Real Time and Relative Indeterminacy in Economic Theory

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chapter 9

REAL TIME AND RELATIVE INDETERMINACY IN ECONOMIC THEORY

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9.1. Introduction

The twentieth century opened under the ‘spell’ of Bergsonisme. It now closes with a renewed and more sophisticated appreciation of the genius of Henri Bergson.\(^1\) In the intervening years, however, Bertrand Russell’s atemporalism influenced more than a few philosophers of science and the character of discussions about science. Whether it influenced the actual work of the scientific community cannot be univocally answered. Certainly, as we shall see below, the natural sciences recognized early in this century the importance of time and indeterminacy at the microphysical level. The social sciences, however, found in the work of philosophers like Russell a reinforcement of their nineteenth-century mechanical prejudices.

Bergson is pre-eminently the philosopher of time and of evolution. The two ideas are closely related. “The more we study the nature of time”, Bergson tells us, “the more we shall comprehend that duration means invention, the creation of new forms, the continual elaboration of the absolutely new” (1911, p. 11). Bergson’s philosophy was born partly as a reaction to the mechanical nature of Herbert Spencer’s evolutionism. In the latter’s approach, the evolution of genuinely new forms is an impossibility. Spencer’s ‘Principle of the Persistence of Force’ means that the evolutionary process consists simply of the rearrangement of existing forms. True creativity is excluded. Furthermore, the mechanism by which these rearrangements came about can be modelled in a deductive fashion. The present is fully contained in the past. History is therefore a mere unfolding of the already-given.\(^2\)

Russell’s early philosophy of science was consistent with the Spencerian mechanism in many essential respects. But while Spencer did not fully appreciate that he had ‘annulled’ time (an odd accomplishment for an evolutionist), Russell wrote eloquently about the irrelevance of time in philosophy and in theoretical science. Consider the following from his essay *Mysticism and Logic*:

\[\text{[T]here is some sense – easier to feel than to state – in which time is an unimportant and superficial characteristic of reality . . . [A] certain emancipation from slavery to time is}

\(^1\) For some examples of the renewed appreciation, see Kolakowski (1985), Lacey (1989), Burwick and Douglass (1992), and Moore (1996).

\(^2\) A summary of this view is contained in Taylor (1992, pp. 74–85).
essential to philosophical thought... Both in thought and in feeling, even though time be real, to realize the unimportance of time is the gate of wisdom.

... Whoever wishes to see the world truly, to rise in thought above the tyranny of practical desires, must learn to overcome the difference of attitude towards past and future, and to survey the whole stream of time in one comprehensive vision (1925, pp. 21–22).

At the beginning of the twentieth century, physicists believed that the fundamental laws of the universe were atemporal, deterministic and hence reversible. This view was shattered by Heisenberg’s discovery in 1927 of indeterminacy at the microphysical level. Some philosophers have interpreted this as a mere ‘uncertainty principle’ resulting from interference of the observed by the observer or the process of observation. Thus there is an appearance of indetermination arising from our ignorance of the true state of the elementary particles. If we had a complete accounting of all the relevant variables, the argument goes, we would find an essentially deterministic explanation of quantum phenomena. Nevertheless, there is persuasive evidence against this ‘hidden variable’ hypothesis.\(^3\) In those cases where the experimental predictions differ, the results have usually been viewed as favoring the indeterminacy interpretation.

On the other hand, most contemporary economic theory has its origins in an application of mechanics to the study of society. This was explicitly recognized by one of the nineteenth-century pioneers of economics, W. Stanley Jevons:

The Theory of Economy thus treated presents a close analogy to the science of Statical Mechanics, and the Laws of Exchange are found to resemble the Laws of Equilibrium of a lever as determined by the principle of virtual velocities. The nature of Wealth and Value is explained by a consideration of indefinitely small amounts of pleasure and pain, just as the Theory of Statics is made to rest upon the equality of indefinitely small amounts of energy (1965, p. vii).

