

ULRICH FEHL'S CONTRIBUTION TO TEMPORAL CAPITAL THEORY

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ABSTRACT: This paper briefly summarizes Ulrich Fehl's important contributions to Austrian capital theory. While his work is well known in Europe he remains a relative unknown to the English speaking world. The intent of this paper is to introduce Ulrich Fehl to English-speaking economists who are interested in the Austrian School of economics.

Ulrich Fehl (born in 1939) was full professor for General Economic Theory at Philipps-University in Marburg (Germany) from 1987 until his retirement in late 2004. He studied economics in Münster, Gießen, and Erlangen/Nuremberg. In 1971 he received his Ph.D. from Philipps-University. From 1980 until 1987 he held the chair for economic theory at Carl-von-Ossietzky-University in Oldenburg (Germany). During this time, Fehl was a lecturer and an assistant professor holding the Ernst Heuss chairs in Erlangen/Nuremberg and Marburg.

I. ULRICH FEHL—GERMAN ECONOMIST OF DISTINCTION

Ulrich Fehl is one of the last universally educated scholars among contemporary German economists. His academic work comprises profound research and teaching macro- as well as microeconomics. Fehl's scope of thinking also extends beyond economics into history and social philosophy. Throughout his academic life, Ulrich Fehl has been a strong proponent of

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evolutionary and Austrian thought among German academic economists. However, owing to the fact that he firmly believes in the traditional value of German as a scientific language, his work has not yet gained the recognition it deserves within the international community of modern Austrian economists, whose *lingua franca* happens to be English. This paper briefly summarizes Ulrich Fehl's most important contributions to Austrian capital theory. It aims to make them accessible to English speaking economists who are interested in the Austrian School of economics.

II. THE REVIVAL OF AUSTRIAN CAPITAL THEORY IN THE 1970s

Fehl's major and most original contributions to Austrian capital theory date from the 1970s. Since the 1980s Fehl concentrated on market-process theory. A very distinctive feature of his approach to market process theory is, however, that it remains deeply rooted in capital theory. Nevertheless, the present paper focuses on a series of books and papers that Fehl wrote between 1973 and 1976. In these, he elaborated on his fundamental thoughts on capital theory in a most clear and formally captivating manner.

In the 1930s, Austrian capital theory, which stresses the time aspect of production, was still an important foundational pillar to the Austrian School of economic thought and influential among many German-speaking economists. Nevertheless, Austrian capital theory fell into oblivion after the great capital theory controversies. More than three decades elapsed before there was some kind of a revival in the 1960s and 1970s. What was probably the most widely discussed new Austrian approach was brought forward by John Hicks (1965; 1973). However, Faber emphasizes that Hicks is a Neo-Austrian only insofar as he takes into consideration the vertical time structure of the production process. Beyond this he does not use the Austrian concepts of the superiority of roundabout models, of time preference, and of the period of production (Faber 1979, pp. 164 ff.). Other scholars, among them Bernholz and Faber himself, tried to employ the concepts of the superiority of roundabout methods and of time preference to prove that the rate of interest is positive. This approach had been formalized by using linear multi-period and multi-sector models. Bernholz's and Faber's further research aimed at relating this formal approach to the Marxian theory of value, the von Neumann-model, neoclassical growth theory, and finally Hicks's theory of capital (Faber 1979, p. V).

In contrast to these approaches, Ulrich Fehl maintained and rehabilitated the period of production as the core concept of Austrian capital theory, which had been widely criticized as being dubious in the 1930s. Thus, Fehl is among the scholars whose work on capital theory is in direct succession to Böhm-Bawerk's.

III. THE PERIOD OF PRODUCTION AND THE PRODUCTION FUNCTION

Ulrich Fehl's (1973) most important contribution to Austrian capital theory is *Produktionsfunktion und Produktionsperiode* ("Production Function and Period of Production"). The first chapters of this book comprise a comprehensive and formally compelling summary of Böhm-Bawerk's temporal-capital theory. Fehl highlights Böhm-Bawerk's idea of a multi-stage (or multi-ring) structure of production: original labor inputs move stepwise forward through several stages of capital goods production and additional amounts of labor are added at each stage. Finally, consumer goods move out at the last stage of production. The more stages an economy contains—i.e., the more "roundabout" its structure of production is—the more productive it will be in time, provided the roundabout process is sufficiently well chosen. In terms of the history of ideas, this concept is based on Menger's concept of a hierarchy of goods (consumer goods are goods of lowest order, while capital goods and basic labor inputs are placed at multiple stages of higher order), and on Wicksell's conception of time as a vehicle for the maturing of goods on their way toward consumption.

