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Carlo Zappia

Equilibrium and Disequilibrium dynamics in the 1930s

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Abstract

The paper deals with some methodological proposals which emerged in the 1930s in the works of the founders of modern analysis of equilibrium over time. Just after the introduction of the notions of intertemporal and temporary equilibrium Hayek, Hicks and Lindahl moved towards an analysis of the disequilibrium process in order to incorporate the interplay between expectations of individual agents and actual realisation of relevant economic variables. The main part of the paper discusses the respective role of Hayek and Lindahl in the development of a dynamic theory. It is argued that while Lindahl's approach can be considered more revealing for the study of disequilibrium than Hayek's discussion of how order may emerge, Hayek's insights on the analogy between economic theory and neural network theory have not yet received enough consideration.

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Introduction

Notwithstanding considerable efforts by at least two generations of economic theorists, the state of art of general equilibrium theory in the Arrow-Debreu framework is still extremely unsatisfactory, especially with respect to the treatment of the time dimension. Indeed, it is now taken for granted even among general equilibrium theorists that, to play a significant role, equilibrium analysis must account for individual agents' expectations about the uncertain future, and that the Arrow-Debreu procedure of collapsing the entire decision process at an initial date is to be interpreted, at most, as a counterfactual argument — the main message of the Arrow-Debreu approach being that "one cannot argue that markets co-ordinate activity if there are many of them missing" (Hahn 1995, p. 12).[1]

Major contributors to the field appear to be deeply concerned with the overall relevance of recent contributions, in spite of advances in very important topics such as missing markets and endogenous uncertainty (on which see Magill and Quinzii 1996). The main contention is that general equilibrium theory rests on uncertain foundations because a convincing analysis of both the disequilibrium behaviour of individual agents and out of equilibrium adjustments of the system is still missing.

The necessity of analysing on which grounds one can assume that equilibrium can be achieved or maintained, if disturbed, is of course a consequence of the largely agreed view that equilibrium is a critical point of an implicit or an explicit dynamics (Hahn 1984). However most general equilibrium models loosely assume that one can concentrate on equilibrium allocations by implicitly arguing that the perception of profit opportunities,

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[1] On this point see also Arrow (1987).

which is characteristic of disequilibrium situations, would lead agents to act in such a way that equilibrium would emerge. On the contrary, it is not at all clear that the pursuit of profit opportunities leads to an equilibrium where such opportunities no longer exist (Fisher 1989, pp. 36-7). [2]

A detached observer would regard this situation as quite surprising, because the fundamental problems which still need to be convincingly addressed are quite similar to those already addressed in the history of economics in the late 1920's and 1930's, when the notions of intertemporal and temporary equilibrium were introduced. What is of primary interest is that, in order to consistently deal with the time dimension of the issue, theorists such as Hayek, Hicks, and Lindahl not only discussed how the static approach to exchange could be re-elaborated in a dynamic framework, but also immediately realised that even their own approach was seriously flawed. They thus argued about possibly more satisfactory ways of theorising, providing some interesting methodological insights. This may mean that current research in equilibrium and disequilibrium dynamics might still gain from a re-examination of the insights provided by the pioneers of the subject.

The paper examines some aspects of the dynamic models proposed by Hayek, Hicks and Lindahl. It is maintained that Hayek, Hicks and Lindahl started their revolutionary analysis by following the same methodological approach. Indeed, in order to improve understanding of the dynamics of economic systems, they concentrated on a notion of equilibrium which differs from the then traditional notion of stationary equilibrium, introducing the notions of intertemporal and temporary equilibrium. Hayek, Hicks and Lindahl also shared the viewpoint that expectations should be consistently

[2] Well-known results on the extremely strong assumptions for tatonnement stability to occur (Scarf 1960) and the controversial outcome of non-tatonnement processes, such as the

introduced in economic theory. In particular, they stressed the role of frustrated expectations as an explanation of the practical impossibility of intertemporal equilibrium. However the three authors differed in the importance they attributed to a methodological implication which can be drawn from their models: that frustrated expectations may lead both to a revision of the plans of individual agents and to a change in the view of the world which generates such expectations. In a sense to be made more specific in what follows, an obvious implication of their argument is that the agents' theories of the working of the system cannot be treated as if they were given *ex ante*. The paper argues the different attitude of Hayek, Hicks and Lindahl towards this issue can help in explaining why their respective insights as to how to develop a dynamic theory differ.

The main part of the paper discusses specifically the respective roles of Hayek and Lindahl in the development of a dynamic theory. On the one hand, Lindahl concentrated on the institutional context within which the adjustment process takes place, particularly with respect to the dynamics of the pricing process. He elaborated a sort of disequilibrium dynamics of the economy in the tradition of what is now known as the Swedish *ex ante* - *ex post* analysis. On the other hand, Hayek worked on a further generalisation of the equilibrium notion in order to make it compatible with non-equilibrated actions by individuals. As far as Hicks's role is concerned, Hicks's models of a futures and a sequence economy are used in the paper as a benchmark for comparing Hayek's and Lindahl's — mostly because the Hicksian models still provide the best representation of recent developments in terms of temporary equilibrium (Grandmont 1987). However I have only sketched Hicks's remarks on the subject because it is only in his later writings, starting from *Capital and Growth* (Hicks 1965), that he came to acknowledge the

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"Hahn process" (Hahn and Negishi 1962), leave mainly unanswered the question of how

fundamental shortcomings of the temporary equilibrium approach. Moreover most of his remarks are anticipated by Lindahl (1939b).

The main conclusion of the paper is stated in the fourth section. There it is argued that while Lindahl's approach can be considered more revealing for the study of disequilibrium than Hayek's discussion of how order may emerge (as contended in particular in Currie and Steedman 1990), Hayek's insights on the analogy between economic theory and neural network theory — where the evolution of the system depends on the relations between agents rather than on agents' attributes — have not yet received enough consideration.[3]

From stationary to intertemporal and temporary equilibrium

The fact that stationary models of the economy could not account for the role of time in economic decisions clearly emerges as a turning point in the analyses of the dynamics of economic systems in the late 1920s and early 1930s. In two almost contemporaneous papers Hayek (1928) and Lindahl (1929) pointed out that a meaningful notion of equilibrium over time — even if used only as an imaginary state of rest in which all economic forces have unfolded all their implications — should contemplate not only regular repetition of prices and quantities but also more complex patterns of price and quantity movements. Indeed, they maintained that those movements of prices and

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disequilibrium actually takes place when individual plans are frustrated.