The full implications of this approach were not widely appreciated until relatively recently. They include the self-same abolition of time, indeterminacy and novelty that characterized nineteenth-century physics (O’Driscoli and Rizzo, 1996, pp. 52–70).

Today there is unrest, if not a crisis, in economic theory emanating from the continued dominance of the nineteenth-century mechanical paradigm. Mechanical models that exclude change and novelty are problematic. This is because such models simply postulate what must be explained, viz., equilibrium. In the social world, as we shall see, equilibrium has a special meaning involving the dovetailing of individual plans. Since equilibrium in society has rather stringent knowledge requirements, it is far from obvious that such a state of affairs must actually exist. Therefore it is incumbent on the social scientist to show how an equilibrium could be generated. The static approach, on the other hand, must postulate either permanent disequilibrium or permanent equilibrium and cannot explain true movement from the former to the latter.

\(^3\) For a brief survey of some of this evidence, see Suppes (1984, pp. 23–25).
Another line of thought – primarily a heterodox or minority viewpoint – connects the ‘subjectivist’ elements of economics with an internal conception of time. In philosophy the latter idea is closely associated with Bergson and Husserl (1964). More recently, in the natural sciences, it has been associated with Ilya Prigogine (e.g., 1986, pp. 243–45) who distinguishes between ‘internal time’ and ‘mechanical time’. The latter corresponds to the aging of a system. From the human perspective, internal time is ‘time consciousness’ which is inextricably associated with change and the emergence of novelty. A concern with time consciousness flows naturally from those approaches to economics, such as that of the Austrian School, which emphasize the ‘subjective’ character of individual decision-making. Decisions are taken on the basis of knowledge, perceptions, valuations and expectations of the individual (Hayek, 1955). These are all contents of human consciousness. It is a short step from these thoughts to that of time. To see this, consider that the kind of decisions in which economists are interested are decisions to act. Action involves the purposeful transformation of a future state of affairs relative to what it would have been without intervention. Thus, action is future-oriented (Mises, 1966, p. 100). An actor must conceive of a future, better than the present, and then bring it about (or, at least, try to do so).

It is the process of acting, rather than the mental picture of completed acts, that discloses time as real duration or the continuous flow of novelty. This is time-as-lived rather than as thought. As we work through an action, we must conceive of a future different from the present and thus be conscious of a heterogeneous time-flow. We shall discuss this further below.

9.2. What is real time?

For our purposes ‘real time’ is time consciousness – consciousness of the passage from one state to another. This is the phenomenon Bergson called ‘la durée réelle’ or real duration and Husserl called ‘internal time consciousness’. By the passage of one state of consciousness to another we must not understand discrete succession of sharply differentiated states. Instead we understand continuous phases that melt, as it were, into one another. Consider that the very idea of ‘passage’ requires a prolongation of the past into the present. Unless we remember the previous state there can be no sense of passage for otherwise each state is solitary or discrete. Memory of a previous state colors one’s perception of the present so that to speak of a present isolated from the past contradicts the idea of time consciousness. Thus the present is not the instantaneous present of Newtonian physics. It is what William James inappropriately called the ‘specious present’ – specious by reference to the purified present of the physics of his day.

We can contrast real time with the common external and mechanical notion of ‘clock time’. The latter has nothing directly to do with time consciousness because it is, simply, a matching of physical motions. The clock’s movements match the
rotation of the earth on its axis. “We have therefore counted simultaneities; we have not concerned ourselves with the flux that goes from one [state] to another” (Bergson, 1911, p. 338). The flux, that is, the perception of succession, could increase or decrease in rapidity without affecting or being affected by clock time. Such changes in time consciousness are known to be induced by various drugs, including marijuana and hashish.

It is useful to consider the essential characteristics of real time more systematically at this point, and to contrast them with those of the static, Newtonian conception, of which clock time is one variant. Real time is: (1) dynamic, (2) irreversible, and (3) possesses a loose causal efficacy.

