

The Hayek/Knight Capital Controversy: The Irrelevance of Roundaboutness, or Purging Processes in Time?

Avi J. Cohen

Neither changes in the durability of goods nor changes in their construction period . . . exerts an identifiable effect on a definable “period of production” in society as a whole. Moreover, they are similarly unconnected with quantity of investment, and quantity of investment is likewise unconnected with any production period. Correspondences in this field are limited and accidental, without theoretical significance for the nature and rôle of capital. It is extremely difficult to give any intelligible meaning to a “period of production,” and it certainly has no meaning of the sort assumed in the Böhm-Bawerk–Hayek theory of capital.
—Frank Knight, “Professor Hayek and the Theory of Investment” (1935)

[Knight’s permanent, homogeneous fund of capital and J. B. Clark’s true capital] are just so many evasions of the real problem of explaining how the existence of a given stock of capital limits the possibility of current investment. Without such an analysis they are just so many empty words, harmful as the basis of the noxious mythology of capital which by creating the fiction of a non-existing entity leads to statements which refer to nothing in the real world.
—Friedrich A. von Hayek, “The Mythology of Capital” (1936)

The 1930s controversy between Friedrich A. von Hayek and Frank Knight over capital theory has been briefly summarized by many authors

Correspondence may be addressed to Avi J. Cohen, Department of Economics, York University, Toronto, Canada M3J 1P3; e-mail: avicohen@yorku.ca. An earlier version of this article was presented at a session of the History of Economics Society meetings at Greensboro, North Carolina, in June 1999. Thanks for helpful suggestions from participants at that session and from two anonymous referees.

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(Ahmad 1991; Blaug 1997; Skousen 1990; Valiente 1980; Weston 1951) and often referred to in passing because of similarities to the Cambridge capital controversies (Hennings [1987] 1990; Hicks 1974; Kurz [1987] 1990; Milgate 1979; Solow 1963). More detailed discussions of the Hayek/Knight controversy have appeared recently in the broader contexts of Knight's wide-ranging intellectual activities during the 1930s (Emmett 1998) and the debate over socialism (Boettke and Vaughn 2002). Missing from the literature is a detailed chronicle and analysis of the controversy and its issues on their own terms. This article attempts to fill that gap, supplementing the public record with correspondence between the authors.¹

Knight and Hayek held fundamentally different conceptions of capital (Cohen 1997, 1998; Emmett 1998). Knight emphasizes a fund of value which is homogeneous, malleable, and permanent. He follows J. B. Clark's (1899) emphasis on capital as a permanent fund of value, while having interest determined entirely by the technical marginal productivity of capital, without reference to either the measurement of capital or time preference. In contrast, Hayek emphasizes heterogeneous, specific capital goods. He follows Eugen von Böhm-Bawerk's ([1884–1912] 1959) emphasis on heterogeneous capital goods and the period of production, but disavows entirely Böhm-Bawerk's subsistence fund determination of the interest rate (Hayek 1941, 146–47). In its place, Hayek (1941, 265, 266) substitutes an intertemporal price system that determines multiple own-rates of interest, but which Hayek believes will tend toward a uniform rate.

The Hayek/Knight controversy, as the opening quotations illustrate, revolves around these fundamentally different conceptions. Given Knight's conception of a homogeneous, permanent fund of capital, specific periods of production are irrelevant and unmeasurable concepts "without theoretical significance for the nature and role of capital." Given Hayek's conception of heterogeneous capital goods, Knight's homogeneous, permanent fund of capital purges any analysis of processes in time and of how a given specific "stock of capital limits the possibilities of current investment." There are subsidiary issues in the controversy—the origins of cycles, what determines the rate of interest,

1. All of the correspondence is located in the Knight papers at the University of Chicago. Because Knight had the fortunate habit of keeping carbon copies of his letters to others, both sides of the correspondence have been preserved. The Hayek papers do not contain any of the correspondence.

and the limitations of equilibrium analysis for explaining issues in which each author is interested—but all are connected to the differing conceptions of capital.

We begin with a chronological overview of the controversy, and then clear away the considerable areas of agreement between Hayek and Knight. This will provide context for the detailed examination of the key issues that takes up the greater part of the article.

Chronology

The controversy between Hayek and Knight occurs in seven main publications and in private correspondence. Table 1 presents a chronology of the seven publications (boldfaced), the key correspondence, and subsidiary articles that are referred to or form the basis for understanding issues in the controversy. Hayek 1931 and Knight 1932 lay out the basic positions that become the subject of controversy, while the direct criticisms and defenses of opposing positions begin with Knight 1933 and end with Hayek's famous 1936 article "The Mythology of Capital." Although both authors subsequently produce major works articulating their respective positions on capital theory (Hayek 1941; Knight 1936b, 1936c, 1944), they choose not to pursue their unresolved differences.