[3] It is also worth noting that the paper centres on Lindahl, rather than, say, on Myrdal, as the main representative of the disequilibrium approach because it is Lindahl's 1939 essay which most clearly delineates the methodological instances at the basis of the approach. However it

quantities which are correctly anticipated by individual agents should be considered compatible with equilibrium over time. For instance, Hayek (1928, p. 76) stated that "to conclude that an economy can persist in a static condition ... all that needs to be assumed is that the wants and the means of production existing at every point in time [within the period under consideration] are known to the individual economic subjects at the time at which they frame their economic plan for the period as a whole." Lindahl (1929, pp. 284-85), on the other hand, dealt with "individuals [who] consider not only the needs of the moment but also those of the future in their economic actions" by assuming that "individuals have full knowledge of all future data which they take into consideration in their economic planning." As a result equilibrium is defined as a situation in which "individuals' ideas concerning the future are such that their actions bring about exactly the conditions which they anticipated."

Therefore both Hayek and Lindahl suggested that the assumption of perfect foresight should be considered as the new benchmark for the replacement of stationary models with an accurate analysis of the behaviour of individual agents over time. That their approach dramatically changed the equilibrium perspective in economic theory is patent. The Arrow-Debreu model is based on the notion of intertemporal equilibrium. The rational expectations approach is a stochastic version of the perfect foresight approach. The literature on learning assumes the intertemporal equilibrium as the state of the economy to be learned by agents. However, the impressive evolution of Hayek's and Lindahl's thought during the 1930s attests that they attributed to intertemporal equilibrium only a fictitious role and considered it as a notion of limited interpretative value. They contended that intertemporal equilibrium could only be used to characterise that imaginary

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should be recalled that, in his essays, Lindahl summarises and elaborates on the efforts of a

state of rest of the economy in which all economic forces have unfolded all their implications.

Lindahl was patently dissatisfied with the perfect foresight assumption from the beginning. He first conceded that the hypothesis that individuals know what future prices will be is equivalent to assuming that they know in advance what the result of their action will be and use this knowledge to act. In the last part of his 1929 article, then, he examined what changes in his analysis of capital and interest would have been necessary in a situation of imperfect foresight, thus implicitly referring, for the first time, to the notion of temporary equilibrium. Extensive use of the temporary equilibrium approach can also be found in Lindahl's 1930 essay on the rate of interest. Moreover, in the introductory section of his 1939 essay, he states that: "The plans of the economic subjects at any given point of time are neither fully consistent with one another nor with the external conditions, and therefore they must be successively revised," as if he was talking of irrefutable empirical evidence. To Lindahl, this is the main question to be addressed by a dynamic theory, because the alternative of assuming that "all plans prevailing at the starting point are based on expectations in conformity with reality, and that they will undergo no change with the lapse of time ... can be treated in essentially the same manner as the equilibrium of static theory," such as in his 1929 essay (Lindahl 1939b, p. 38, 38n.).[4]

As for Hayek, commenting on the requirement of what the individuals must know for the intertemporal equilibrium to hold, he concludes "that this will never be so in reality is obvious" (Hayek 1928, p. 76). Moreover, in an attempt to clarify the links between the

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considerable number of Swedish economists (as stressed in Hansson 1982).

[4] In his reconstruction of the evolution of the Stockholm School, Hansson (1982, 195-6) argues that the gestation of Lindahl's 1939 paper might well have started in the early 1930s. It is worth noting that a footnote to the imperfect foresight section of the 1929 essay, hints at the successive developments (Lindahl 1929, p. 339-40n.).

analysis of equilibrium relationships over time and his theory of the trade cycle, he comes to the conclusion that inherent in the latter there was the "very pressing question ... of how the entrepreneurs will react to the expectations of particular price changes, ... what determines the expectations of entrepreneurs and particularly of how such expectations will be affected by any given change of present prices" (Hayek 1935, p. 155).[5]

A few years later, Hicks made similar statements as well. Hicks's first essays on dynamics, which clearly shows the influence of Hayek, clarifies the notion of equilibrium over time in the following way (Hicks 1933, p. 32): "however the economic data vary, there will always be a set of prices which, if it is foreseen, can be carried through without supplies and demands ever becoming unequal to one another and so without expectations becoming unequal to one another. The condition for equilibrium, in this widest sense, is Perfect Foresight. Disequilibrium is the Disappointment of Expectations." But just two years later, when he appears quite close to the "method of anticipation" to be elaborated in *Value and Capital*, he shows more attention for the intricacies of the issue (Hicks 1935, pp. 58-9): "If I am right, the whole problem of applying a monetary theory is largely one of deducing changes in anticipations from the changes in objective data which call them forth. ... once the connection between objective facts and anticipations has been made, theory comes again in its rights. ... Nevertheless, it does seem to me most important that ... we should bring out very clearly the assumptions which we are making about the genesis of anticipations."

Therefore the notion of intertemporal equilibrium seems to have become obsolete in the minds of Hayek, Hicks and Lindahl just after it had been introduced. That the

[5] A recent reconstruction by Foss (1995) of the genesis of Hayek's 1933 Copenhagen lecture makes it clear that the lecture, substantially reproduced in Hayek 1935, was probably given

purpose of the three authors was to incorporate the interplay between expectations and actual realisations of the economic variables is apparent in the quotations just given. The evolution of their theories can therefore be interpreted as the outcome of their immediate dissatisfaction with the novel notion of intertemporal equilibrium. Lindahl first introduced the related notion of temporary equilibrium, with the aim of giving an equilibrium representation of the phenomena induced by imperfect foresight, but his ultimate aim was to abandon the equilibrium approach in general. Hayek, on the other hand, never used the notion of temporary equilibrium, nor did he consider it as a meaningful tool for dynamic analysis. He concentrated on a possible generalisation of his notion of equilibrium as a starting point for analysis. However, as we will see, both Hayek and Lindahl had been struggling for a long time in order to find out how to deal with proper dynamics. Hicks, on the other hand, considered for long the temporary equilibrium model as the main instrument for analysing the dynamics of an economy.

Before turning specifically to the evolution of Hayek's and Lindahl's thought, it is worth examining the basic characteristics of the temporary equilibrium approach and its emergence as a sort of generalisation of intertemporal equilibrium. These characteristics are probably best illustrated in Hicks's 1939 models. By following this procedure of Hicks, it can be seen more precisely how a "pure futures economy" would evolve into a sequence economy as a result of the abandonment of the perfect foresight assumption. The Hicksian models still constitute the skeleton of both the temporary and the intertemporal equilibrium models used in current literature (see in particular Radner 1982, and Grandmont 1987). In what follows, I will use the standard representation of the temporary equilibrium approach given by Grandmont (1982), because it makes clear the role played

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in response to Myrdal's allegation that there was no place for expectations in Hayek's *Prices and*

by the expectation functions of the agents in explaining the evolution of the economy, that is in the realisation of equilibrium over time.