9.2.1. Dynamism

‘Dynamics’ often refers to the equations of motion in reversible Newtonian systems. The conception of time implicit in such dynamics is static. This is easily seen in differential equations because here we are dealing with instantaneous magnitudes such as velocity and acceleration. The ‘succession’ of instants in a Newtonian world is separated only by the differential of time (dt). Thus, essentially, we are dealing with the present. “You are therefore really speaking only of the present — a present, it is true, considered along with its tendency” (Bergson, 1911, p. 22).

The dynamics of real time, however, arises only in the context of becoming. Becoming is to be contrasted with juxtaposition in space. It is not simply being ‘at’ a certain condition at \( t_1 \), and at another condition at \( t_2 \). (This is the so-called ‘at-at theory’ of becoming pioneered by Russell and extended by Salmon (1984, p. 147–57.) The phases of a process of becoming are not discrete; they exhibit a quality of interpenetration. No phase has full meaning except by reference to the other phases. This can be understood in both a backward and forward-looking manner. In the former, the role of memory is crucial.

We shall have to consider a moment in the unfolding of the universe, that is, a snapshot that exists independently of any consciousness, then we shall try conjointly to summon another moment brought as close as possible to the first, and thus have a minimum of time enter into the world without allowing the faintest glimmer of memory to go with it. We shall see that this is impossible. Without an elementary memory that connects the two moments, there will be only one or the other, consequently a single instant, no before and after, no succession, no time . . . To tell the truth, it is impossible to distinguish between the duration, however short it may be, that separates two instants and a memory that connects them, because duration is essentially a continuation of what no longer exists into what does exist (Bergson, 1966, p. 49, emphasis added).

From a forward-looking perspective, duration is inseparable from expectation. We can imagine the present enduring into a future only if that which is and that which putatively will be are bridged by expectation.
9.2.2. Irreversibility

If nothing of scientific importance hinges on a future state being after the present or the past being before the present (Russell, 1993, pp. 337–38), then time and its processes are reversible. Any state can be gone through more than once because its character is not affected by what has happened before or what is expected after. The history of such a system does not matter. Strictly speaking, it does not have a history because all of its characteristics exist or coexist at an instant in time. Any prolongation of this instant into many does not follow from the analytics of a reversible system. It is purely an ad hoc construction. J.C.C. Smart provides us with a compelling illustration of this:

Suppose our four-dimensional geometry is interpreted as a geometry of space-time . . . Let 'cricket ball', be the expression which in our four-dimensional representation refers to the cricket ball through its entire history. Then it makes no sense to talk of cricket ball, changing or staying the same . . . What we express in our ordinary language representation by saying that the spherical cricket ball becomes ellipsoidal we express in our four-dimensional representation by saying that the three-dimensional cross-section for \( t = t_1 \) is spherical and that the three-dimensional cross-section for \( t = t_2 \) is ellipsoidal. In both these last two uses of 'is' the 'is' must of course be timeless (1978, p. 164, emphasis added).

Since \( t_1 \) and \( t_2 \) exist simultaneously or are juxtaposed, it is possible to move from \( t_1 \) to \( t_2 \) and from \( t_2 \) to \( t_1 \). From the three-dimensional perspective, it is thus possible for a spherical cricket ball to become ellipsoidal and then for it to become spherical again. The cricket ball can go through the same state more than once.

Real time, however, is irreversible. This is because consciousness cannot go through the same state twice. Fundamentally, our consciousness of time is an experience of change. In a completely changeless universe there would be only one instant in which all characteristics are juxtaposed because the sense of before-and-after would be destroyed. Thus time and change go together. But there is a paradox here. Consciousness endures by changing. The sense of continuation must be based, as we have seen above, on memory. Yet memory is responsible for the sense of change – of novelty. The present is new by reference to the contents of memory. "What makes [the] present phase novel, that is, richer with respect to its immediately anterior phase? Precisely the fact that the antecedent phase is still remembered . . ." (Čapek, 1971, p. 128). More exactly, the person is new as he accumulates more and more experiences even if these experiences are unchanging in terms of objective measurements (e.g., constant visual or aural stimuli). He is thus at a new moment of his history. Perspectives will change if only because consciousness is older (Bergson, 1911, pp. 5–6). To use a mechanical analogue, the system is aging.