The controversy begins in earnest when Knight attacks what he calls the Jevons/Böhm-Bawerk/Wicksell/Hayek theory—that the quantity of capital corresponds to the length of time over which "primary" factors of production are employed to create "secondary" capital goods. Knight (1933, 327) claims the theory involves "fatal confusions" and "can be defended as true only under assumed conditions so divergent from the basic facts of modern economic life that there is a strong presumption against employing it fruitfully as a tool of analysis." He has three main criticisms. First, there is no distinction between primary and secondary factors. Second, "there is no productive cycle, or length of production period, which has determinate length or meaning" (328). Third, the theory of capital is not involved in business cycle theory. Knight also restates his views on the determination of the interest rate, the permanence of capital, and the simultaneity of production and consumption in a stationary state, which eliminates any interval of a production period.

Hayek (1934)² responds to criticisms of the period of production by acknowledging that the average period of production depends on the rate

2. Hayek 1934 is, in part, an implicit reply to Knight 1933 as well as to Burchardt 1932–33 and Hill 1933.

Table 1 Chronology of the Hayek/Knight Capital Controversy

1927	Hayek, "On the Problem of the Theory of Interest"
1928	Hayek, "Intertemporal Price Equilibrium and Movements in the Value of Money"
1931	Knight, "Professor Fisher's Interest Theory: A Case in Point" Hayek, <i>Prices and Production</i>
1932	Knight, "Interest" Burchardt, "Die Schemata des stationären Kreislaufs bei Böhm-Bawerk und Marx"
1933	Hayek, "Price Expectations, Monetary Disturbances, and Malinvestments" Edelberg, "The Ricardian Theory of Profits" Hill, "The Period of Production and Industrial Fluctuations" Gifford, "The Concept of the Length of the Period of Production" Knight, "Capitalistic Production, Time, and the Rate of Return"
1934	Marschak, "A Note on the Period of Production" Hayek, "On the Relationship between Investment and Output" Knight, "Capital, Time, and the Interest Rate"
1935	Knight, "Professor Hayek and the Theory of Investment" Hayek, <i>Prices and Production</i> , 2d ed. Knight, "The Ricardian Theory of Production and Distribution" Hayek, "The Maintenance of Capital"
1936	Hayek, "The Mythology of Capital" Hayek, Letter of 16 July 1935 to Knight* Knight, Letter of 15 August 1935 to Hayek* Knight, Letter of 7 October 1935 to Hayek* Hayek, "Utility Analysis and Interest" Hayek, Letter of 21 June to Knight Knight, Letter of 2 July to Hayek Knight, "The Quantity of Capital and the Rate of Interest" (pts. 1–2)
1937	Hayek, "Economics and Knowledge"
1939	Hayek, <i>Profits, Interest, and Investment</i>
1941	Hayek, <i>The Pure Theory of Capital</i>
1944	Knight, "Diminishing Returns from Investment"

Note: The main publications in which the controversy played out are in boldface.

*These three letters were exchanged after Hayek sent a draft of "Mythology" to Knight; hence their placement in the chronology.

of interest. It is not a “technical datum,” and the “backward-looking interpretation of the ‘period of production’ will always lead to absurd conclusions” (227). He then develops new concepts of the investment function and the period of investment. Hayek claims, contrary to Knight, that “the concept of a definite time-structure of investment is even more important for the understanding of the dynamic processes of the accumulation and consumption of capital than for the mere description of the conditions of a stationary equilibrium” (208). He emphasizes how the specificity of capital goods determines how changes in the interest rate affect the period of investment, and attacks Knight’s concept of perpetual, homogeneous capital. Hayek maintains that a decrease in the interest rate will increase both roundaboutness and the quantity of capital.

Knight’s (1935c) response to Hayek (1934)³ reiterates his claim that there is no intelligible meaning to a period of production, and hence no determinate connections with the quantity of investment, or with the quantity, durability, or construction period of capital. Knight (1934, 275), drawing on his view that “production and consumption are simultaneous,” claims that “the production period for consumed services, if the expression is to be used at all, is zero.” Knight (1935c, 88) also claims that “the production period for the capital equipment of society is all past economic history”—an assertion based on his interpretation of the period of production as looking infinitely backwards to original, primary factors. In defending the concept of permanent capital, Knight contends that liquidation of capital never occurs in a stationary or progressive society, and that in a depression, liquidation does not destroy physical capital but simply converts it into money.

