An illustration**

A numerical illustration shows the twin forces that are at work. There is the *interest rate effect* that is caused by bank credit creation; and there is the *relative prices effect* that is caused by shortages in the supply of consumption goods. Consider two roundabout production methods:

one (single late stage) delivers net revenue of £110-00 after one-year; and the other (single early stage) delivers £259-37 after ten-years. (In a primitive Crusoe context, these might be the alternatives of collecting saplings for immediate use as fuel and planting saplings to deliver mature trees for use as fuel.) At a 10 per cent discount rate, the capitalised values (£100) of the net revenue from each project are identical:

$$\begin{aligned}\text{£100-00} &= \text{£110-00} \times (1.1000)^{-1} \\ \text{£100-00} &= \text{£259-37} \times (1.1000)^{-10}\end{aligned}$$

Now, with an expansion of bank credit that causes the discount rate to fall to 8 per cent, the capitalised values would rise to £101-85 for the late stage project and to £120-14 for the early stage project:

$$\begin{aligned}\text{£101-85} &= \text{£110-00} \times (1.0800)^{-1} \\ \text{£120-14} &= \text{£259-37} \times (1.0800)^{-10}\end{aligned}$$

This illustrates how a reduction in the discount rate gives an extra incentive to invest in the earlier stage of production.

The consequential incentive to divert resources (from the late to the early stage) would have the subsequent effect of creating a shortfall in the supply of consumption goods and a general tendency for their prices to rise. Now, if those higher prices were to increase net revenues from the sale of consumption goods by (say) three per cent (so as to raise net revenues from £110-00 to £113-30 and from £259-37 to £267-16, respectively), the capitalised values (at a 10 per cent discount rate) would also rise by three per cent from £100-00 to £103-00. However, (assuming that the capital outlay required for each project remains unchanged at £100-00) the internal rate of return from the late stage project would rise to 13.30 per cent, as compared with a rise to only 10.33 per cent for the early stage project:

$$\begin{aligned}\text{£100-00} &= \text{£113-30} \times (1.1330)^{-1} \\ \text{£100-00} &= \text{£267-16} \times (1.1033)^{-10}\end{aligned}$$

This illustrates how an increase in the prices of consumption goods (relative to the prices of associated investment goods) gives a greater incentive to invest in the late stage project; that greater incentive derives from the possibility of repeated investments earning 13.30 per cent, with the potential to net £348-58 over ten-years:

$$\text{£348-58} = \text{£100-00} \times (1.1330)^{10}$$

a sum whose capitalised value of £134-39

$$\text{£134-39} = \text{£348-58} \times (1.1000)^{-10}$$

is directly comparable with that of only £103-00 for the early stage project.

To summarise: a fall in the discount rate gives an incentive to invest in the *more* roundabout method (early stage) of production; and a rise in the prices of consumption goods (in relation to the capital outlay necessary to produce them) gives an incentive to invest in the *less* roundabout method (late stage) of production. Now, if the initial reduction in the discount rate were caused by bank credit creation, these results (generalised) allow a business cycle theory to be built upon capital theory and the impact of two price distortions: the interest rate effect and the relative prices effect.

## Business cycles: theory and practice

Hayek's business cycle theory shows how inter-temporal distortions to the price mechanism can adversely affect a market economy. So long as bank credit creation holds the *market* rate of interest below the *natural* rate, incentives exist (the interest rate effect) to divert investment from late stages of production (that is, from the more imminent production of consumption goods) to early stages of production (that is, to the less imminent production of consumption goods). Even once that diversion of resources is underway, intermediate goods previously and irrevocably committed might sustain the flow of consumption goods for some time; but, sooner or later, this must end. As resources continue to be diverted to early stages, a scarcity of consumption goods is inevitable -

[a]t the same time that longer-term projects are being undertaken, the resources needed for their completion are being depleted by increased consumption. This constellation of effects is what makes the subsequent downturn inevitable (Garrison, 2004).

- so creating a tendency for consumption goods prices to rise in relation to the prices of investment goods (the relative prices effect). Ultimately, with the eventual cessation of bank credit creation, a period of readjustment begins as (with the market rate now rising) investment incentives become redirected to favour late stages of production.