One may also understand the irreversibility of real time in another, closely related, way. Any present moment is affected, or more precisely, is defined in relation to the expectations held by the agent at its emergence. As the present recedes into the past, memory is now enriched by that particular fusion of
expectation and primal experience. Now, strictly speaking, the same present moment cannot occur again because the background, the memory of the agent, is now richer or more comprehensive. Viewed prospectively, the remembered experience of the agent is inseparable from his prospective attitude or expectation. (In a sense, they are simply two aspects of the same phenomenon.) This means that the agent’s expectational attitude is continually changing as he moves forward through time. As a consequence, each present experience must be different from its predecessor.

9.2.3. Loose causal efficacy

In the static or mechanical time perspective, succession is illusory. It is simply an appearance based on human intellectual limitations. This was the position of Bertrand Russell who believed that “the apparent indeterminateness of the future . . . is merely the result of our ignorance” (1993, p. 238). Everything is, from the omniscient standpoint, coexistent. It is the task of philosophy and theoretical science, the argument claims, to embody, as far as practical, this ontological stance. From the abolition of succession it is a short distance to the abolition of time. While most contemporary economists are doubtless unaware of Russell’s views, they embody his philosophy in the positive heuristic of their research program. Apparent changes are reinterpreted as cross-sections of a higher-order function. Thus, an agent’s expectations may appear to change but the analyst who knows the structure of these ‘changes’ will see that they can be fully explained by changes in the data. In the terminology of Frank Hahn (1984, p. 55), the agent’s theory is the same; it is just the messages sent by the economy that have changed. So change is thereby minimized to the status of (hopefully) only occasional exogenous shocks (Cowan and Rizzo, 1996, pp. 286–88).

If succession, on the other hand, is genuine and if it grows out of the past, then what is the epistemic relationship between past and present? Russell believed it was logical implication (1993, p. 216). As we have seen above, acceptance of this view effectively annuls succession and time. Implication is a timeless relation and it is a mere accident of our limited intelligence that prevents us from seeing everything at one grand instant. Since we reject the assimilation of causation to logical implication (Cowan and Rizzo, 1996, pp. 299–300), we are left with the following choice: either the present is a complete creation ex nihilo or it is loosely determined by the past. The latter is the position for which we, and Bergson before us, are arguing.

Creation ex nihilo must be outside of time. This is because it is inconsistent with any form of persistence of the past and hence of duration. To the extent that a past state persists in memory the novelty of present consciousness is limited. Memory persists in the new conscious state, and not simply as a contrasting

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4 For a discussion of the historical roots of this idea, see Čapek (1959, pp. 82–90).
image. If the latter were the case, there would be no continuity in our conscious life. The individual would experience re-creation at each instant. We would then have to agree with Russell that “[t]here is no logical impossibility in the hypothesis that the world sprang into being five minutes ago” (1995, p. 159). Or, we might add, one minute, one second, or, in the limit, that the world is only a present world. The claim that the world is entirely present is indistinguishable from the claim that it is outside of time and implies that the past is only a construction from present materials. All of these implications are untenable, for then we are left with the obvious, unanswerable question: Whence this illusion of change and of a real past (Bergson, 1911, p. 339)?

The indeterminacy of the future is a relative indeterminacy. Although the future is caused by the present, it is not necessitated by it. The view that the only alternative to strict causality is absolute indetermination is false. Even at the macrophysical level the evidence is against it. Consider:

The predictability of the positions of any given macrophysical particle ... is only approximate ... The projected trajectory of a particle, which, in our macrophysical perspective, appears as a precise geometric curve with no transverse thickness, is, in reality, a thin tube, a bundle of possible routes, which, although very thin, still has transversed dimensions corresponding to the quantic indeterminations of the future positions ... In other words, it is only by virtue of our macroscopic myopia that the field of the diverse possibilities seems to shrink so that it appears finally as a precise infinitely thin line of ‘the only possible route’ (Čapek, 1959, pp. 88–89).