Think of an economy in which trade takes place at an infinite, discrete sequence of dates. Let us suppose that the state of the economy at *t*, say x_t, is completely determined in terms of the forecasts of *n* individuals at date *t* about the future state, say x_{t+1}, through a relation of the following type: $x_t = f(\ldots , x^e_{i,t+1}, \ldots)$. The map *f*, which could be interpreted in terms of the "fundamentals" of the economy, is intended to describe the result of the (implicit) equilibrating market process at date *t* for a given set of forecasts[6]. The specification of the way in which forecasts are made at each date must of course take into account the agents' information on current and past states of the economy. In the simplest case, where the sequence of states of the economy is the only information available to individuals, the expectation function for each individual takes the following form: $x^e_{i,t+1} = \psi (x_t, x_{t-1}, \ldots)$

The aim of this representation is to describe a sequence of temporary equilibria, in which the past history of the states of the economy determines the current temporary equilibrium state and the agents' forecasts. As was established by Hicks's analysis of the futures economy and its generalisation provided in the Arrow-Debreu model, if at the initial date markets for exchanging commodities are opened both for spot and for future delivery, that is if at each future date futures markets exist for each good to be delivered at each future date, all decisions taken at the initial date can be realised (and expectations will be fulfilled). The representation is essentially timeless, because the structure of the

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Production. Needless to say, Hayek's much more developed arguments are stated in Hayek 1937.

[6] In Hicks's terms markets are opened only on Monday each week and a Walrasian equilibration process without actual exchanges is assumed to work until supply and demand are brought into equilibrium (Hicks 1939, p. 122).

model is such that no revision of individual plans is necessary, even if production and exchange take place sequentially over time (Hahn 1973, p. 54-6). If there is a complete array of markets, in fact, the equilibrium of the economy can be represented as a sequence of states $\{x_t\}$ and forecasts $\{x^e_{i,t+1}\}$ for all dates. This is an extremely simple representation of an intertemporal equilibrium.

If, on the other hand, one wants to represent the possibility of the inconsistency of plans, the first step is to assume that markets are incomplete.[7] There is now no reason to think that expectations will be fulfilled, even assuming "very intelligent" individuals. For there will generally be at least some individuals who will not be able to carry out their particular plans and markets will of necessity be re-opened at each date. In this scenario, expectations will thus play an essential role in the determination of current variables and the map from expectations to actual states and the *n* expectation functions describes a sequence of temporary equilibria.[8] Intertemporal equilibrium is included as a special case.[9]

Before moving on to a more specific analysis of the link between expectations, plans and actual realisations of economic variables, it would be worth recalling which kind of consistency between the plans of individuals — and which implicit equilibration process — is assumed for intertemporal and temporary equilibrium to hold. As is well known, given the different ways in which the process of equilibration unfolds, the

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[7] This is not only a much more realistic assumption. The incompleteness of markets can be derived from 'first principles' such as the impossibility of contracting upon the realisation of uncertain events when the individual partitions of agents differ, which is typical of situations of moral hazard (see Radner 1982).

[8] In Hicks's terms the equilibrium reached on each Monday refers only to supplies and demands on markets opened on that Monday (Hicks 1939, p. 123).

[9] It is worth noting that in this representation the complete markets hypothesis plays the same role of perfect foresight. It is a well-known result by Arrow (1964) that a number of security markets which corresponds to the dimension of uncertainty (i.e. to the number of possible states of nature) is enough to give birth to the same allocation of the complete markets case. However, in this last case, perfect foresight return to be a necessary condition for equilibrium.

hypotheses on consistency in the two cases differ. On the one hand, intertemporal equilibrium guarantees that the plans of individuals are consistent not only *ex ante*, but also *ex post* over an infinite sequence of future dates. There is no possibility of an unforeseen event occurring to induce agents to modify their own plan. On the other hand, temporary equilibrium requires *ex post* consistency only at each (current) date, for the fulfilment of expectations over future dates cannot be guaranteed in general. In the latter case, the evolution of the economy over time is described as a sequence of temporary equilibria, where at each date the plans over future periods are formulated on the basis of the revised expectations of the possible future realisations of the states of the economy.

What did Hayek and Lindahl think of this way of describing the evolution of the economy over time? They agreed, on different grounds, that a proper dynamic analysis would entail both a much closer examination of the process of revision of plans, and an analysis of the causal connections between certain given initial conditions and the subsequent outcomes at a future date. For these purposes, not even the temporary equilibrium model was considered to be satisfactory. It is worth noting that Hicks's critical comments on the relevance of the temporary equilibrium approach are much more recent than Hayek's and Lindahl's; he does not emphasise the shortcomings of the approach until *Capital and Growth* (1965). Moreover, while he shared some of the critiques put forward by the other two authors, he never provided a complete alternative to the temporary equilibrium approach. I shall thus postpone the analysis of Hicks's critical arguments to the section after next and now move to an appraisal of the solutions proposed by Hayek and Lindahl for bridging the analytical gap.

From temporary equilibrium to dynamics

As Currie and Steedman (1990, Ch. 5) have recently argued, Lindahl's 1939 essay *The Dynamic Approach to Economic Theory* still constitutes one of the more conscious treatment of the insufficiency of both the intertemporal and the temporary equilibrium approach one can find in the literature. In that paper, Lindahl's dismissal of the hypothesis of consistency between *ex ante* plans and their *ex post* realisations is stated on the grounds that, even during a short period of time, it is unlikely that individuals with imperfect foresight may find their plans wholly feasible. As a result, the temporary equilibrium approach cannot account for the occurrence of unforeseen events during a period, a fact which is relevant particularly when the plans of individuals are not synchronised with respect to the moment of their revision.

The abandonment of the perfect foresight assumption implies that "though each plan is in principle designed for the entire future, it ... has immediate relevance only for the period next in time. The actions undertaken in later periods will be determined by new or revised plans" (Lindahl 1939b, p. 47). Lindahl thus discusses the question of whether it is reasonable to assume that the plans will be revised only at the end of each current period, as required in the temporary model where, as in the Hicksian Monday, prices adjust so as to make supply and demand for the current period equal. Lindahl argues that, although this assumption can be made with respect to each single agent, by means of a specific analysis of the appropriate length of the "period of registration" of relevant events, things cannot work in the same manner when a group of agents is taken into account. In fact, in discussing the appropriate length of the period during which the consistency of plans required by temporary equilibrium is satisfied, Lindahl (1939b, p. 55) states that: "In

reality, however, the synchronisation is very incomplete, and the period during which the relevant plans of all members of the group are retained unchanged, must therefore be taken to be fairly short. ... . One cannot count upon all these plans being kept wholly unaltered during any long period. The attempt to realise the plans must quickly reveal that they are more or less incompatible. The actual course of events cannot correspond to all anticipations of the individuals about the behaviour of the others. The result must therefore be a modification of some of the plans."