The published controversy climaxes in 1936. Hayek (1936b, 200) agrees that Böhm-Bawerk’s conception of the average period of production is flawed—“I have full sympathy with those who see in the concept of a single or average period of production a meaningless abstraction which has little if any relationship to anything in the real world.” And he rejects any distinction between original and produced means of production, claiming his own theory does not depend on such a distinction. Hayek says, “There is no other author with whom I feel myself so much in agreement, even on some of the central questions of the theory of interest, as with Professor Knight,” and he goes on to praise Knight’s

3. Knight 1934 covers much of the same ground, but Knight (1935c, 94 n) says “no one is under compulsion to read both articles.”

“masterly expositions of the relationship between the productivity and the ‘time-preference’ element in the determination of the rate of interest” (201).

The key disagreement is over Knight’s conception of capital as a permanent fund. According to Hayek, Knight’s conception serves “to eliminate time entirely from the analysis of the capitalist process of production” (1936b, 222) and “prevents him from seeing at all how the choice of particular methods of production is dependent on the supply of capital, and from explaining the process by which capital is being maintained or transformed” (204). For Hayek, Knight’s permanent fund of capital and J. B. Clark’s “true capital”

are just so many evasions of the real problem of explaining how the existence of a given stock of capital limits the possibility of current investment. Without such an analysis they are just so many empty words, harmful as the basis of the noxious mythology of capital which by creating the fiction of a non-existing entity leads to statements which refer to nothing in the real world. (222)

Knight began the controversy by claiming Hayek’s concepts are hopelessly “divergent from the basic facts of modern economic life,” and Hayek concludes it with an attack in kind on Knight’s concepts as a “fiction” unconnected to “the real world.”

Knight never responds directly in print. Hayek sends Knight the manuscript of “Mythology” (“the enclosed draft of a reply to your strictures”) in a letter of 16 July 1935 (Hayek 1935a). Knight (1935a) responds on 15 August 1935, writing, “There is very little that I could say in reply that would be worth saying. . . . For the most part, you seem to me merely to reiterate dogmatically that quantity of capital has to have some meaning and that the only meaning you can see is length of production period.” And in a subsequent letter of 7 October 1935, Knight (1935b) declines to respond publicly to “Mythology,” saying, “I have lost interest in carrying the controversy any further in print.” When Hayek (1936a) invites Knight in a letter of 21 June 1936 to comment on the manuscript of *The Pure Theory of Capital* (PTC), Knight (1936a) politely declines, citing other work commitments.

In his most important articles on capital theory, Knight (1936b, 1936c, 1944) makes no new criticisms of Hayek. Similarly Hayek, in *PTC*, does not develop new criticisms of Knight, saying that “what I have to say

about [Knight's view of capital as a perpetual mystical fund] I have said in another place [1936], and here I shall not discuss it again" (1941, 94).

Agreements

As in the controversy between Böhm-Bawerk and Clark (Cohen 1993; Cohen and Drost 1996), Hayek and Knight agree more than one might think from reading their blunt interchanges. Areas of agreement include stationary state conditions, indistinguishable primary and secondary factors of production, interest-related measurement problems with capital, the unimportance of time preference, and the importance of productivity in determining the interest rate.

In the stationary state, Hayek (1934, 226) allows that Knight's concept of the simultaneity of production and consumption (which is the same as Clark's synchronization) is true.

In response to criticism, Hayek agrees with Knight in rejecting any distinction between primary and secondary factors of production (Böhm-Bawerk's original and produced factors). Hayek (1936b, 208) claims his theory does not depend on this distinction:

It is quite erroneous to regard propositions concerning the greater productivity of roundabout methods as depending upon the possibility of identifying the contribution of the "original" factors of the remote past. . . . *only the future time intervals* between the moments when the factors are, or will be invested, and the moment when the product will mature are relevant, and *never the past periods* which have elapsed since the investment of some "original factors." The theory looks forward, not back.

Hayek also comes to agree with Knight that, due to measurement problems, there is no unique relationship between the quantity of capital, roundaboutness of production, and the interest rate. Knight's position (1935c, 81) is that "the quantity of the capital bears no simple or definite relation either to its durability or to any definable time interval." Hayek (1936b, 206) says it is "*inadmissible, to reduce the description of the range of periods for which different factors are invested to . . . a single time dimension such as the average period of production.*"

Time preference plays a relatively unimportant role in determining the interest rate for both authors. Hayek ([1927] 1984, 64) and Knight (1934, 272 n) both reject the notion of inherent positive time preference

and agree that subjective factors play little role in the determination of interest. Time preference determines only the rate of savings and when stationary equilibrium is reached. Hayek (1936c, 58 n) says, “The credit of having brought out this point clearly is entirely due to Professor F.H. Knight, with whose more recent statements on this point I find myself in complete agreement.”