Of course, the looseness of causal processes is even clearer at the microphysical level where probabilistic forms of explanation are commonplace (Salmon, 1984, pp. 242–59). So the determination of the future is one of general patterns and not of precise details. As we have seen, the continuity of real time does not only permit loose or pattern causation but it requires it. The idea of a deterministic process is either an approximation or a contradiction. A process is extended in time and, as such, it embodies a form of ‘memory’. Therefore, its novelty is both genuine and limited.

9.3. The ‘extended present’

An example of the importance of the real time perspective for economic thought can be found in the work of the Austrian economist, Ludwig von Mises. Mises, it seems, was influenced by Bergson’s philosophy, but this influence has yet to be documented fully. Mises understood that for purposes of explaining human action the present cannot be the mathematical instant. Such a present does not endure long enough to be utilized by the actor. “[F]rom the praxeological aspect there is between the past and the future a real extended present” (Mises, 1966, p. 100). The extended present encompasses what from the instantaneous perspective belongs to the recent past. “The present encloses as much of the time passed away as is still actual, i.e. of importance for acting” (p. 101). For the past to prolong
itself into the present consciousness of the actor obviously requires memory. So the real extended present must embody memory of the past. But since all action is future-orientated, i.e. aims at improving the future state of affairs beyond what it would be without the action, the extended present must also encompass expectation (p. 100).

To see the importance of Mises’s idea of the extended present for his treatment of an economic issue, consider his analysis of the role of product prices in the investment decisions of entrepreneurs (1966, pp. 336–37). He asks the question: Do entrepreneurs base their plans on the present prices of the products they intend to produce? Mises answers in the negative because these are really just-past prices. Since production takes time they are interested in the prices that will prevail when the products come to market. But these do not yet exist so the obvious question is the relationship between just-past present prices and future prices. Mises sees the “prices of the immediate past” as a “starting point of deliberations leading to forecasts of future prices” (p. 336). This, however, is ‘only’ a starting point. Future prices do not have a “direct causal relation” [Ibid.] to past prices. In other words, they are not tightly caused or necessitated by the past. There is a loose causal relationship that admits of favorable or unfavorable surprises in the eventual prices of the products. Nevertheless, there is no creation ex nihilo. The surprises or novelties facing the entrepreneur are limited for they “do not construct afresh every day a radically new structure of prices” (p. 337).

The Misesian real extended present is to be contrasted with the three atemporal approaches that pervade modern economics. The first is the instantaneous present of the Arrow-Hahn-Debreu model of general ‘inter-temporal’ equilibrium. In this model all decisions are taken at a single instant for all future dates and contingencies. So, for example, the agent makes provision at that instant for umbrellas on December 25, 2010, if it is raining. While time in the calendar sense exists in this model, the passage of time is economically irrelevant. The future could be compressed or elongated at will without necessitating any essential changes in the model. In fact, analytically, there is no difference in Arrow-Debreu between a commodity at a future point in time and one at a distant geographical point. Since all decisions are made at the primordial instant, there is no reevaluation of the probability of future contingencies as time goes on. The agents do not learn. Hence they do not endure.

The second approach sees the relationship between the past and present as one of logical containment. Here, while prices change over time, past prices logically imply (via some functional relationship) present prices for all time periods. So the present in rigidly contained in the past and thus no novelty is possible. Since the operation of ‘logical implication’ is timeless, such a model does not embody the passage of time in any essential way. A sufficiently intelligent observer in possession of the relevant formulae could see this universe at a single instant. The appearance of time is thus the result of human ignorance.
The third atemporal approach against which we can compare the Misesian extended present is simply the forward-looking version of the above containment model. In the rational expectations approach, future prices are implied by the complete array of present data. Therefore the future is not emergent but a simple displacement of already-existent parts (Bergson, 1911, p. 8). Once again, the ‘duration’ between the present and the future is inessential; it can be compressed to a single present instant without any essential change in the analysis. Time in these approaches is a purely ad hoc construction.