Furthermore, in the analysis of the pricing process it emerges that "in an actual dynamic case, there is no necessity for equality of demand and supply" within each period. However, Lindahl (1939b, p. 60) contends that to make things intelligible "the opposite concept of prices as continuously changing under the influence of the demand and supply function is equally not correct." Lindahl's proposal for a theory of the dynamics of the economy is of course the period analysis which was to become the distinctive trait of the Stockholm School. Here the hypothesis of an instantaneous process of equilibration in each period — such as in the Hicksian Monday — is dropped, in order to deal with possible inconsistencies between *ex ante* plans and their *ex pos*t realisations in each current period. Following the so-called pure disequilibrium approach, the link between static (i.e. equilibrium) and dynamic theory established by instantaneous equilibration in each current period is definitely severed.[10]

It is worth recalling that, in the disequilibrium approach it is an *ex post* accountancy balance of the actions actually implemented during any period that is assumed as the reference point for analysis. Hence the main problem of a dynamic theory becomes

[10] Hansson's reconstruction of the development of the dynamic method attributes to Lundberg's and Myrdal's critiques a major role in convincing Lindahl of the need to give up the temporary equilibrium approach (Hansson 1982, pp. 71-3, 114-116)

how to analyse the changes resulting from anticipations which are mutually inconsistent, or the effect of exogenous changes which are unanticipated.[11] As we will see, Lindahl's main contribution to the Swedish approach is an accurate inspection of the process of revision of the plans of individuals.

Let us now come to Hayek. In Hayek's opinion of the usefulness of the temporary equilibrium approach is founded on a methodological argument explicitly given in the introductory chapters to *The Pure Theory of Capital* (Hayek 1941), although implicit in Hayek's 1935 and 1937 essays. In Hayek's view, the attempt to make equilibrium theory more realistic made by Lindahl and others[12] is deemed to be incoherent, for equilibrium analysis cannot be conceived as a tool for representing actual economies. Indeed, a thorough explanation of the dynamic properties of actual economies would require "an explanation of the economic process ... in terms of causation which must necessarily be treated as a chain of historical sequences ... a unilateral dependence of the succeeding event on the preceding one." Thus equilibrium analysis is definitely not appropriate to elucidate the causal connections of an actual economy. As a result, while "this kind of causal explanation of the process in time is of course the ultimate goal of all economic analysis", Hayek concludes that "equilibrium analysis is significant only in so far as it is preparatory to this main task" (Hayek 1941, p. 17). It is well known that Hayek never discussed the phases of the causal process.[13] In the next section I intend to provide an explanation of why it is that Hayek's contribution is limited to the preparatory phase.

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[11] In Myrdal's words (1939, p. 121): "the very changes during the period which are required to bring about this *ex post* balance."

[12] The fact that temporary equilibrium is intended as a step forward towards a more realistic description of the dynamics of economic systems is explicitly stated both by Hicks and Lindahl.

[13] Hayek announced a second volume of his *Pure Theory of Capital* to deal with the causal processes of capital accumulation, but he never wrote it. Hansson (1991, p. 177) maintains that it

Instead of concentrating like Lindahl on the description of the adjustment process in disequilibrium, Hayek chose to deepen those aspects of his notion of equilibrium which explain why equilibrium is impossible to reach.[14] As a result, Hayek insights on how to deal with the dynamics of economic systems are to be found in his refinement of the notion of equilibrium. So before we move on the Hayekian notion of equilibrium should be examined in greater detail.[15]

Hayek's 1937 paper on *Economics and Knowledge* starts from a refinement of the notion of equilibrium over time as a "societal equilibrium." In Hayek's word, "for a society we *can* speak of a *state* of equilibrium at a point of time — but it means only that the different plans which the individuals composing it have made for action in time are mutually compatible" (Hayek 1937, p. 41). Hayek argues that in order for the notion of equilibrium used in economic theory to be significant, it must be capable of describing the way in which individual agents, endowed with specific personal knowledge, undertake actions which are compatible both with uncertainty about exogenous events and with the possible actions undertaken by the other individuals operating in the system. Indeed, it is mainly because of informational differences that individual agents may have different opinions on how the system behaves. Thus, according to Hayek, equilibrium is characterised in the following way. On the one hand, the plans of individuals must exhibit both individual consistency and mutual compatibility. Individual consistency may be

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is Lindahl, and the Swedish in general, who actually endeavours Hayek's call for "causal analysis." The same argument is endorsed by Currie and Steedman (1990).

[14] The usefulness of the notion of equilibrium is that it can signal whether "the present situation carries the seed of inevitable disappointment to some [the individual agents], which will make it necessary for them to change their plans" (Hayek 1941, p. 21).

[15] For a fuller account of Hayek's equilibrium notion see Zappia 1996. It is also worth noting that there is a strand of Austrian literature which argues that Hayek's notion can give birth to a generalised notion of the consistency of plans, such as that proposed by O'Driscoll and Rizzo

considered part of every individualistic theory of equilibrium behaviour. Mutual compatibility specifies the notion of equilibrium in the sense restated by Hahn (1984): in situations of uncertainty, the plans of individuals are based on a theory of the overall workings of the economy which concerns the influence of exogenous factors and the behaviour of other agents. Therefore equilibrium should be regarded as a state in which the activity of exchange confirms the theory formulated by each agent on the behaviour of the system.[16]

There is, however, a further condition for a Hayekian equilibrium to hold, which is implicit in Hayek's reasoning and whose relevance is only completely clarified in the explanation of the competitive process out-of-equilibrium (Hayek 1948 and 1968). This third condition is as follows: if equilibrium is to prevail, it is necessary for the process of exchange to convey the information dispersed throughout the economy, so that in equilibrium all agents will be capable of reaching a common interpretation of the relevant exogenous events. Prices must therefore carry out a role of transmission and aggregation of the information dispersed in the system. Evidently, Hayek believes that compatibility with exogenous factors, which is a component of his notion of equilibrium, can only be obtained at an aggregate level, since individuals can only assess this compatibility after they have exchanged their private information with that of the other agents operating in the system. As a consequence, the achievement of equilibrium requires that a certain degree of

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(1985, Ch. 5), which is partly consistent with non-equilibrated actions (for instance, see Boehm 1986).

[16] Hahn's well known definition is that "an economy is in equilibrium when it generates messages that do not cause agents to change the theories they hold or the policies they pursue" (Hahn 1984, p. 59). It has been argued by Littlechild (1982) that Hahn's notion of equilibrium is a stochastic generalisation of Hayek's. It is also worth noting that Hahn's justification (1984, p. 47) of the relevance of equilibrium constructs, that "agents will not continue in actions in states in which preferred or more profitable ones are available to them nor will mutually inconsistent actions allow given prices to persist", closely resembles Hayek's (see footnote 13).

knowledge becomes common to all agents at the same time.[17] In Hayek's view, the subject matter of equilibrium theory is the explanation of how the compatibility of the plans of individuals can be assured. But the achievement of equilibrium, and the properties which it satisfies, depends on the degree of knowledge that the market mechanism can aggregate and transmit throughout the system. Hayek (1937, p. 53) clearly argues that no optimal allocation is guaranteed by the market process, and that the analysis must be shifted towards the process of discovery and transmission of knowledge which equilibrium analysis implicitly assumes away.

