Hayek's Contribution to Business Cycle Theory: A Modern Assessment

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Introduction

The manner in which resources are integrated within more or less capitalistic (or roundabout) methods of production is the key to Hayek's analysis of business fluctuations. Any change to this structure of production has a cumulative impact. In setting Austrian capital theory within this dynamic framework, Hayek's unique contribution was to explain how monetary expansion sets in motion incentives which initiate a boom, but which steadily disrupt the balance between production methods. The inevitable outcome is crisis and slump.

Although Hayek produced a consistent set of theoretical arguments, their long and confused gestation created much controversy. His four books and their associated journal articles spanned publication of *The General Theory.* Hayek's hostility to Keynes's method added much heat to the various exchanges, but the intention is not to focus upon those debates, nor to set Hayek's theory into the context of the history of business cycle analysis. Rather, it is to provide a retrospective interpretation of Hayek's exposition as a coherent whole.

At the risk of confusion and even some annoyance to those familiar with the original presentations, I have made extensive use of modern terminology, especially that relating to investment appraisal criteria. Nevertheless the arguments are always from Hayek, and origins may be readily traced if the quotations in closest proximity are taken as a guide.

Hayek's first major works were *Monetary Theory and the Trade Cycle* (1929; first English edition, 1933) and *Prices and Production* (1931; revised and enlarged edition, 1935). *Prices and Production* reproduced

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four lectures delivered at the LSE in 1930–31, "at a time when I had arrived at a clear view of the outlines of a theory of industrial fluctuations but before I had elaborated it in full detail or even realised all the difficulties which such an elaboration presented" (Hayek 1935, vii). In presenting his revised and extended edition, Hayek warned of its deficiencies, though without regret, for the comments and discussion provoked by the first attempt—"which could rarely have been equalled in the economic controversies of the past" (Kaldor 1960, 149)—gave the direction "for a later more complete elaboration."

Monetary Theory and the Trade Cycle had emphasized "the monetary causes which can *start* the cyclical fluctuations" (Hayek 1933, 17), and this was complemented by *Prices and Production*, focusing more closely upon "successive changes in the real structure of production," which are the real phenomena of the trade cycle. Later still, and taking account of recognized defects in the earlier analysis, came *Profits, Interest and Investment* (1939) and *The Pure Theory of Capital* (1941).

In the two earlier books, the impact upon investment incentives of a fall in the rate of interest (brought about by new money or new saving) is coherently discussed (i.e., the "interest rate effect"). In the latter two books, attention is directed more at the impact upon investment incentives of changes in relative prices (i.e., the "relative prices effect"). The intention here is to show that these two forces are mutually compatible and that Kaldor (1942) was wrong to represent them as inconsistent theoretical formulations.

Capitalistic Methods of Production

By lengthening capitalistic processes of production, it is possible to obtain a *greater* quantity of final goods from a given volume of original factors of production; but these goods become available at a *later* date than if shorter processes are used. This is the economic decision: whether it is more profitable to maintain or to alter the structure of production depends upon the balance between the price received for the final product and the prices which must be paid for intermediate goods.

At each stage of production, a margin (the excess of the value of the intermediate good over the factor and material costs of producing it) must exist to provide the inducement to invest. Entrepreneurs allocate resources across the many different stages of production so as to maximize total returns. Where there are differences in time-discounted

margins (or yields), investments are switched between stages until yields are equalized (as a consequence of diminishing returns). So, what might cause differentials between yields to open up? Alternative possibilities are 1) a change in the level of saving, and 2) monetary expansion. Both give rise to the "interest rate effect."

The Interest Rate Effect

For simplicity, output is assumed to show the same diminishing returns (with respect to the application of additional units of a factor) at each stage of production; but, while the marginal physical product curve for the factor is identical at every stage, its value (at any point on that curve) is more heavily time-discounted at earlier stages than at later stages of production.