With time preference off to the side, Hayek (1936c, 58) also agrees with Knight that the expected productivity of investment determines the rate of interest—“the rate of interest is determined practically by the productivity of investment alone.” Despite the shared emphasis on technical productivity, important differences remain between the authors. For Hayek, the interest rate is the outcome of a historical process of intertemporal optimization mediated by a particular time structure of production, where the productivity of investment (Böhm-Bawerk’s third reason for interest) is the most important determining variable. For Knight, the rate of interest within equilibrium price theory *is* the marginal productivity of capital, with no mediating factors.

Issues in the Hayek/Knight Capital Controversy

While the major issue in the controversy is differing conceptions of capital, subsidiary, related issues include the origin of cycles, determinants of the interest rate, and limitations of equilibrium analysis. We will consider each in turn.

Capital Conceptions

Key differences over conceptions of capital prompt Hayek’s attacks on Knight’s homogeneous, permanent fund of value and Knight’s attacks on Hayek’s claim that the quantity of capital corresponds to the length of the period of production or period of investment.

Hayek (1934, 228–29) first attacks the homogeneous nature of Knight’s fund of capital, in a passage that clearly describes and rejects the idea of putty capital:

The notion that capital . . . is completely mobile and can at will and without any loss of value be transformed in any concrete form, . . . would be true only if the concrete capital goods were just so many units of homogeneous “energy” which could be put to any use, *i.e.*

if they were completely non-specific. But this . . . corresponds even less to reality than the assumption of complete specificity. . . . *all* the capital goods existing at any one moment are at least partly the result of an historical process which again and again has put existing capital goods to other uses than those for which they were originally intended, and that in consequence the actual form that capital takes will be very different from what it would be if the structure could be built up *ab ovo* with the help of an equivalent fund of free capital.

In attacking Knight, Hayek also defends his own emphasis on specific, heterogeneous capital goods. Hayek argues time and again that while capital goods have some flexibility of purpose, their specificity is a core cause of cycles. In the face of unexpected changes, the specific capital structure “limits the choice among the known methods of production” (1936b, 214), causing cycles that would not happen if the capital stock could be costlessly restructured to optimally match the new conditions.⁴

Hayek then attacks the permanence of Knight’s fund of capital. He calls Knight’s “basic mistake . . . the idea of capital as a fund which maintains itself automatically” and rejects Knight’s claim that “once an amount of capital has been brought into existence, the necessity of re-producing it presents no economic problem” (1936b, 201–2).

Knight’s permanent capital concept eliminates the possibility of analyzing what are, for Hayek, crucial cycle problems. The income stream from an initial investment

becomes a permanent income stream only by an infinite series of further decisions. . . . By jumping directly to the desired result, the permanent income stream, Professor Knight slurs over so much that is essential for an understanding of the process that any use of his concept of capital for an analysis of . . . the course of further changes becomes quite impossible. (1936b, 208 n)

4. Hayek’s attack on Knight later resurfaces in Joan Robinson’s attack on movements along a “pseudoproduction function.” She argued that “each equilibrium point represents a situation in which prices and wages have been expected, over a long past, to be what they are today, so that all investments have been made in the form that promises to yield the maximum net return. . . . The effect of a change in factor prices cannot be discussed in these terms. Time, so to say, runs at right angles to the page at each point on the curve. To move from one point to another we would have either to rewrite past history or to embark upon a long future” (1973, 103–4). Each point on a neoclassical production function represents an optimal capital structure built up *ab ovo* to match the corresponding factor prices. But with specific capital goods, an unexpected change leads to a historical process (a long future) that puts existing capital goods to other uses than those for which they were originally intended. The assumption of putty capital precludes the need for historical analysis by allowing one to rewrite past history for each point.

But Knight is not interested in using capital theory to explain cycles, so for him this criticism is irrelevant. Knight's permanent capital concept is consistent with his focus on equilibrium price theory, which he believes is rigorously possible only under static (including steady state) conditions. For Hayek, permanent capital eliminates the basis of his research agenda—the historical process of cyclical change caused by specific capital structures.

The flip side of the capital conceptions controversy is Knight's attack on Hayek's claim that the quantity of capital corresponds to the length of the period of production or period of investment. Hayek asserts that there is an inverse relationship between the interest rate and both the quantity of capital and roundaboutness. Knight rejects this assertion, arguing (as already quoted) that "the quantity of the capital bears no simple or definite relation either to its durability or to any definable time interval" (1935c, 81) and that "correspondences in this field are limited and accidental, without theoretical significance for the nature and rôle of capital" (88).