It must be stressed that it is an outgrowth of Hayek's definition of the plans of individuals in a societal equilibrium that one cannot think of the agents' theories of the system as if they were given *ex ante*, nor imagine that the adjustment to equilibrium only takes place because of the emergence of exogenous uncertainty. Specifically, in terms of the formal representation of section 2, the expectation functions ψ cannot be considered as given in dynamic analysis. A further implication concerns the set of possible expectation functions. As it will be argued in the following section, it is an outgrowth of Hayek's view of the dynamics of the economy that not even the set of possible ψ is known from the outset. It is the main point of the next section that this outgrowth of Hayek's analysis is crucial in order to understand why he differs from Lindahl (and Hicks) in his attempt to explain the process of the revision of expectations. We now turn to an inspection of how the two authors dealt with the revision of expectations, with particular respect to the interaction between individuals' adjustments and aggregate outcomes.

[17] As we shall see in the next section, this argument constitutes the basis for Hayek's idea of

Frustrated expectations and the revision of the plans of individuals

As we have seen in the previous section, the major contributors to the analysis of equilibrium over time in the 1930s agreed that, in order to understand the dynamics of an economy, the main task to pursue was the explanation of the process of revision of the plans of individuals. In this section I intend to explain why they chose different ways of doing it. I shall argue that the main difference may be traced back to their respective interpretations of the way in which the process of revision unfolds. To be specific, I shall maintain that Hayek's reluctance to explore the "causal explanation of the process in time" in an explicit disequilibrium model emerges as a consequence of his own notion of equilibrium.[18]

In the previous sections I have considered Hicks's model as the standard for comparing the suggestions provided by Hayek and Lindahl. Indeed, Hicks's contribution to the development of the temporary equilibrium approach was so far reaching that it can still be considered as the standard representation of the approach. But Hicks never offered a complete alternative to the temporary equilibrium approach. It is only in his later writings that he came to acknowledge temporary equilibrium's fundamental shortcomings.[19] In particular, he admitted that "the fundamental weakness of the Temporary Equilibrium method is the assumption, which it is obliged to make, that the market is in equilibrium even in the very short period ... but even in a very competitive economy such very short-

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the role of competition.

[18] It is well known that there are a number of explanations for Hayek's "retreat" from economic theory (for instance, see the contrasting interpretation of Caldwell 1988 and Birner 1994). I shall not take part in this debate, but I shall assume that Hayek's notion of spontaneous order was intended to generalise the notion of equilibrium provided in Hayek 's 1937 essay.

run equilibration is hard to swallow" (Hicks 1965, p. 76). He also recognised that in the temporary equilibrium method "it is necessary to assume that prices remain unchanged throughout the single period; and that these prices are equilibrium prices which, within the single period, equate supply and demand ... but the artificiality of such construction is only too obvious" (Hicks 1965, p. 73). As a result, in the temporary equilibrium approach "equilibrium prices and price expectations are, at least to some extent, reciprocally determined. Such reciprocal determination is, however, a piece of telescoping; in dynamic analysis, telescoping is dangerous" (Hicks 1965, p. 66).[20] Hicks thus came to the conclusion that instantaneous equilibration as a hypothesis cannot help in dealing with "truly dynamic analysis". One should note that thirty years earlier Hicks had sponsored the temporary equilibrium approach for the same reason which he now considered as a drawback, that is for its too strict connection with static analysis.

Lindahl's 1939 essay is a sort of manifesto for a new dynamic theory. The necessity for a more general approach is apparent when he states the basic assumption of dynamic theory as follows: "their [the individual agents'] actions, for a shorter or a longer period in the future, represent merely the fulfilment of certain plans, given at the beginning of the period and determined by certain principles which it is possible to state in one way or

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[19] See, for instance, Hahn's comment that "Hicks's period analysis in *Value and Capital* was the beginning of Hicksian dynamics but it was only in his later writings that it emerged as a recognisable theory of a process" (Hahn 1994, p. 18). On this point see also Hamouda 1990.

[20] Commenting on the Swedish influence on his own work, Hicks (1991, p. 374) adds: "The problem is to get a theory of behaviour over a period (week or longer). Such a period has a start and a finish. All I had done, by 1939, was concerned with the start. There ought to be a corresponding theory of the finish. It also would be a 'point of time' theory, so one might think, and for a long time I did think, that it would be just like the theory of the start. But that is not correct. For there are two things that will have happened between the start and the finish: 1) informational things, the moving-on of expectations ... and 2) the actual things that have happened during the period. The things that happened before the start are bygones; for any analysis of the period they are data. But the things that happened during the period, though they have a similar place with regard to the finish of the period, do not have a similar place in the analysis of the

another. These principles should in general state that the plans are made for the fulfilment of certain aims ... and that they are based on individual expectations concerning future conditions, expectations which in turn are influenced by individual interpretation of past events." Lindahl, anticipating most of Hicks's 1965 critical comments, first makes it clear why even the most sophisticated temporary equilibrium analysis cannot account for the "true" dynamics implied by the revision of individuals' plan. Thus he provided a much more accurate discussion of how to improve on the shortcomings of the temporary equilibrium approach. Unlike the temporary equilibrium model, where the different periods are considered separate and complete descriptions of the workings of the economy, Lindahl is looking for a method of linking the different periods, so as to derive a causal sequence of events in which it is explicitly shown how the *ex post* outcomes of the current period influence the *ex ante* plans for the following one. As we have just seen, the analysis of the links between different periods is much more complicated than in the temporary equilibrium model, because it is no longer assumed that there is compatibility between *ex ante* plans and *ex post* realisations within each period. It is in order to deal with the causal elements of dynamic analysis that the notion of individual planning became the main subject matter of the dynamic method.[21] Lindahl deals particularly with divergent expectations as the main cause for the revision of the plans of individuals. As we have seen in the previous section, Lindahl emphasises that most planned actions depend on the realisation of certain conditions to become apparent in the future. As a consequence,

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period as a whole. They are part of what in analysis of the period, has to be explained." On Hicks's reconsideration of the temporary equilibrium approach, see Petri 1991 and Allgoewer 1997.

[21] Hansson's reconstruction of the development of the Swedish dynamic method stresses that, although the notion of planning in disequilibrium analysis was introduced by Myrdal and Lundberg, it is Lindahl's 1939 paper that stated the pivotal role of individual planning for the dynamic method.

changes in expectations and the related revision of plans are considered as the normal succession of events.