## Price expectations

With the development of business cycle theory in the 1930s, the relevance of a constant proportional rate, as against an accelerating rate, of monetary expansion was debated; but the role of price expectations was neglected. At one extreme, in the absence of price expectations, it is a logical proposition that, '[i]f capital is to become progressively deeper, inflation must accelerate, but ... a constant proportional rate of monetary expansion would suffice to sustain and retain viable a once and for all step change in the time structure of production' (Laidler, 1994, p. 12). At the other extreme, if agents fully adjust their behaviour according to rationally formed price expectations so that prices move instantaneously to new equilibrium levels, the key issue of whether 'further injections of bank credit' might 'enable the economy finally to achieve and then to sustain indefinitely a more roundabout structure of production', invites the 'standard Austrian argument that attempts to stave off trouble by further credit creation would lead to rising inflation and the ultimate collapse of the currency' (Laidler, 1994, p. 11).

Keynes's *General Theory* had encouraged central bankers to pursue 'the policy of an autonomous rate of interest, unimpeded by international preoccupations' (Keynes, 1936, p. 349). In that macroeconomic context, monetary disturbances to real economic activity were less likely to be the unwitting and unintended consequence of established commercial banking practice. They were intended to achieve real macroeconomic objectives; but while fully-fledged Keynesian economics subsequently invoked the full paraphernalia of monetary and fiscal demand management policies, the goal of full employment without inflation proved elusive. Even as aspirations became progressively diminished through the last quarter of the century, the one instrument left in play - the interest rate - was, and continues to be, routinely tailored *as if* it were relevant to the amelioration of every perceived macroeconomic underperformance.

Now, in regard to the issue of whether economic growth fostered by bank credit creation is *necessarily* unsustainable, the outcome turns on whether forced saving delivers sufficient *real* resources to meet capital investment commitments in full. The issue is whether investment projects, encouraged at relatively early stages of production by monetary expansion, might be

completed, either before a monetary expansion is curtailed, or before rises in the prices of consumption goods switch incentives to favour late stages of investment. In the primitive context of Robinson Crusoe having set aside (as saving) some fish, in order to provide time to build a boat (committing resources to an early stage of production), an inadequate amount of saving would soon be apparent and cause Crusoe to revert to fishing (re-committing resources to a late stage of production). In a less primitive context, the principle remains: real resources are necessary to undertake real capital investments. Given the direction of bank credit creation that is presumed by Hayek's business cycle theory (placing new buying power in the hands of investor-debtors), real resources are diverted from late to early stages of production, and an investment boom is initiated. Given the presumption that bank credit creation cannot extend indefinitely, simple practicalities suggest that some investment projects would be completed (before a monetary expansion is curtailed, or before rises in the prices of consumption goods switch incentives to favour later stages of investment) and that some would be left unfinished (like Crusoe's boat).

Projects, whose capital completely turns over, before the *market* rate of interest reverts to the higher *natural* rate, would be retrospectively viewed as sound investments. Those that come on-line, but are still time-discounting future earnings as the *market* rate of interest begins its rise towards the *natural* rate, less so. At the furthest extreme, some projects would be abandoned on the basis that sunk costs are no justification for further commitments. Yet, in retrospect, such a boom would have proven no less sustainable than one drawing from simultaneous reductions in the *market* and *natural* rates of interest; that is, a boom initiated by an increase in voluntary saving. The explanation lies with three practicalities: that the (macroeconomic) saving function is not robust; that saving is inter-temporally unpredictable; and that every historical increase in real voluntary saving (in proportion to income, and with the possible exception of the most recent) has always been reversed. It might even be argued that bank credit creation gives a more reliable basis (in terms of duration) for investment decisions; but that case would be a misleading diversion. Even with the most favourable outcome to a bank credit-led investment boom, the overall situation would be one where too few consumption goods are produced sooner-rather-than-later, and too many consumption goods are produced (or were planned to be produced) later-rather-than-sooner. This, rather than whether a bank credit led investment boom is, or is not, sustainable is the more telling point.