The larger part of the book, however, is dedicated to a revision and critique of Böhm-Bawerk's approach, and to a thorough discussion of the main (neoclassical) objections to the Austrian concept of the average period of production. Here, the first key issue that Fehl addresses is the question of whether Böhm-Bawerk had developed a macro- or a microeconomic theory, or both. Böhm-Bawerk himself always remained vague on this issue, and this vagueness brought forth criticism from those espousing the atemporal, neo-classical theory of capital and growth. Fehl emphasizes that traditional, temporal capital theory is a macro-approach by nature since its pivotal notion—the average period of production—is not part of the individual entrepreneur's calculus. Instead, for the entrepreneur, only the subjectively immediate dimensions of cost and revenue are elements of decision making. This does not render the average period of production less instructive—it is still a key tool for analyzing the production process from a scientific perspective. Its specific appearance depends on (a) the allocation of labor

to specific stages of production, (b) the number of specific stages of production, and (c) the temporal length of specific stages of production.

The key insight Fehl gains from his revision and critique of Böhm-Bawerk's capital theory is that it needs to be complemented with a sound microeconomic foundation. Therefore, he derives a set of temporal production functions which, at the analytic, micro-level, are compatible with Böhm-Bawerk's macro-level deduction of the average production period. This is the major achievement of *Produktionsfunktion und Produktionsperiode* for temporal capital theory. Starting from Allais's concept of the temporal production function, Fehl performs his exercise with substantial formal rigor. However, at this point, the approach is attached to equilibrium theory. Since economic reality is associated with ubiquitous dis-equilibria, Fehl concludes that further research in Austrian capital theory might be performed along the lines drawn by Lachmann (1956), who emphasized that all capital goods are heterogeneous, not only in a temporal respect but also with regards to the multiple specificity of their actual uses (Fehl 1973, p. 309). However, such a step can not be made until the formal foundations of capital theory are sufficiently precise. Hence, in a series of papers following *Produktionsfunktion und Produktionsperiode*, Ulrich Fehl further developed and clarified Böhm-Bawerk's initial approach.

IV. THE AVERAGE PRODUCTION FUNCTION AS A BASIC ELEMENT OF TEMPORAL CAPITAL THEORY

In "Die durchschnittliche Produktionsperiode als Grundbegriff der temporalen Kapitaltheorie—Bestandsaufnahme und Neufassung" ("The Average Production Function as a Basic Element of Temporal Capital Theory—Stock Taking and Revision") Fehl (1976a) examines how Böhm-Bawerk's concept of the average production function relates to John Hicks's (1965) respective (microeconomic) concept.

Hicks's objective is to understand more clearly the role of interest rate variations for the structure of production and capital, while Böhm-Bawerk's initial concept of the average period of production predominantly copes with the labor inputs on the several stages of the production process. Fehl demonstrates that Hicks's *Capital and Value* in fact does not yield the information it aims at. Instead, it is more of a contribution to the theory of income distribution rather than to capital theory. In further steps of his analysis, Fehl undertakes to meet the initial objective of Hicks's analysis, i.e., to integrate the "value relations" implied in the temporal structure of production with the concept of the average production function. He tackles this task by developing a weighing scheme

for the different stages of production. The weighing scheme is based on the insight that labor inputs may be measured in terms of productivity—early labor inputs (in relation to the point of time at which consumer goods move out of the last stage of the production process) have a higher marginal productivity than later labor inputs. Absolute rates of productivity increase from stage to stage. Finally, the period of production as defined by FehI's new weighing scheme equals the capital-output ratio. While Böhm-Bawerk's average period of production does not explicitly comprise the interest rate, the capital-output ratio does. At this point in the analysis, FehI is able to demonstrate how changes in the ratio of wages to interest affect the temporal composition of the capital stock in terms of the value relations between the single stages of production. He emphasizes that Böhm-Bawerk's average period of production equals the capital-output ratio only if Wicksell-effects are excluded. This is only the case as long as the factor-price curve is linear and the differential between net marginal productivity of the capital stock and the interest rate is zero. This is a significant step beyond Böhm-Bawerk, because revaluations of the capital stock relative to the output (measured in consumer goods) can now be understood as a result of positive or negative Wicksell-effects, depending on the actual curvature of the factor-price curve.