It is apparent that Lindahl's analysis is conceptually similar to Hayek's. One might note that the former puts emphasis on plans conditioned upon future (unknown) events while the latter puts it on plans based on personal (unshared) knowledge. But the overall approach suggested is similar in many respects.[22] However, the two authors provided distinctly different insights as to how to develop the dynamic method, and their respective analyses entail methodological consequences which also differ substantially. Lindahl proceeds to explain how the analysis of the pricing process must be amended in order to take exchanges at disequilibrium prices into account. Contrary to Hicks's much more durable confidence in the hypothesis of instantaneous equilibration within each current period, Lindahl immediately recognises that the development of a causal analysis requires the introduction of trading at disequilibrium prices. It is during the process of determination of prices that the expectations of individuals can be fulfilled or, in the more general case, need to be revised. The dynamics of the system, which Lindahl calls "the theory of economic development", can thus be explained by considering two basic elements: the assumptions about individual planning and the emergence of unexpected exogenous events. The interaction of these two elements generates the aggregate outcome, which is not an equilibrium if individuals are forced to revise their expectations both by external events and the realisation of planned actions. As regards the latter cause of revision of plans and expectations, the endogenous one, Lindahl considers that it may

[22] Lindahl (1939b) recognises that Hayek's 1937 paper is "quite in harmony" with his own dynamic analysis. However, there is no evidence that the two authors converged towards the same treatment of these issues because of direct knowledge of the other author's work. Of course, as recalled previously, many indirect relationships can be tracked down, such as the knowledge of Myrdal's work.

emerge because the organisation of exchanges is such that the announcement of prices for exchange and the acts of exchange do not temporarily coincide. If this is the case, prices announced by dealers at the beginning of a period will be associated with acceptances of trade by other dealers which do not necessarily correspond to those anticipated by those who set prices, so that some agents will be rationed at that prices. This will force a change in the announced prices for the subsequent period.

Lindahl was unable to elaborate a convincing theory of the price mechanism based on these considerations. In fact, while it is true that prices are fixed at the beginning of each period so as to induce adjustments of quantities with respect to the *ex ante* plans, prices adjust instantaneously at the conjunction of two consecutive periods, thus leaving unexplained a crucial aspect of the pricing process.[23] But the outgrowth of Lindahl's analysis is clear: even within a very short period of time, one cannot take for granted that a Walrasian process of equilibration by prices takes place. Hence it is the process of price adjustments which brings about an endogenous process of revision of expectations. As a result, a necessary implication of Lindahl's analysis is that a dynamic theory necessarily entails the discussion of the organisation of exchanges.

On the other hand, Hayek seems to be much more confident in the ability of the competitive price mechanism to eliminate trading at non-equilibrium prices (in particular this holds for Hayek 1945, as noted in Desai 1994). Moreover he does not deepen the multiple aspects of the individual process of revision of plans. Currie and Steedman, in particular, have recently argued that this is a notable drawback of Hayek's approach if

[23] It is interesting to report Hicks's viewpoint about the actual achievements of Lindahl's theory. Hicks (1956, p. 223-4) interpreted Lindahl's disequilibrium approach as embedded in a fixed-price temporary equilibrium model. Hicks contended that Lindahl's dynamic approach still adheres to the temporary equilibrium approach because notwithstanding the assumption that

compared with Lindahl's. In fact, "Lindahl does not have a purely mechanistic conception of the activity of planning. Nor does he suppose that all human actions are necessarily the result of conscious deliberation" (Currie and Steedman 1990, p. 93). They also argue that the limited interest shown by Hayek in the complexities of the process of individual planning illustrates by comparison that Hayek's 1937 essay is much less "radical," in a methodological sense, than Lindahl's 1939 essay.

Despite the way Hayek develops his notion of equilibrium, which concentrates on how it is possible that subjective interpretations of different individuals endowed with different knowledge may be compatible in a market economy, it is certainly true that Hayek's interest in the process of individual planning is less pronounced than Lindahl's. Indeed, although starting from an analysis of individual planning, Hayek's contribution seems to be much more concerned with the question of which knowledge is transmitted and generated by the process of interaction of individual actions.[24] But, although the Hayekian notion of equilibrium assumes individual consistency,[25] one may suggest that, contrary to Currie and Steedman's interpretation, this may depend on Hayek's deep conviction that there is a way to pursue the analysis of the economic process of exchange which is different from Lindahl's. In fact, I intend to show that a different interpretation of Hayek's approach can be provided.

In Hayek's view, the market process necessarily entails interaction between the minds of individuals, and the competitive process is seen more as a matter of relationships

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prices are fixed at the beginning of each period quantities adjust so as to establish equilibrium at each date.

[24] This is the so-called Hayek's knowledge problem (see Kirzner 1992).

[25] Hayek explicitly states that this is the least controversial among the conditions necessary for equilibrium to prevail. Shackle, Lachmann and the so-called radical subjectivists (for instance, see Vaughn 1994) have pointed out this aspect in order to state that Hayek did not consistently develop the subjectivist approach. In this sense, they share Currie and Steedman’s contention.

among individuals than as a matter of the characteristics of individuals. As a result, the individual processes of expectation formation, and the dynamics generated by the revision of plans, cannot be examined only at the individual level. They can only be dealt with as elements of the market process. To be more specific, those elements of Hayek's theory which make his notion of spontaneous order different from an intertemporal equilibrium — such as the reference to conventional behaviour and the aggregate emergence of habits and contractual arrangement — cannot be explained as the result of an individual process of revision of expectations. They emerge as what can be called the organicistic outcome of the market process.[26]

Let us consider Lindahl's framework as a reference point. Hayek's insight is that while it is true that to allow trading at disequilibrium prices implies that the plans of agents would not be independent of the way the market is organised, this problem cannot be resolved at an individual level, that is by a closer inspection of the process of individual planning. Likewise, it is essential to distinguish between the process of revision of expectations and the process of revision of the expectation function. In the former case, which is the one Lindahl mostly concentrates on in his dynamic theory, the individual enters the market with a theory of how the economy works, and upgrades it. In the latter, the interaction with other individuals makes it necessary to contemplate the possibility that the individual decides to abandon a theory, which turned out to be inadequate, in favour of

[26] It is also worth noting that Lindahl (1939b, p. 37) stressed that plans can also be interpreted in a broader sense, so as to include those "habits and persistent tendencies which have a definite and calculable character comparable to the explicit plans", and which, maybe unconsciously, underlie their actions. But he then proceeds without taking this *caveat* into account in the discussion of the disequilibrium process. That habits and conventions are crucial for the understanding of economic activity is a typical Hayekian argument, at least starting from "The meaning of competition." However it does not emerge as a consequence of the deepening of the individual decision process. On this point, see Zappia 1997.

a new one. [27] This second process appears to be more general, and it is in dealing with it that Hayek's contribution shows its peculiarity.

The subject matter of Hayekian analysis is not so much to explain the individual process of substitution of subjectively more convenient theories of the way the economy works for theories which proved to be "incorrect". It is rather to understand whether this process can be dealt with at the individual level or not. It must be admitted that, as concerns this question, the evolution of Hayek's thought is contradictory. His answer is not explicit in the 1937 essay. Moreover in the 1945 essay on the use of knowledge in society the question itself seems to become unimportant, since the co-ordinating properties of the price system are magnified. However these aspects are so important for Hayek's view that they explicitly re-emerge in the essays on competition, probably as a consequence of a reconsideration of the methodological basis for a subjective approach to economic theory.