Investment *per se* is not necessarily a good thing; not even if, by the sacrifice of jam today, a greater abundance of jam is gained tomorrow. That outcome would be desirable, *only if* it were desired! So, although a credit-led investment boom might be capable of sustaining a higher economic growth rate, the net benefits accruing to consumers would be negative: the benefit from an increased future volume of consumption goods would be more than countered by the negative impact of forced saving. It is because new bank credit is never distributed uniformly across all sections of the community, that relative prices are affected and the efficiency of a market economy compromised. However, with a bank credit-led consumption boom, the interest rate effect and the relative prices effect would be active simultaneously and with offsetting tendencies. So, the particular distortions that were emphasised in the 1930s would have less emphasis today.

### **Dispensing with Keynes: investment incentives and the multiplier**

Hayek represents Keynes's idea - that new investment is profitable only when there is an increase in consumers' demand - as 'part of the same widespread fallacy to which the businessman is especially prone' (Hayek, 1978, p. 213). The error lies in applying what holds for a single industry, to industry as a whole:

[w]hile, of course, the relative magnitude of the demand for equipment of a particular industry will depend upon the demand for the product of that industry, it is certainly not true to say that the demand for capital goods in general is directly determined by the magnitude of the demand for consumers' goods (Hayek, 1935, p.143).

Any dependency of investment upon consumption applies only to *existing* techniques; it cannot be relevant to 'investment which can increase productivity per head of worker by equipping a given labour force with *more* capital equipment' (Hayek, 1978, p. 213). That first possibility might relate, for example, to investing in a second shop (with an assistant) to meet an increased demand for sweets; and the second possibility might relate to investment in automatic sweet dispensers. The latter would be 'encouraged by *low* product (consumer good) prices (which makes it necessary to save on labour costs) and discouraged by high ones' (Hayek, 1978, p. 213). Indeed, by Hayek's formal analysis, a general rise in consumption goods' prices enhances the *relative* profitability of less roundabout processes; and *vice versa*.

Hayek's economic theory is predicated upon the assumption of full employment, which he defends as relevant even to an economy in recession:

[a]n analysis on the assumption of full employment, even if the assumption is only partially valid, at least helps us to understand the functioning of the price mechanism, the significance of the relations between different prices and of the factors which lead to changes in these relations. But the assumption that all goods and factors are available in excess makes the whole price system redundant, undermined and unintelligible (Hayek, 1972, p. 103).

Where resources are fully employed, there is an obvious trade-off between the provision of goods for current consumption and the provision of goods for future consumption. Advance through economic growth can be achieved only by present sacrifice. Any attempt to force growth by monetary expansion has immediate inflationary implications that cannot be ignored. Yet, according to Keynes's *General Theory*, this difficulty is absent in the presence of widespread unemployment among productive factors.

Keynes argues that, with high unemployment, a bond-financed credit-led investment boom could achieve *quantity* adjustments (that is, higher levels of output) without the consequences that derive from forced saving. This is not to say that consumption goods prices would not be affected. Indeed, more highly priced consumption goods were expected to reflect diminishing returns to labour and higher unit costs. Involuntarily unemployed labour would acquiesce in the real wage reductions that this implies, and so there would be no inflationary impetus. However, the case was made by default, because Keynes failed to show the *processes* of adjustment. Investment *instantaneously* raises aggregate real income and the *instantaneous* multiplier provides the exact amount of new saving to finance the original investment. However, in admitting the practical limitations of this instantaneous multiplier, Keynes discusses the extreme case, where new investment expenditure is a total surprise so that, in the first instance, no additional consumption goods are available to meet the increase in demand. Then,

the efforts of those newly employed in the capital-goods industries to consume a proportion of their increased incomes will raise the prices of consumption-goods ... causing a postponement of consumption (Keynes, 1936, p. 123).