Knight is correct in the sense that Hayek never provides a precise model or explicit proof of his claims. Hayek (1941, 141–42) also freely acknowledges that "all attempts to reduce the complex structure of waiting periods . . . are bound to fail, because the different waiting periods cannot be reduced to a common denominator in purely technical terms."⁵

Hayek goes on to succinctly identify a problem that Knut Wicksell first clearly identified and that later plays a major role in the Cambridge controversies—attempting to measure capital independently of the rate of interest.⁶ With heterogeneous inputs,

5. Hayek (1941, 142) notes that the one attempt that would succeed depends on the assumptions of a single homogeneous input and one-commodity output, but dismisses this attempt because "neither of these assumptions is true in reality."

6. Wicksell ([1911] 1934, 149) described the fundamental problem heterogeneous capital goods create for the measurement of capital: "Whereas labour and land are measured each in terms of its own technical unit (e.g. working days or months, acre per annum)[,] capital . . . is reckoned . . . as a sum of exchange value—whether in money or as an average of products. In other words, each particular capital-good is measured by a unit extraneous to itself. [This] is a theoretical anomaly which disturbs the correspondence which would otherwise exist between all the factors of production. The productive contribution of a piece of technical capital, such as a steam engine, is determined not by its cost but by the horse-power which it develops, and by the excess or scarcity of similar machines. If capital were to be measured in technical units, the defect would be remedied and the correspondence would be complete. But, in that case, productive capital would have to be distributed into as many categories as there are kinds of tools, machinery, and materials, etc., and a unified treatment of the role of capital in production would be impossible. Even then we should only know the yield of the various objects at a

in order to arrive at an aggregate . . . amount of waiting involved in each process we have to assign definite 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, 143)

Despite recognizing all of the “ambiguities and inconsistencies” with measuring capital and the period of production, Hayek continues to assert the importance of these concepts and relations. He believes that Knight’s suggestion to dismiss the production period concepts because of their imprecision “serves to expel the idea of time from capital theory altogether” (Hayek 1936b, 206).

In a clever debating tactic, Hayek (1936b, 216–17) also counters Knight’s criticism of the immeasurability of periods of production by appropriating Knight’s own defense of maintaining perpetual capital intact. Knight (1935c, 90 n) says, “The notion of maintaining any capital quantitatively intact cannot be given exact definition; but this limitation applies to all quantitative analysis in economics, and the notion itself is clear and indispensable.” Knight’s “limitation,” Hayek points out, could equally be applied to the notion of a production period, which, although not capable of exact quantification, is clear and indispensable (at least to Hayek).

Knight (1935a) responds to this counterargument in correspondence, having been sent a draft of Hayek’s “Mythology” article:

As to what you say . . . about the difficulties of measuring quantity of capital, I should like to reply in the terms of a momentarily popular piece of American slang—“So’s your old man.” This is our boobery’s way of referring to the type of “argument” referred to in logic as *tu quo que*. What I mean is that whatever may be the difficulties of measuring the quantity of capital, those of measuring any production period are almost infinitely greater; and “incidentally” you have to my knowledge never made any suggestion as to how one would even attack the problem. (In fact, you would have to get the quantity of capital first,

particular moment, but nothing at all about the value of the goods themselves, which it is necessary to know in order to calculate the rate of interest, which in equilibrium is the same on all capital.” See Cohen and Harcourt 2003 on the implications of this problem for the Cambridge capital theory controversies.

and divide by some arbitrarily selected income flow, in or out, as I have suggested two or three times in print.) I have never blinked, and in fact have emphasized, the difficulties of giving the notion of capital quantity any precise meaning, and the fact that it certainly cannot be done when economic conditions are changing. But I have also pointed out that neither can any other economic magnitude whatever be given an “absolute” definition.

While Knight has similar measurement problems (which he bypasses in his 1944 Crusonia plant model), the imprecision and weaknesses in Hayek’s capital theory still remain. Hayek provides a powerful and intuitive vision of capital and the structure of production that emphasizes specific, heterogeneous capital goods, and he recognizes the complications and problems this causes for his theories. But he never follows through with definite models or precise results that address the complications and problems.

Knight’s Crusonia plant model is consistent and precise in illustrating Knight’s conception of capital as a permanent, homogeneous fund of value. It also provides a powerful and intuitive vision in which interest is determined in equilibrium entirely by the technical marginal productivity of capital. But it is based on extremely restrictive one-commodity assumptions that eliminate capital-measurement problems. Although Hayek never comments directly, his criticism of models of production as organic growth is easily applied to the Crusonia plant model, which is directly in that tradition:

The technically given structure of investment is rarely if ever so simple . . . that particular units of [output] can always be unequivocally ascribed to particular quantities of input. The popularity which the examples of the growing of trees or the maturing of wine have enjoyed . . . is due to the fact that these examples correspond pretty closely to this simplest of cases, the “point input–point output” case. But to assume that all cases of investment can be treated on these lines is to evade the main problems. (Hayek 1941, 151)

Thus the accusations of unreality that each hurls at the other—Knight’s claim that Hayek’s concepts are hopelessly “divergent from the basic facts of modern economic life,” and Hayek’s attacks on Knight’s concepts as a “fiction” unconnected to “the real world”—are justified,

in the sense that neither author can rigorously sustain his conception of capital outside of a one-commodity model.