In his analysis of competition, Hayek argues as follows: "Competition is essentially a process of the formation of opinion: by spreading information, it creates that unity and coherence of the economic system which we presuppose when we think of it as one market. It *creates* the views people have about what is best and cheapest, and it is because of it that people know at least as much about the possibilities and opportunities as they in fact do. It is thus a process which involves a continuous change in the data and whose significance must therefore be completely missed by any theory which treats these data as constant" (Hayek 1948: 106, my italics). If seen in this perspective, Hayek's viewpoint is clearer. To concentrate on the analysis of the formation and revision of expectations by individual agents may be useless unless one focuses on the social process of co-ordination

[27] The first case concerns the updating of the parameters of the expectations function, while the second case concerns the updating of the functions themselves. Of course, from a

through the market, and the social institutions that this process generates.[28] But something more interesting can be noted if one looks at the methodological underpinnings of this argument.

In his methodological essays of the 1940s, notably *Scientism and the Study of Society* and *Individualism: True and False*, Hayek gives a slightly different motivation for his interest in the market process from an "aggregate" point of view. In discussing the basis of "true" individualism, he states: "human Reason, with capital R, does not exist in the singular, as given or available to any particular person, as the rationalist approach assumes, but must be conceived as an interpersonal process in which anyone's contribution is tested and corrected by others" (Hayek 1946, p. 15). And commenting on the results of conscious human action, he adds: "The individuals are merely the *foci* in the network of relationships and it is the various attitudes of the individuals towards each other ... which form the recurrent, recognisable and familiar elements of the structure" (Hayek 1942, p. 34).

As has been recently noted (Birner 1996 and 1999), there is a close relationship between these methodological statements and Hayek's theory of cognitive psychology (Hayek 1952). Moreover Hayek's analogy between the functioning of the human mind and society as a neural network can be considered as the starting point of recent attempts to apply artificial network theory to the dynamics of economic systems (for example, see the model of boundedly rational learning presented in Salmon 1995). It is a fundamental feature of network theory that the evolution of the system depends not so much on the characteristics of the elementary units (called nodes) as on the links among these

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mathematical point of view, the two process of adjustments might be indistinguishable, for instance if we deal with linear functions.

[28] The secondary literature on Hayek, and Austrian economics in general, has pointed out these aspect many times. Amongst others, see Langlois (1985) and Klausinger (1991). For a comprehensive assessment of the "contextual argument" in Hayek's theory, see Boettke 1998.

elementary units. To be more specific, in informationally complex environments the informational constraints do not only affect the informational sets of individual agents but also the manner by which people act and learn the environment.

Hence my conclusion is that it is Hayek's idea of competition as a matter of relation among individuals, rather than as a matter of the attributes of individual entities, that explains why he did not follow Lindahl in his approach to dynamic theory. Even if one considers a process through which individuals modify their own theories of the system in a disequilibrium setting similar to the one which can be imagined to hold in Lindahl's approach, the more fundamental question of how these theories are generated cannot be examined yet. As a result, both Hayek's prominent interest toward the evolution of those institutions which favour the process of exchange and his relative understatement of the importance of the individual process of planning can be explained.[29]

Concluding remarks: lessons from the 1930s

In this paper I have examined the methodological proposals which emerge from the contribution of the founders of modern analysis of equilibrium over time. By considering Hicks's models of a futures and a sequence economy as the standard representations of intertemporal and temporary equilibrium, the paper has concentrated on Lindahl's and Hayek's approach to the study of the dynamics of the economic system.

In order to emphasise the importance of the institutional context within which the adjustment process takes place, both Lindahl and Hayek dealt with the problem of how to

model the process of revision of expectations. But the proposals that can be derived from their models are substantially different. On the one hand, Lindahl concentrated on the way in which the dynamics of the economy forces individual agents to revise their own expectations. Lindahl's proposal of a disequilibrium approach is based on the observation that, given the organisation of exchange, agents do not usually face equilibrium prices, and the dynamics of the economy can thus be seen as the result of individual adjustments to non-equilibrated aggregate outcomes. However during this process the individual entities do not evolve. They still constitute the basic, pre-defined elements of analysis.

On the other hand, Hayek concentrated on the idea that agents cannot be treated as if their theories of the system were given *ex ante*. Hayek's proposal is not so much to abandon the equilibrium approach, as to generalise it in order to understand how different institutional contexts influence both the actions of individuals *and* their way of thinking about economic activity. The evolutionary elements which characterise Hayek's theory of social institutions (in particular Hayek 1973) are thus mainly derived from his own ideas on the competitive process.

Let me conclude with a remark on the legacy of the 1930s. Current attempts to generalise equilibrium theory recognise as a starting point for research the view that ignorance is an inherent feature of every individual decision regarding future events. The kind of formal representation of decision making under uncertainty which is emerging, for instance in models with non additive probability over future events, does not consider individuals striving to formulate a correct vision of a pre-defined future, but tries to contemplate, in a Shackleian manner, the unpredictable consequence of choices. In a sense, Lindahl's call for a closer inspection of individual planning and the process of

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[29] That *The Sensory Order* provides a foundation for Hayek's subjectivism has been recently

revision of expectations has found a tentative answer. What is still missing is a closer consideration of Hayek's point. My perception is that in order to handle Hayek's point, one should probably look at recent attempts to apply artificial network theory to economics, as Hayek himself, maybe unconsciously, suggested.

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claimed by Caldwell (1994).

REFERENCES

Allgoewer, E. 1997. Hicks on economic theory in time. *Journal of the History of Economic Thought*, 19: 222-40.

Arrow, K. J. 1964. The role of securities in the optimal allocation of risk-bearing. *Review of Economic Studies*, 31: 91-6.

Arrow, K. J. 1987. Rationality of self and others in an economic system. In R. M. Hogarth and M. W. Reder (eds.), *Rational Choice*. Chicago: The University of Chicago Press.

Birner, J. 1994. Introduction. In J. Birner and R. Van Zijp (eds.), *Hayek, Co-ordination and Evolution*. London: Routledge.

Birner, J. 1996. Mind, Market and Society. Network Structures in the work of F. A. Hayek. Trento: CEEL Working Paper 1996-02, University of Trento.

Birner, J. 1999. The surprising place of cognitive psychology in the work of F. A. Hayek. Mimeo. *History of Economic Ideas*. Forthcoming.

Boehm, S. 1986. Time and equilibrium: Hayek's notion of intertemporal equilibrium reconsidered. In I. M. Kirzner (ed.), *Subjectivism, Intelligibility and Economic Understanding*. New York: New York University Press.

Boettke, P. 1998. Economic calculation. *The* Austrian contribution to political economy. *Advances in Austrian Economics*, 5.