Where entrepreneurs have allocated resources to achieve maximum returns, a fall in the rate of interest must increase yields across all stages of production, but it has the greatest impact at the stage which is most heavily time-discounted. This differential impact is revealed by the following: looking back (from time t) over the yields (y) achieved at successive stages of production (t, $t - 1$, and $t - 2$), equilibrium obtains where

$$y_{t-2} = y_{t-1} = y_t$$

Each of these yields is a time-discounted value, for example

$$y_{t-2} = a_{t-2}\,(1 + r)^{-2}$$

where a is the undiscounted margin (at the earliest stage of production, two periods back) and r is the discount rate (rate of interest). If initial conditions are such that

$$y_{t-2} = y_{t-1} = y_t \quad \text{at discount rate } r_1$$

it follows that

$$y_{t-2} > y_{t-1} > y_t \quad \text{at discount rate } r_2 < r_1$$

and that

$$y_{t-2} < y_{t-1} < y_t \quad \text{at discount rate } r_0 > r_1$$

which, together, show that at the highest (lowest) interest rate, the shortest (longest) process is the most profitable. Thus, as the rate of interest falls, yields increase generally, but the incentive favors

"capital deepening"; and as the rate of interest rises, yields fall generally, but with a bias to favor "capital shallowing."

Less urbanely, perhaps, it is confirmed that a fall in the rate of interest gives an advantage to processes using proportionately more capital. Not only would this be so for new enterprises (established upon the basis of new money), but preexisting operations would also have an incentive to switch resources away from direct production methods, and to increase expenditure upon intermediate goods. With a fall in the rate of interest,

> the old distribution of factors between stages would evidently not represent an equilibrium position but one at which the discounted value of the marginal product would be different at every stage. And if the total quantity of the factor which is available remains the same the new equilibrium distribution will apparently be one at which not only the price of the factor will be higher but at which also a considerable quantity of it is used in the earlier stages and correspondingly less in the later stages. (Hayek 1935, 82)

Assuming a fixed, fully employed supply of productive resources, entrepreneurs with new money can acquire additional resources only by out-bidding those entrepreneurs with whom those resources are currently employed. The degree to which prices are affected, by the interest rate incentive to reallocate resources to reach this "new equilibrium distribution," depends upon the degree to which substitution is possible. Some intermediate goods are less readily moved, being "more specific" (less versatile) than others. However, the essential conclusion is that it is wrong to suppose that the rate of interest is of relevance only as "a direct cost factor." More important is "its effect on prices through its effect on demand for the intermediate products and for the factors from which they are produced" (Hayek 1935, 83).

The stimulus to investment, created by a fall in the rate of interest, depends upon entrepreneurs' expectations of new profits to be achieved from the application of additional funds. If all entrepreneurs were precisely correct in anticipating enhanced future yields, additional funds would be directed only to those stages offering the highest returns, and other potential (less-profitable) ventures would remain without funds.

Here, the role of the price mechanism is to work towards achieving an efficient allocation of resources. A voluntary switch away from consumption expenditure in favor of higher saving, would cause the rate of

interest to fall and appropriate adjustments (to the balance between the production of intermediate goods and final goods) to take place. As a result, new saving is taken up by new investment across the full range of capitalistic stages of production (but with a bias favoring the earliest stages). However, where monetary expansion has been the cause of a fall in the rate of interest, the situation is less happily resolved.

Bank Credit Money, and the Cumulative Process of Investment

The rate of interest can be brought down if new money is made available "by way of credits to producers." To a degree, the impact of new money is similar to that generated by new saving but, unlike the latter, investment financed by new money takes place without a prior reduction in expenditure upon final goods. So, although the increased demand begins to push up the prices of intermediate goods, the output of final goods may remain unaffected. Even after the switch to more roundabout methods is underway, goods may have advanced so far in gestation (and be so specific as to preclude reallocation) that final goods are forthcoming at an unchanged rate for some time; but, sooner or later, this must end in the consequence of the diversion of resources to the production of intermediate goods (see Hayek 1935, 88).