Keynes saw the postponement of consumption ('forced saving') as temporary, lasting for the time necessary to allow consumption goods industries to increase their production. Consumption would then rise above its normal level - to compensate for the temporary postponement - before reverting back to that normal level. While recognising that these adjustments were relevant to the

analysis of business cycles, Keynes maintains that they do not

in any way affect the significance of the theory of the multiplier ... nor render it inapplicable as an indicator of the total benefit to employment to be expected from an expansion in the capital-goods industries (Keynes, 1936, p. 124);

and, as if haunted by this problem, he states that '[p]rice-instability arising in this way does not lead to the kind of profit stimulus which is liable to bring into existence excess capacity' (Keynes, 1936, p. 288). Why not? For some unexplained reason, the unexpected abnormal profits would be universally recognised to be windfall gains accruing to those just fortunate enough to have products 'at a relatively advanced stage of production'.

Keynes describes no route that avoids the consequences of forced saving. Furthermore, his 'aggregations conceal the most fundamental mechanisms of change' (Hayek, 1931, p. 277) and implicitly deny the importance of the *composition* of any idle resources that are readily available. Appropriate resources must be immediately to hand in the form of factors of production, in the form of work in progress at every stage of completion and in the form of consumption goods. Only then might there be no bottlenecks, nor shortfalls in levels of production to meet new demands from formerly unemployed workers. Yet, the message of Keynes's *General Theory* is that higher levels of investment might be financed by monetary expansion; that is, without inflation and without any significant shortfall in the provision of consumption goods.

Such events are only made possible by the unrealistic assumption of elastic and appropriate supplies of factor inputs and intermediate products. That such propositions were countenanced reflects upon the limited objectives of Keynes's *General Theory*. Investment appraisal, periods of gestation, cash flow, pay-back periods, and problems of finance are not pertinent to the problem of raising aggregate expenditure to a level that generates full employment. That narrow focus has led and continues to lead economic policy to be targeted upon full employment, with little consideration of the consequences for the composition of production or the implications for cyclical activity or economic growth.

### **Hayek's achievement**

Hayek's intention was for *The Pure Theory of Capital* to provide a basis, from which to elucidate the function of capital in a money economy. That second stage was never achieved. In retrospect, Hayek believed that Austrian capital theory had stalled and he regretted that others had not been drawn to the task (Hayek, 1994, 96). Yet, while Hayek's contribution in advancing Austrian capital theory is acknowledged to contain 'some of the most penetrating thoughts on the subject that have ever been published' (Machlup, 1976, p. 29), a general view is that it provides 'little in the way of specific constructive results' (Steedman, 1994, p. 23) being an exercise in pure logic and of 'doubtful practical value' (Fletcher, 1989, p. 246). So, although *The Pure Theory of Capital* is described as 'a remarkable contribution to knowledge', that assessment is qualified by the fact that it is 'inconceivable that any statistical or practical use can be made of the Austrian theory of capital' (Shackle, 1981, p. 250).

There is no argument in relation to statistics. *The Pure Theory of Capital* does not lend itself to applied statistical work and that is enough to condemn it to modern eyes:

[t]o an economist today ... only that is true which can be proved *statistically*, and everything that cannot be demonstrated by statistics can be neglected; ... the modern fashion demands

that a theoretical assertion which cannot be statistically tested must not be taken seriously and has to be disregarded (Hayek, 1975, pp. 6-7);

and yet

[n]obody would probably seriously contend that statistics can elucidate even the comparatively not very complex structures of organic molecules, and few would argue that it can help us to explain the functioning of organisms. Yet, when it comes to accounting for the functioning of social structures, that belief is widely held (Hayek, 1967, p. 31).

In advancing Austrian capital theory beyond the early fraught attempts to achieve meaningful quantification, Hayek's work achieved much deeper insights into the structures of capitalistic production. The quality, that distinguishes Austrian capital theory from the more widely appreciated neoclassical theory of production, is its close proximity to entrepreneurial experience. Business practice recognises that time is essential to the gestation of capital; and, thereafter, that production and earnings extend into a finite and uncertain future. These features are fundamental to entrepreneurial activity. Rational entrepreneurial decisions - to incorporate (present and future levels of) costs, the (present and future levels of) availability of labour, plant and machinery, the (present and future levels of) interest rates, periods of gestation and the duration of earnings - are captured by Austrian theory. By contrast, the out-of-time constrained optimisation of neoclassical theory offers no basis to analyse entrepreneurial activity. With that appreciation of *The Pure Theory of Capital*, a paradox is resolved: that an exercise in pure logic should be deemed too realistic to serve as a tool for analysis;

[d]egrees of realism range from K (for capital) to an aerial photograph of the Rust Belt. K is too simple; everything from the *Pure Theory* to the aerial photograph is too realistic (Garrison, 2001, p.11).