Caldwell, B. 1988. Hayek's transformation. *History of Political Economy*, 20: 513-41.

Caldwell, B. 1994. Hayek's scientific subjectivism. *Economics and Philosophy*, 10: 305-313.

Currie, D. and Steedman, I. 1990. *Wrestling with Time*. Ann Harbour: Michigan University Press.

Desai, M. 1994. Equilibrium, expectations and knowledge. In J. Birner and R. Van Zijp (eds.), *Hayek, Co-ordination and Evolution*. London: Routledge.

Fisher, F. M. 1989. Adjustment processes and stability. In J. Eatwell, M. Milgate and P. Newmann (eds.), *The New Palgrave. General Equilibrium*. London: Macmillan.

Foss, N. J. 1995. More on "Hayek's transformation". *History of Political Economy*, 27: 345-364.

Grandmont, J. M. 1982. Temporary general equilibrium theory. In K. J. Arrow and M. D. Intriligator (eds.), *Handbook of Mathematical Economics*, vol. II. Amsterdam: North Holland.

Grandmont, J. M. 1987. Introduction. In J. M. Grandmont (ed.), *Temporary Equilibrium: Selected Readings*. New York: Academic Press.

Hahn, F. H. 1973 [1984]. On the notion of equilibrium in economics. In *Equilibrium and Macroeconomics*. Oxford: Basil Blackwell.

Hahn, F. H. 1994. John Hicks the theorist. In H. Hagemann and O. F. Hamouda (eds.) *The Legacy of Hicks*. London: Routledge.

Hahn, F. H. 1995. General equilibrium for intellectual historians. Mimeo. Paper presented at the Siena Meeting of ESHET. Siena.

Hamouda, O. F. 1990. Hicks's changing views on economic dynamics. In D. E. Moggridge (ed.), *Perspectives in the History of Economic Thought*. Aldershot: Edward Elgar.

Hansson, B. A. 1982. *The Stockholm School and the Development of Dynamic Method*. London: Croom Helm.

Hansson, B. A. 1991. The Stockholm school and the development of dynamic method. In L. Jonung (ed.), *The Stockholm School of Economics Revisited*. Cambridge: Cambridge University Press.

Hayek, F. A. 1928 [1984]. Intertemporal price equilibrium and movements in the value of money. In *Money, Capital and Fluctuations. Early Essays*. London: Routledge.

Hayek, F. A. 1935. Price expectations, monetary disturbances and malinvestment. In *Profit, Interest and Investment.* London: Routledge, 1939.

Hayek, F. A. 1937. Economics and knowledge. In Hayek 1976.

Hayek, F. A. 1941. *The Pure Theory of Capital*. London: Routledge.

Hayek, F. A. 1942 [1955]. Scientism and the study of society. In *The Counter-Revolution of Science*. Chicago: The Free Press.

Hayek, F. A. 1945. The use of knowledge in society. In Hayek 1976.

Hayek, F. A. 1946. Individualism: true and false. In Hayek 1976.

Hayek, F. A. 1948. The meaning of competition. In Hayek 1976.

Hayek, F. A. 1952. *The Sensory Order. An Inquiry into the Foundations of Theoretical Psychology*. London: Routledge.

Hayek, F. A. 1967. *Studies in Philosophy, Politics and Economics*. Chicago: Chicago University Press.

Hayek, F. A. 1968 [1978]. Competition as a discovery procedure. In *New Studies in Philosophy, Politics, Economics and the History of Ideas.* Chicago: Chicago University Press.

Hayek, F. A. 1976. *Individualism and Economic Order*. London: Routledge.

Hicks, J. R. 1932. Equilibrium and the trade cycle. In Hicks 1982.

Hicks, J. R. 1935. A suggestion for simplifying the theory of money. In Hicks 1982.

Hicks, J. R. 1939. *Value and Capital*. Oxford: Clarendon Press.

Hicks, J. R. 1956. Methods of dynamic analysis. In Hicks 1982.

Hicks, J. R. 1965. *Capital and Growth*. Oxford: Oxford University Press.

Hicks, J. R. 1982. *Money, Interest and Wages: Collected Essays in Economic Theory*, vol. II. Oxford: Basil Blackwell.

Hicks, J. R. 1991. The Swedish influence on Value and Capital. In L. Jonung (ed.), *The Stockholm School of Economics Revisited*. Cambridge: Cambridge University Press.

Kirzner, I. M. 1992. *The Meaning of Market Process. Essays in the Development of Modern Austrian Economics*. London: Routledge.

Klausinger, H. 1991. Equilibrium methodology as seen from an Hayekian perspective. *Journal of the History of Economic Thought*, 12: 61-75.

Lachmann, L. M. 1986. *The Market as an Economic Process*. Oxford: Basil Blackwell.

Langlois, R. N. 1985. Knowledge and rationality in the Austrian School: An Analytical Survey. *Eastern Economic Journal*, 9: 309-330.

Lindahl, E. 1929. The place of capital in the theory of price. In Lindahl 1939a.

Lindahl, E. 1930. The rate of interest and the price level. In Lindahl 1939a.

Lindahl, E. 1939a. *Studies in the Theory of Money and Capital*. London: George Allen and Unwin.

Lindahl, E. 1939b. The dynamic approach to economic theory. In Lindahl 1939a.

Littlechild, S. C. 1982. Equilibrium and the market process. In I. M. Kirzner (ed.), *Method, Process and Austrian Economics*. Lexington: Lexington Books.

Magill, M and Quinzii, M. 1996. *The Theory of Incomplete Markets*, vol. I. Cambridge, MA: MIT Press.

Myrdal, G. 1939. *Monetary Equilibrium*. London: William Hodge.

O'Driscoll, G. P. and Rizzo, M. J. 1985. *The Economics of Time and Ignorance*. Oxford: Basil Blackwell.

Petri, F. 1991. Hicks's recantation of the temporary equilibrium method. *Review of Political Economy*, 3: 268-88.

Radner, R. 1982. Equilibrium under uncertainty. In K. J. Arrow and M. D. Intriligator (eds.), *Handbook of Mathematical Economics*, vol. II. Amsterdam: North Holland.

Salmon, M. 1995. Bounded rationality and learning: procedural learning. In A. Kirman and M. Salmon (eds.), *Learning and Rationality in Economics*. Oxford: Blackwell.

Vaughn, K. I. 1994. *Austrian Economics in America. The Migration of a Tradition*. Cambridge: Cambridge University Press.

Zappia, C. 1996. The notion of private information in a modern perspective: a reappraisal of Hayek's contribution. *European Journal of the History of Economic Thought*, 3: 107-131.

Zappia, C. 1997. Private information, contractual arrangements and Hayek's knowledge problem. In W. Keizer, B. Tieben and R. Van Zijp (eds.), *Austrian Economics in Debate*. London: Routledge.