FehI further elaborates on the consequences of this result in an article on Wicksell-effects and how they relate to the formation of the capital stock (FehI 1976b).

V. WICKSELL-EFFECTS AND CAPITAL ACCUMULATION

FehI shows that Wicksell-effects, i.e., the occurrence of a positive differential between the capital stock's marginal productivity and the interest rate, are in fact the result of ubiquitous revaluations of the capital stock itself, which appear in the course of accumulation. One can conceive of the Wicksell-effect as a key link between capital theory and market-process theory. Any revaluation of the capital stocks takes place because factor intensities vary over the different stages of production. Hence, the structure of relative prices changes when factor-price relations change.

Up to this point, FehI's findings basically remain in line with insights derived by means of comparative-static analysis within a neoclassical, two-sector model. However, FehI goes beyond comparative-static analysis and asks whether the Wicksell-effect is not only related to variations of a given capital stock, but also plays a role for the process of capital formation itself. Neoclassical, comparative-static analysis of alternative

states of capital accumulation cannot answer this question. Instead, the very process or period of transition between two states needs to be explained. For this purpose, Fehl resorts to a hypothesis which Wicksell had developed about the ubiquitous occurrence of differentials between interest rates and the net marginal productivity of capital. Wicksell hypothesized that, in the course of capital formation, a part of the necessary savings is always used in “unproductive” ways (1961, p. 292)—i.e., in the bidding up of capital values rather than in the creation of quantities of capital. Fehl finds this conjecture confirmed by his own analysis, but he emphasizes that also the reverse effect is possible. Some capital values—in the lower stages of production—are, at the same time, bid down. The bidding up and bidding down of capital values are not to be seen as “unproductive,” but rather reflect market-driven capital restructuring.

IV. TECHNICAL PROGRESS AND EMPLOYMENT FROM THE PERSPECTIVE OF AUSTRIAN ECONOMICS

Ulrich Fehl’s thoughts on temporal capital theory summarized so far assume constant technology. Technical progress and the respective adaptation of the temporal structure of production are covered by a paper he published in 1975.

Fehl begins with a review of John Hicks’s objections to Austrian capital theory. For Hicks, the Austrian approach is of limited analytical range because the concept of the average production period only makes sense if durable capital goods are excluded from the analysis (Hicks 1973, p. 8). Instead, his alternative “Neo-Austrian” approach to capital theory is based on flows of income and expenses, which he directly relates to specific, durable investments. Every single production process has a specific temporal duration (Hicks defines any capital item as a “process”) which is shaped in such a way that its capital value is maximized at a given interest rate. Hicks’s main point of reference is the “simple profile” process of production:

There is a construction period, lasting m weeks, in which labour is applied at a constant rate but in which there is no final output. It is followed by a utilization period, lasting further n weeks, in which labour is supplied at a constant rate—I shall describe this form as a Simple Profile. (Hicks 1973, p. 41)

In the “standard case” all processes employed in a given economy have the same temporal structure.

Today, *Capital and Time* is among the classics of capital theory. It may suffice to summarize Hicks's further inferences in a nutshell. The transition from one steady state growth path to another depends on how technical progress and employment are related to each other and on the role savings play for capital accumulation. Different patterns of technological change require different modes of adaptation in the realm of factor allocation and different temporal relations between savings and consumption. Hicks distinguishes between "neutral," "backward biased," and "forward biased" technological progresses. "Backward bias" implies that labor inputs are saved at early stages of the production process. In the case of "forward bias," labor becomes dispensable at the later stages. If full employment is to be maintained, "forward biased" technological progress requires savings early in the process of transition, while consumption needs to increase later. "Backward biased" technological progress immediately requires higher consumption and "dis-savings" in order to avoid lay-offs. Both transitions are facilitated if wages are flexible. Only if all stages are affected in the same way by technological progress it is deemed "neutral" (Hicks 1973, p. 77). "Neutral technical progress" allows for higher real consumption without any employment problems.