As factors are switched into longer-term projects, a hiatus in the flow of final goods into the market is inevitable. There is then an increased scarcity of the latter (there having been no increase in voluntary saving) which must cause the prices of final goods to rise. This forces a reduction in consumption which, being unplanned, attracts the description "forced saving." The situation is now such that the demand for factors (in greater demand for the production of *both* intermediate goods *and* final goods) causes money incomes to rise. This adds to the pressure upon the prices of final goods, so that the original profitability gap (between the production of intermediate goods and the production of final goods) begins to close.

Entrepreneurial expectations of profits are enhanced by rising prices of final goods and, so long as banks are willing to extend loans, the whole process is cumulative. Yet, the creation of new bank credit cannot continue forever. With its eventual cessation, there begins a difficult period of readjustment, as incentives become set for a return to shorter (less roundabout) processes. (See "the relative prices effect"

below.) This readjustment may even involve a degree of "overreaction," if the accumulated shortfall in final goods has created deceptively attractive scarcity price premia.

Asymmetry in the Switch from Short/Long to Long/Short Processes

Monetary expansion lowers the rate of interest and raises the profitability of *all* investments, but the profitability of more roundabout processes is raised by greater amounts. Nevertheless, it is entirely rational for entrepreneurs to continue to use capital which is entirely specific to existing short processes (where yields, though not the highest to be obtained, remain above the rate of interest), while switching new investment to more roundabout processes (see Hayek 1935, 93n.)

In reverse, the argument is rather different; for, if the rate of interest is *raised,* it immediately lies above yields on *all* processes. The gap is greater the longer the process, so that long processes are more promptly abandoned. (Although the "sunk cost" argument applies, the calculation must account for the provision of additional funding over the period to completion of final goods.) With the abandonment of longer processes, the profitability of shorter processes is directly enhanced. Nevertheless, some time may pass before the factors released from longer processes are recruited into nascent shorter processes which, starting from scratch, only gradually absorb resources. Moreover, their period of unemployment may be protracted, if entrepreneurs hesitate to commit themselves "once the temporary scarcity of consumers" goods has disappeared (Hayek 1935, 93).

The whole process, consisting of new money, a lowered rate of interest, the switch to longer processes, the increased scarcity of final goods, and the switch back to shorter processes, is described by the Hayekian fable:

> The situation would be similar to that of a people of an isolated island, if, after having partially constructed an enormous machine which was to provide them with all the necessities, they found out that they had exhausted all their savings and available free capital before the new machine could turn out its product. They would then have no choice but to abandon temporarily the work on the new process and to devote all their labor to producing their daily food without any capital. (Hayek 1935, 94)

Indeed, even these difficulties may be understated because the accumulation of capital may have allowed a growth of population (or, perhaps, an influx of immigration) far beyond the level which might be gainfully employed without capital.

Hayek draws from these arguments "the fundamental truth" that it is impossible to increase the level of consumption without *prior* new saving. Even where existing equipment has the (temporary) capacity to produce a higher level of final goods, for this level to be maintained continuously there must be a proportionate increase in the volume of intermediate goods at every auxilliary stage. This cannot be achieved without prior saving.

In Hayek's view, many economists were misled by the vast stocks of underused durable capital during the depression of the 1930s. The requirement for a prior commitment to many *other* lengthy processes was generally overlooked. Rather than constituting proof of "an excess of capital and that consumption is insufficient," unused capacity demonstrated that the level of demand for final goods was "too urgent" to permit investments in long processes to take place, even though much of the necessary durable capital were already available. This unused plant and machinery was the consequence of former "misdirections of capital" (Hayek 1935, 96).

Policy in a Business Depression

From Hayek's analysis of "the interest rate effect" comes the conclusion that cheap credit policy should not be used to stimulate consumer demand in order to lift an economy from depression. Such measures could only exacerbate the problem of unemployment which arises from structural misalignments across production processes.

Hayek argues that, with precise control, bank credit expansion *could* achieve remedial action; for it is theoretically possible for the precise timing, amount and direction of new advances to compensate the first excessive price rise of final goods, and then for its subsequent withdrawal precisely to compensate the flow of additional final goods (as the supply pattern of final and intermediate goods adapts itself to the pattern of demand). However, in an uncertain world, this is asking for the moon! No good can come of credit expansion. What *is* required is "the most speedy and complete adaptation possible of the structure of production between the demand for consumers' goods and the demand

for producers' goods as determined by voluntary saving and spending" (Hayek 1935, 98). Any creation of "artificial demand" introduces distortions into the allocation of resources and causes a postponement of a lasting adjustment. Although unemployed resources might be quickly absorbed by such artificial stimulus, "new disturbances and new crises" would be the inevitable result.