9.4. The plan: Newtonian or durational?

A plan is an integrated series of intended actions over time. As such it may seem to be the single most important place to start in an effort to understand the role of time in economics. While this will, in fact, turn out to be the case, the concept of a plan, as completed and as a mental picture of possible acts, embodies time in a static or Newtonian manner. Consider the plans of agents in an Arrow-Hahn-Debreu general equilibrium model. The plan consists of a mental picture of spatialized time in which the allocational (budgetary) decisions of individuals over time are identical to allocations over space. The only knowledge the individual has is that possessed at the primordial instant.

Although the plan-as-contemplated involves a static conception of time, the plan-as-created is a durational act. The process of planning is in real time because as we think we experience and we learn.5 We could not go from a state of indecision to one of decision unless this were true. Ignoring the growth of knowledge would require that the plan be settled upon from the beginning as in the Arrow-Hahn-Debreu model. It is also true that since the plan will be used as a guide to action over time, there must be a process of implementation during which the agent experiences and learns. This again is a process in real time. So the plan as created (revised) and implemented is in real time, while the plan merely as an object of contemplation is static. This is an example of what Bergson meant by the statement, “We do not think real time. But we live it...” (1911, p. 46).

While the contemplated plan is essentially a static object of thought, it nevertheless contains a residue, as it were, of its durational origin. The individual knows that he will learn during the implementation of his plan. Therefore he will insist that it embody a certain degree of flexibility. A rigid commitment to a certain course of action may be optimal given the initial state of knowledge, but it may not be optimal when that knowledge changes. Flexibility in a plan is the outward manifestation of the fact that the plan will be lived as well as thought.

5 An earlier presentation of this idea is in O'Driscoll and Rizzo (1996, pp. 62–64).
9.5. Coordination and time

The central importance of plans for economics appears in the interpersonal context. Since plans usually involve intentions to engage in market exchange, their effective implementation requires coordination among individuals. Thus, in a simple two-person situation, if A intends to sell a house for $100,000, it is important that there exist a B who intends to buy at that price. Otherwise, there will be discoordination of plans and the need for plan revision on the part of one or both parties. In a world of unpredictable change, plans are rarely, if ever, coordinated ab initio. Thus, a crucial phenomenon in economics is the process of plan creation, and revision engendered by the initial errors of discoordination.

Our task in this section is to examine the implications of real time for the analysis of the process of plan revision. We shall briefly discuss several approaches in ascending order of their ability to deal with real time.

(i) In his influential 1937 analysis of plans Hayek (1948) argued that if the plans of individuals are incompatible with each other, it is because some individuals are wrong in their predictions of the behavior of others. Sellers of houses may be overly optimistic about the prices that buyers are willing to pay, for example. Nevertheless, Hayek suggests, “it may be inevitable that in the course of his attempt [to implement his plan, the individual] will find the facts are different than he expected” (p. 52, emphasis added). Furthermore, “the relevant knowledge which he must possess that equilibrium [i.e. mutual compatibility of plans] may prevail is the knowledge which he is bound to acquire in view of the position in which he originally is, and the plans which he then makes” (p. 53, emphasis added). Hayek appears to be saying, first, that it is well-nigh inevitable that the individuals will learn that they were mistaken in the assumptions upon which their plans were based. He then goes on to say that the knowledge they need in order to have mutually compatible plans is knowledge they will certainly acquire as they discover their errors. Thus, sellers of houses will not only discover that they are asking too much but they will also discover the ‘correct’ asking-price – one that will render buyer and seller’s plans compatible.

Hayek’s deterministic ‘process’ is quite similar to, if less explicit than, that outlined in Erik Lindahl’s 1939 essay. Here Lindahl specifies his deterministic research program:

The first step in this analysis is to explain a certain development as a result of certain given conditions prevailing at the beginning of the period studied. These given conditions must be stated in such a way that they contain in nuce the whole subsequent development (Lindahl, 1939, p. 21).