For Fehl, Hicks's main achievement is the very clear analysis of the transition from one growth path to another that may be induced by technological progress (Fehl 1975, p. 175). Nevertheless, he wondered why the classical Austrian concept of the average production period should not be reconcilable with Hicks's classification of technological progress. In *Produktionsfunktion und Produktionsperiode*, Fehl had already complemented Böhm-Bawerk's original approach with a microeconomic foundation consisting of (temporal) production functions. Thereby he solved the problem of attributing initial labor inputs to durable capital goods (1973, pp. 135 ff.). Referring to this fundamental analytic framework, he now deduces that "neutral technical progress" leaves the length of the average production period unchanged. A "forward bias" increases it and a "backward bias" shortens it. The fact that a "forward bias" requires a higher amount of savings in order to nurture the transition process over time now reappears as a longer average period of production: Labor inputs are being withdrawn from the production of consumer goods and relocated to the stage of capital goods production. They require sustenance out of savings throughout the entire transition period. In contrast to this, "backward biased" technical progress implies a transition period during which labor inputs may be sustained at the expense of the capital stock, i.e., through dis-saving.

V. CONCLUDING REMARKS:
FROM CAPITAL THEORY TO MARKET PROCESS THEORY

Temporal capital theory has been, to a significant extent, a traditional domain of German scholars. Scholars like Stackelberg, Strigl, and Eucken were among its last prominent representatives. Ulrich Fehl's book *Produktionsfunktion und Produktionsperiode* is a truly original and comprehensive contribution to this German tradition of economic theory. It is complemented by his later work on Wicksell-effects and on technical progress.

Other protagonists of the revival of Austrian capital theory in the 1970s, like Hicks, were rather selective in their borrowing from the Böhm-Bawerkian tradition. Some branched out to relate it to other schools of thought and reformulated core elements (i.e., the superiority of roundaboutness) due to perceived deficiencies within Böhm-Bawerk's original approach (Faber 1986, pp. 26 ff.). Fehl's revision and critique of Böhm-Bawerk resulted in a rehabilitation and sound microeconomic foundation of the period of production as a core element of Austrian capital theory.

Despite the renewed interest that arose in the 1970s, the specific German tradition of temporal capital theory has found only limited interest since World War II—at least measured against the total output of other economic literature. In the opening paragraphs of an article about Walter Eucken's thoughts on temporal capital theory, Fehl hypothesizes about the reasons for this (Fehl 1989, pp. 71 ff.). Mainstream macroeconomics had been dominated by Keynesian thought for quite a time, and Keynesianism paid no particular attention to the temporal structure of production. This did not change much when neoclassical growth theory emerged as a hegemonic paradigm. Furthermore, Stackelberg, Strigl, and Eucken passed away at comparatively young ages and thus never completed their works on temporal capital theory. Last but not least, however, it needs to be kept in mind that many German capital theorists, at some point in their scientific development, moved beyond the distinct realm of capital theory and approached a more general theory of economic coordination.

This was clearly the case with Walter Eucken (Fehl 1989), but a very similar move may also be recognized in Ulrich Fehl's intellectual vita. In the 1980s, Fehl's work on the spontaneous order of the market process (Fehl 1983, 1986) brought him into close intellectual contact with the Anglo-Austrian School of economic thought—particularly with Hayek's, Kirzner's, and with Lachmann's works, whose contributions to capital theory he had already recognized in the 1970s. Fehl conceived of the

market process as being simultaneously propelled by arbitrage, accumulation (or dis-accumulation respectively), and innovation. The “concerted action” of these factors keeps the market process far from the state of equilibrium and makes the emergence of a structure which implies an order *sui generis* possible, to be clearly distinguished from the order of equilibrium or near-equilibrium (Fehl 1986, pp. 75 ff.). Thus, Fehl complemented the traditional Austrian concept of capital’s temporal heterogeneity with its pervasive structural heterogeneity and its adaptation to the market process—which is ultimately driven by entrepreneurship. With these insights, Fehl finally moved close to Lachmann’s view on capital and its structure (Lachmann 1956).

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