The Relative Prices Effect

Whatever the causes which set them in train, it is the intricate distortions caused to the structure of production that are "the decisive factors in determining cyclical fluctuations." These, rather than "the superficial phenomenon of changes in the value of money" (Hayek 1933, 41n.)—by which these distortions can be set in motion—are worthy of the closest attention.

In part, distortions are created by the "interest rate effect" and in part, they are created by the "relative prices effect." While the first faltering steps towards a description of the latter are to be found in Hayek's earlier works, the analysis was undermined by confusing exposition:

> In the stage of production immediately preceding that in which the final touches are given to final goods, the effect of the fall in the price of final goods will be felt more strongly than the effect of the increase of the funds available for the purchase of intermediate goods of all kinds. The price of the product of this stage will, therefore, fall, but it will fall less than the prices of consumers' goods. This means a narrowing of the price margin between the last two stages. But this narrowing . . . will make the employment of funds in the last stage less profitable relatively to the earlier stages and therefore some of the funds which had been used there will tend to be shifted to the earlier stages. This shift of funds will tend to narrow the price margins in the preceding stages, and the tendency thus set up towards a cumulative rise in prices of the products of the earlier stages will soon overcome the tendency towards a fall. (Hayek 1935, 75–76)

However, Hayek appears to reverse the causal sequence in stating that investments in working capital "will now be attracted to the earlier stages, where, since the change in the rate of saving, relatively higher prices are to be obtained" (Hayek 1935, 76); and "the increased prices

in the earlier stages of production (the lowered rate of interest) will favour production in lines using much capital and lead to their expansion at the expense of lines using less capital" (Hayek 1935, 77n.) which is all rather confused! (If "yields" is substituted for "prices" in the above two quotations, some clarification may be achieved.)

It is *not* the relative price rise of intermediate goods in the earlier stages of production which enhances their yields. Rather, the relative enhancement of their time-discounted yields (the result of new saving and the reduced rate of interest) attracts investment and causes their prices to rise. (This is the process which eventually restores equilibrium, but only in the absence of *forced* saving.) It is hardly surprising that defenders of the Keynesian faith were able to play upon alleged contradictions between the "two versions" of Hayek's theory.

The Relative Prices Effect Illustrated

The effect of monetary expansion is to lower the rate of interest without creating a simultaneous reduction in the demand for final goods. The immediate impact of the "interest rate effect" is to lengthen production processes; but, whereas the subsequent higher relative prices of final goods have the effect of increasing yields across all capital investments, it has the greatest impact upon the least roundabout processes. The following numerical illustration is intended to clarify the nature of the differential impact which changes in final goods' prices have upon investment incentives.

For an investment period of given length, new investment continues to be undertaken if the net present value (of revenue from the sale of the final goods produced) exceeds the cost of the investment. New investment ceases when

$$x_0 = \int_0^n be^{-rt}\,dt = b(1 - e^{-rn})/r \qquad (1)$$

where

x_0 = cost of investment at time $t = 0$
b = value of continuous annual net revenue from final goods
n = period of time after which net revenue expires
r = rate of interest

Levels of investment are assumed to be optimal, each marginal ($100) unit giving an internal rate of return equal to the market rate of interest of (say) 7 percent. Values of b may be found for any production

method, and the following were obtained from equation (1) for selected values of n:

n:	5	10	15	20	25	30
b:	\$23.70	\$13.90	\$10.80	\$9.30	\$8.50	\$8.00

These values reflect a capital structure in full equilibrium. To show the impact of an increase in the price of final goods, each b value was raised by 5 percent, and set into equation (1) to give the following solutions for the unknown r

n:	5	10	15	20	25	30
r:	0.089	0.081	0.078	0.076	0.076	0.075

These values show all yields to lie above the original 0.07, which provides the incentive to invest in *all* methods of production ("capital widening"); but the incentive is greatest for the least roundabout method of production, which gives the bias for "capital shallowing."