Origins of Cycles

Hayek and Knight often argue at cross-purposes, simply repeating their own positions because the other doesn't seem to hear or respond to the arguments offered. Knight (1935c, 94 n), with tongue only partly in cheek, justifies this by quoting Herbert Spencer: "Only by varied iteration can alien conceptions be forced on reluctant minds." This pattern of argument results not only from different capital conceptions, but also from different explanations of the origins of cycles.

Hayek's major concern is to explain business cycles. His interest in capital theory is derivative, as a necessary foundation for explaining business cycles caused by changes in the time structure of production. On the other hand, Knight has little interest in cycles. He sees cycles as originating from monetary factors and price stickiness. Cycles are due to frictions in the equilibrium process which, with freely flowing mobile capital, would lead to efficient allocation and smooth growth. There is no connection between cycle theory and capital theory for Knight.

These differences cause conflicts in analyzing the liquidation of investments under changing conditions. Most of Hayek's work during this period is devoted to analyzing how changes in the interest rate, expectations, or investment affect the real structure of production and contribute to cycles. Period-of-production analysis for Hayek is essential for answering "the fundamental question: how the limitation of the available capital limits the choice among the known methods of production" (1936b, 214). With Hayek's emphasis on heterogeneous, specific capital goods, changing conditions cause problems of obsolescence, economic depreciation, maladjustments, Wicksell effects, and cycles.⁷

Knight (1935c, 91) claims liquidation is a monetary phenomenon, not a real phenomenon: "What people really want to do . . . by way of liquidating investments, especially in connection with a depression, is to convert them into 'money,' not into consumable product, and this is . . . a problem in the theory of money, and not one in the theory of capital or production." Knight acknowledges Hayek's concerns about how

7. A referee points out that the Austrian experience with disinvestments in the early 1930s may have influenced Hayek.

the existing structure of production limits choices when circumstances change, but sees the problems as price stickiness, not capital structure:

A depression, in its critical aspect of serious unemployment (of persons and property) no doubt generally involves more or less previous mistaken commitment of resources, human and non-human, sustained by immobility. But it is *essentially* a matter of price maladjustment, sustained by price stickiness. If labour were mobile and wages flexible, no fixity in the capital structure would give rise to unemployment, of labour or capital, though efficiency might be greatly reduced. (94)

Knight's final response to the analysis of unanticipated changes is to simply rule it out of bounds for economic analysis:

Any unanticipated change in conditions will create a discrepancy . . . between the historical cost of capital instruments and their value on the capitalisation basis; . . . in any such a case, the historical cost will be treated as if it did not exist. The amount of capital is always the capitalised value of an expected future stream of services. When conditions change, capital simply appears or/and disappears, and is written up or written down without reference to "production." Such an event is not a part of the economic sequence, which consists of acts correctly related to consequences, but represents a discontinuity. (1934, 277)

Knight is aware of the limitations of equilibrium analysis for dealing with what he calls "historical/evolutionary" economics—changes in given conditions. And this is such a change. But this claim is disingenuous on Knight's part and seems to be designed to avoid responding to Hayek's major concerns. When Knight analyzes topics like capital theory that concern him, he stretches the application of equilibrium analysis to suit his purposes. By avoiding the liquidation problems caused by heterogeneous capital goods that are no longer optimally suited to changed conditions, Knight sustains his vision of homogeneous, malleable capital, eliminating any adjustment problems to changing conditions.

What Determines the Interest Rate?

Hayek's heterogeneous, specific capital goods are organized in a particular time structure of production that is central in the determination of the interest rate. The real rate of interest as

determined by the price relationships between capital goods and consumers' goods is thus prior to, and in principle independent of, the interest on money loans. . . . The fundamental price relationships are the result of a demand for capital goods in terms of consumers' goods or of an exchange of present consumers' goods for future consumers' goods. (Hayek 1941, 266)

The real rate of interest is the outcome of intertemporal price decisions for capital versus consumer goods, and for present versus future consumer goods. Hayek (1941, 353) describes the real rate of interest as “not a price paid for any particular thing, but a rate of differences between prices which pervades the whole price structure.”