If simplification is to be judged by the versatility of theory in practical application, *The Pure Theory of Capital* is certainly too complicated (or realistic) either to deliver tractable microeconomic conclusions or to serve macroeconomic forecasting. However, in revealing the deficiencies of earlier presentations and in pointing to its own omissions, *The Pure Theory of Capital* propagates the important message that dynamic complexity is rarely overstated and - for the same reason - that economic coordination is mostly likely to be achieved in the highest practical degree as a spontaneous order within a liberal market system of production and exchange.

## References

- Colonna, M., H. Haggmann and O. Hamouda (1994) (eds) *Capitalism, Socialism and Knowledge, The Economics of F.A. Hayek, Volume II* (Aldershot: Edward Elgar)
- Fletcher, G.A. (1989) *The Keynesian Revolution and Its Critics*, second edition (London: Macmillan)
- Harcourt, G. C. (1972) *Some Cambridge Controversies in the Theory of Capital* (London, Cambridge University Press)
- Garrison, R.W. (2004) 'Overconsumption and Forced Saving in the Mises-Hayek Theory of the Business Cycle' *History of Political Economy* vol. 36, no. 2 (summer); cited from <http://www.auburn.edu/~garrir/strigl.htm>
- Hayek, F.A. (1931) 'Reflections on the Pure Theory of Mr J.M. Keynes, Part I', *Economica*, 11, 270-95
- Hayek, F.A. (1933) *Monetary Theory and the Trade Cycle* (London: Jonathan Cape)



- Hayek, F.A. (1935) *Prices and Production*, 2nd edition, revised and enlarged (London: Routledge and Kegan Paul)
- Hayek, F.A. (1939) 'Profits, Interest and Investment' in *Profits, Interest and Investment and other Essays on the Theory of Industrial Fluctuations* (London: Routledge) pp. 3-72
- Hayek, F.A. (1967) *Studies in Philosophy, Politics, and Economics* (London and Henley: Routledge and Kegan Paul)
- Hayek, F.A. (1972) *A Tiger by the Tail* (London: Institute of Economic Affairs)
- Hayek, F.A. (1975) *A Discussion with Friedrich von Hayek* (American Enterprise Institute for Public Policy Research, Washington, D.C.)
- Hayek, F.A. (1978) *New Studies in Philosophy, Politics, Economics and the History of Ideas* (London and Henley: Routledge and Kegan Paul)
- Hayek, F. A. (1983) 'The Austrian critique', *The Economist*, 11 June, pp. 45-8; reprinted in Hayek, 1995, pp. 247-54
- Hayek, F. A. (1995) *Contra Keynes and Cambridge: Essays, Correspondence*, vol. IX, edited by B. J. Caldwell (London: Routledge)
- Knight, F. (1936) 'The quantity of capital and the rate of interest', *Journal of Political Economy*, 44: 434-5
- Laidler, D. (1994) 'Hayek on neutral money and the cycle', in Colonna, Hagmann and Hamouda, 1994, pp. 3-26
- O'Brien, D. P., and J. R. Presley (1984) (eds) *Pioneers of Modern Economics in Britain* (London: The Macmillan Press)
- Robinson, J. (1953) 'The Production Function and the Theory of Capital', *Review of Economic Studies*, 21(2): 81-106
- Shackle, G.L.S. (1981) 'F. A. Hayek, 1899 - ', in O'Brien and Presley 1984, pp. 234-61
- Steedman, I. (1994) 'On *The Pure Theory of Capital* by F.A. Hayek' in Colonna, Hagmann and Hamouda, 1994, 3-25