New Saving and New Credit

Monetary expansion stimulates investment expenditure both by forcing down the market rate of interest and by forcing up the *relative* price of final goods. This idea of a *differential* impact upon prices can be traced to Ricardo's *Principles* (see Moss and Vaughn 1986, 548) where it is argued that a diversion of labor, from the production of final goods into the production of intermediate goods, increases the prices of the former, and so reduces real wages. This acts as a further stimulus to investment but sets up a bias towards *less* roundabout methods. Hayek took this argument further. "So long as investment continues to increase, the discrepancy between prices and costs of consumers' goods must become progressively larger till the rise in the rate of profit becomes strong enough to make the tendency to change to less durable and expensive types of machinery dominant over the tendency to provide capacity for a larger output" (Hayek 1939, 33). It was this proposition which was to create so much controversy.

Although the Ricardo effect may be discussed at both the macroeconomic and the microeconomic levels, the methodological approach of the Austrian School led Hayek to emphasize the impact within individual firms. Hayek emphasized supply constraints arising during a dynamic path of adjustment. Rising commodity prices and unchanged

costs of production raise profits across the widest range of the firm's activities; but the greatest increases lie with short-term investments.

New investment, previously intended for fixed machinery, buildings and other items of long gestation, is diverted into working capital. While the *average* period of turnover is little effected, the marginal impact upon new investment expenditures is certain to be great (see Hayek 1942, 231). Rapid changes may be introduced into current outlays, and funds ear-marked for amortization diverted into working capital. In this way, a firm can increase its output while, simultaneously, it reduces its fixed capital. The numerical illustration given above can be drawn upon to show how this can happen.

Suppose that alternative methods of production use, respectively, capital of duration five years and capital of duration twenty years, and that each is operated with 60 units (× \$100) of capital of which 12 and 3 units, respectively, expire at the end of each successive year. For each to give an internal rate of return of (say) 7 percent, the respective annual output figures would be \$23.70 and \$9.30, respectively, (see above). The annual value of final goods produced with the 120 units of capital would be \$1980.00 (60 × \$23.70 plus 60 × \$9.30).

If this situation were disturbed by a rise in final goods' prices, the rate of return on investment in each method would rise, but the rise would be greater for the less roundabout method. Unless additional funds were available, investment would be switched into capital of duration five years; but this is possible only at a rate of 3 units per year.

After five years, the amount of five-year duration stock would have been raised to 75 units and that of twenty-year duration stock would have been lowered to 45 units; and final output (valued at original prices) would have risen to \$2,196.00 (75 × \$23.70 plus 45 × \$9.30). Capital stock would still be at 120 units but, thereafter, would go into decline. The reason is the requirement (from year six onwards) for 15 (rather than 12) units of replacement investment to maintain the stock of five-year duration stock at 75 units. The twenty-year duration stock would continue to diminish until year twenty, when none would be left. Thereafter, the annual output of commodities would be constant at \$1,777.50 (75 × \$23.70).

The Ricardo effect is thus shown to have the initial effect of raising output (even though the level of investment is unchanged), but capital shallowing (or a "concertina effect") occurs where less roundabout methods take prior claim upon investment funds. Ultimately, there is a

reduction in the aggregate stock of fixed capital. It was this proposition which Keynesian economists were unable (or unwilling) to understand (see Moss and Vaughn 1986, 545 and n. 1).

The illustration assumes full employment. If there were unemployed resources, monetary expansion might reduce Keynes's "involuntary unemployment," by raising final goods' prices. A low rate of interest and abundant resources might permit an increase in investment expenditure across the full range of roundabout methods. Nevertheless, while abundant resources might mean that "the decline of investment may be postponed for a long time . . . it is bound to come" (Hayek 1939, 31). New investment places income in the hands of those formerly unemployed, and raises the demand for final goods; but only by the unlikely device of Keynes's *instantaneous multiplier* might price rises be avoided. Without this device, final goods' prices would rise and so create a bias to favour short-duration investments. (For a more detailed exposition, see Steele 1989, 57–59.)