Despite the intertemporal conception of the interest rate, Hayek believes in a tendency towards a uniform rate of interest or real rate of return. He describes “a system of rates of profit, which in terms of any one commodity will tend to correspond to a uniform time rate” (1941, 354).

For Knight, the real rate of interest is a price paid for a particular thing—the marginal productivity of capital. In the one-commodity Crusonia plant model, which eliminates all of the complications of heterogeneous capital goods, the rate of interest is equal to the natural growth rate of the plant. Investment can only take the form of sacrificed consumption, and the real rate of interest is “the rate of growth in the capital (potential, permanent, and constant consumable income) . . . to the rate of consumption sacrificed for the sake of investment” (1944, 31).

The homogeneous Crusonia plant, as capital, is self-perpetuating and permanent, exemplifying Knight's conception of capital as a homogeneous, permanent fund of value. Production and consumption are simultaneous, and without any inputs there is no period of production. Although Knight emphasizes the fund concept of capital, the rate of interest is determined purely by the technical productivity of the homogeneous capital good—the plant.

Limitations of Equilibrium Analysis

Beyond the stationary state, both Hayek and Knight are keenly aware of the serious limitations of equilibrium analysis for explaining issues in which each is interested. Knight's interests, besides equilibrium price theory, are in investment, saving, and the determination of interest in the

capital market. Hayek's interests are in business cycle theory and, later, in the coordination of knowledge. Yet, during their controversy, both continue using equilibrium analysis despite voicing serious reservations about its limitations. With these contradictions between preachings and practices, Hayek's attack on Knight over this issue belies the remarkable agreement between the authors.

Knight (1935f) distinguishes between statics (equilibrium under given conditions), dynamics (movements toward or away from equilibrium under given conditions), and historical/evolutionary economics (changes in given conditions). Knight (1936c, 614) believes that the statics of "normal-equilibrium price analysis has no application to a situation of . . . the capital market." Because the stock of capital can grow or fall "without a definite prospect of coming to a stationary level" (616), equilibrium price theory is inapplicable. What is needed instead is "a special methodology" that can deal with "historical changes" (617).

Despite these statements, Knight uses equilibrium models in his analysis, albeit with sometimes unorthodox modifications. Thus he applies a static, equilibrium framework to the analysis of historical changes in the capital market. Hayek (1936b, 227) picks up on this contradiction: "The emphasis which [Knight] places on the complete mobility of capital certainly conveys the impression that he wants to apply his concept to dynamic phenomena." Hayek points out that Knight himself acknowledges that the concept is not so applicable. Hayek (1936b, 227 n) quotes Knight (1931, 206): "The one important difference between . . . interest and . . . ordinary prices arises from the fact that saving and investment is a cumulative process. It is a phase of economic growth, outside the framework of the conventional "static" system."

Hayek correctly identifies the contradictions in Knight's use of the equilibrium/statics method. Knight does want to deal with a changing world, and recognizes that his tools are more correctly limited to a static world. Yet Knight plunges ahead with his equilibrium analysis anyway.

Knight never responds to Hayek on this point of methodology. This is not surprising, since the authors have remarkably similar concepts of long-run, historical change and the inapplicability of equilibrium analysis. Knight (1931, 210) states that "long-run, historical changes must be faced as problems of historical causality and treated in terms of concepts very different from those of given supply and demand functions and a tendency toward equilibrium under given conditions." Hayek (1941, 17) uses the concept of "broad dynamics" to denote historical change as an

“explanation of the economic process as it proceeds in time, an explanation in terms of causation which must necessarily be treated as a chain of historical sequences.” The descriptions are almost identical in emphasizing historical causality.⁸

Hayek’s interest in business cycles leads him to such historical, non-equilibrium explanations. As early as 1934 he states that “once unforeseen changes occur after capital has been invested in a definite form, all further investment will be influenced by the historical accident of the existence of certain capital goods, and the movement towards a state of equilibrium will at best be an asymptotic movement” (1934, 227).

As Bruce Caldwell (1988) notes, by the time Hayek writes *PTC* and begins shifting attention to the coordination of the knowledge problem, he gives up on his earlier view of equilibrium analysis as “identical with that of economic theory” (Hayek [1928] 1984, 75). He comes to believe that “causal explanation of the process in time is of course the ultimate goal of all economic analysis, and equilibrium analysis is significant only in so far as it is preparatory to this main task” (1941, 17).

Capital theory and the role of specific capital goods in limiting and directing future investment and growth fall clearly into the category of subjects that must be analyzed in historical terms rather than the equilibrium framework of the stationary state. “The very existence of non-permanent resources which will not or cannot be reproduced in an identical form is incompatible with the idea of a strictly stationary, repetitive process. It will always cause a process of continuous change in which each step is determined by the historical accident of the existence of a certain collection of non-permanent resources” (Hayek 1941, 297).