The Inevitable Slump

In a boom triggered by new opportunities arising from invention or discovery, expansion is held in check by a rise in the rate of interest, which limits the transfer of resources from other uses. In a boom triggered by monetary expansion, this mechanism is absent. The rate of interest is held down and investors take advantage of cheap loans. New demand for investment is financed by forced saving, as a diminished supply drives up prices of final goods. This sets up the Ricardo effect, which then feeds upon itself. The numerical illustration above shows how output can rise for a period before falling away to a new *lower* level. It also shows how the amount of investment expenditure can remain at a constant level, while capital stock is falling. In the static Keynesian framework, an outward shift of the investment demand schedule leads to a higher level of investment at a higher rate of interest, and so a Keynesian could not possibly accept that this higher rate of interest could be responsible for a reduction in capital stock. "To argue this way, involves the same fallacy as saying that a rise in demand for a commodity will cause a rise in its price, and the rise in price causes a restriction in demand (because less is bought at a higher price than a lower price), the increase in demand will lead to a reduction in the amount bought" (Kaldor 1960, 169–70).

Conclusion

Monetary expansion and a lowered rate of interest encourage capital investment generally, but they particularly favor indirect capitalistic methods of production. The subsequent effect of rising final goods' prices is to offset this bias. There is no logical contradiction involved by the integration of these two forces. In bringing them together, Hayek showed an original and perceptive understanding of the central role which integrated production methods have within the theory of business fluctuations.

It is central to the Hayekian paradigm that any change takes time and incurs adjustment costs. Some change is warranted in that it is directed by market forces to follow an economically efficient dynamic path. Even so, cyclical patterns may be inevitable, given the differential impact upon prices and the lagged response to those signals.

In an investment boom, changes to the structure of production are inevitable, but unwarranted changes are manifest when monetary expansion is responsible. Once the boom is underway, the rate of interest *must* eventually rise, either because of limits to saving, or because of an end to monetary expansion. A higher rate of interest tells against more roundabout methods. The combined effect of a higher interest rate and of rising final goods' prices is cumulative. While there is no mathematically precise calculation to indicate the end of the investment boom, the process is not one which can be sustained. "The apparent exhaustion of investment opportunities at the end of the boom will then be due not to the fact that the investment opportunities which have existed before have all been used up, but to the fact that because of the rise in the rate of profits in certain stages . . . many kinds of investment which were profitable before have ceased to be so" (Hayek 1939, 34). With many types of labor specifically attached to particular types of employment, unemployment must arise from *any* switch of investments; but an investment boom initiated by monetary expansion creates severe distortions to the structure of production. Even prior to the rise in the interest rate, rising rates of return cause formerly profitable investment projects to be abandoned. The rise in the rate of interest accelerates this process. Increasingly, the effect on incomes in these newly unprofitable sectors leads to a reduced demand for final goods and to further unemployment; as does the reduced demand for intermediate goods required in the production of final goods.

The boom is bust, but, sooner or later, the recession bottoms out. Again there is no mathematical calculation to show precisely when, but the easing of resource constraints together with the reduced yield from the production of final goods, must set the Ricardo effect into reverse. Investment in more roundabout methods begins once again.

In the Keynesian era, there was an unwillingness to accept dynamics, whether Hayekian or of another variety. In particular, many English economists were unable to apply the relevant instruments of dynamic analysis and so were unable to answer the question under discussion, i.e., would smooth growth be possible, or would there have to be cycles? That question can be answered only by writing out the differential equations of the Hayekian system in order to recover its primitive. The primitive is a weighted sum of the roots of the characteristic equation. There would be cycles if those roots are complex. Whether they are or not depends upon the parameter values of the system. Some day, some one will find that primitive for a Hayekian system, as Samuelson did for a Keynesian one. Whether Hayek would approve, or regard the search and discovery as pseudo-scientific, is another matter.

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