Conclusion

The Hayek/Knight controversy revolves around fundamentally different capital conceptions and, not surprisingly, ends without a satisfying resolution. Both authors abandon their attempts to convince each other, and, after the controversy peters out, publish major works on capital theory

8. Hayek’s focus on historical causality emerges from his growing belief in the limitations of equilibrium analysis: “The fundamental problem of all economic theory . . . is . . . the question of the significance of the concept of equilibrium and its relevance to the explanation of a process which takes place in time. . . . some of the formulations of the theory of equilibrium prove to be of little use and . . . not only their particular content but also the idea of equilibrium as such which they use will require a certain amount of revision” ([1933] 1939, 138).

(Knight 1936b, 1936c, 1944; Hayek 1941) that say nothing new about each other's work.

In the heat of the controversy, Knight pillories the Austrian concepts of roundaboutness, the period of production, and the associated distinction between original and produced factors of production. He attacks what he calls the Jevons/Böhm-Bawerk/Wicksell/Hayek theory—that the quantity of capital corresponds to the length of time over which “primary” factors of production are employed to create “secondary” capital goods. Knight argues that there is no distinction between primary and secondary factors, and that the period of production is an unmeasurable and irrelevant concept, uncorrelated with the quantity of capital. Knight also rejects the use of capital theory to explain business cycles.

Hayek agrees with Knight's rejection of the distinction between primary and secondary factors, claiming that his theory does not depend on any such distinction. Hayek also recognizes the measurability problems associated with any period of production, due to the influence of the interest rate on the calculation of the length of any production period. Outside of a model with a single homogeneous input and one-commodity output, Hayek (1941, 141–42) freely acknowledges that “all attempts to reduce the complex structure of waiting periods . . . are bound to fail, because the different waiting periods cannot be reduced to a common denominator in purely technical terms.”

But Hayek continues to insist on the importance of the concept of a period of production for understanding the *historical processes* whereby changes in the interest rate affect methods of production and how the existing capital stock limits investment possibilities. Hayek steadfastly maintains that decreases in the interest rate will prompt more roundabout, capital-intensive production, even though he cannot prove this result in heterogeneous goods models. Correspondingly, Hayek's main criticism of Knight's concept of a permanent fund of capital is that it purges time from the analysis of the *process* of production. Without roundaboutness, Knight has no story explaining the determination of the real interest rate, which Hayek finds unsatisfactory. Hayek's story has interest as the outcome of intertemporal price decisions for capital versus consumer goods, and for present versus future consumer goods.

Throughout the controversy, Knight and Hayek accuse each other of unrealism. The accusations are justified in that neither can sustain his

capital conception outside of a one-commodity model. This inability to extend results to more general models prevents the two authors from resolving this point of contention. Without more general results, Knight, and especially Hayek, resort to repeated assertions of the truth of their conceptions, but without proof.

Differing interests in capital theory also contribute to the lack of resolution as well as to repeated arguments at cross-purposes. Knight's primary interest is in a price-theoretical explanation of interest. Hayek's interest in capital theory is secondary, emanating from his primary interest in business cycles. The valuable insights for Hayek that specific capital goods and periods of production contribute to explaining cycles are irrelevant to Knight.

The differences between Hayek and Knight over what determines the interest rate are so vast that a resolution is impossible. For Hayek, the interest rate is the outcome of dynamic processes of intertemporal optimization by both consumers and firms. Knight understands the interest rate as determined in steady state equilibrium by the technical productivity of homogeneous capital alone. A final factor in the unresolved controversy between Knight and Hayek is the shared awareness of the limitations of equilibrium for analyzing capital theory or business cycles. The controversy occurs as they are moving in opposite directions on the role and applicability of economic theory. Knight is ruling more and more phenomena out of economic bounds, while Hayek is moving to expand the boundaries of economics to include more coordination-of-knowledge phenomena (Emmett 1998; Boettke and Vaughn 2002). Despite their reservations, both continue using equilibrium methodology during their controversy. When Hayek calls Knight on this contradiction, Knight does not respond, perhaps because he agreed. But Knight never develops the "special methodology" that he says is necessary to deal with the long-run, historical changes that characterize the capital market. Instead, he disengages and stands behind his simplifying assumptions that eliminate change, adhering to the insights and results of his capital conception in the one-commodity Crusonia plant model. Hayek, on the other hand, turns away from equilibrium analysis altogether, and moves outside the boundaries of traditional economic theory to tackle the problems of the coordination of knowledge. No debate on equilibrium is ever joined.

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