The model must portray the process of plan revision as the necessary consequence of the conditions existing at the moment in time in which the discoordination obtained. These ‘given conditions’ are quite comprehensive. Thus,
[If we know (1) the plans of the economic subjects concerned at the initial point of time, if we further know (2) how these individuals are likely to change their plans in the future under different assumptions, and if we have (3) enough knowledge of external conditions to make definite statements with regard to future changes in plans, and the results of the actions undertaken then it should be possible to provide a theoretical construction of the developments that will be the outcome of the initial position (Lindahl, 1939, pp. 37-38).

This model clearly does not imply a real-time approach for it explicitly endorses the ‘container’ view of causation which holds that the present can be deduced from the past. This was Laplace’s view of the physical universe. In neither Lindahl’s nor Laplace’s framework can there by any genuine processes in time. As we have seen, in such approaches, the elapsed period of time is purely arbitrary. If everything that causes an effect is present at \( t_0 \), then so too will be the effect. If, on the other hand, not everything is present, then the state of the world at \( t_1 \) cannot be the deterministic consequence of the world at \( t_0 \).

(ii) If we go beyond simple mutual compatibility of plans to a fuller conception of economic coordination, Hayek understands that the deterministic quality of the process of plan revision must be attenuated. Consider the following example. Plans of buyers and sellers may be compatible as in the case of the house buyers and sellers discussed above. This does not imply, however, system-wide coordination of plans. For example, there may be potential buyers who are willing to pay more than the current buyers, or potential sellers willing to charge less than the current sellers. In either case there are unexploited opportunities for mutual gain and hence lack of complete coordination. Learning about these opportunities is not well-nigh inevitable because it is not knowledge that the individual is bound to acquire in the process of implementing his plans. One can successfully implement a plan without finding a better opportunity elsewhere. The individual “may learn of the new facts as it were by accident, that is, in a way which is not a necessary consequence of his attempt to execute his original plan . . .” (Hayek, 1948, p. 52, emphasis added).

Simply because a process of learning and of plan revisions is not deterministic does not imply that a near-coordinated outcome is impossible. In fact, Hayek believes that such an outcome is highly likely and that the world is characterized by a high degree of plan coordination. The process of plan revision is more likely to produce improvements in coordination the closer the system is to full coordination (equilibrium) in the first place (Hayek, 1976, p. 125; 1941, p. 23, n. 1). This is because, under conditions close to full coordination, errors will be fewer or smaller and hence (so Hayek apparently believes) easier to detect and correct.

If Hayek is correct that the economy is generally close to a state of full coordination at most times, then the underlying economic reality will yield more readily to the deductive method. The state of the world at \( t_0 \) will ‘yield’ a world
at \( t_0 \) that is a tolerable approximation to the actual world. By definition of ‘near coordination’, the novelities added by time are relatively unimportant.

(iii) More recently, Hayek (1978) has conceived of competition in particular and the market in general as a ‘discovery procedure’. In this view, the essence of economic processes is the discovery of new knowledge and the emergence of novel behavior and structures. If plan revision is associated with new discoveries, then the new plans of agents cannot be anticipated fully by all within the system. Learning processes in response to prior plan discoordination will themselves produce some (greater or lesser) discoordination as expectations are upset by the new behavior. Under these circumstances, the state of exact and full plan coordination cannot, in principle, be achieved.\(^6\) This is because the very process that is responsible for whatever degree of coordination we enjoy is itself a discoordinating force (O’Driscoll and Rizzo, 1996, p. xxvii). In this conceptualization, economic processes cannot be modelled in a deductive manner for we must, to be faithful to reality, exhibit their essential novelty. This novelty implies that agents cannot forecast what they will learn, plan and do on the basis of current data. Consequently, plans of such real-time agents cannot be fully coordinated. This is the economic meaning of the general incompatibility of real time and equilibrium.

(iv) Although the later Hayek recognizes the indeterminacy of economic processes, his analysis is incomplete in a number of respects. There is no explanation of why or how a creative market order could still be stable or fairly orderly. (It is true that Hayek emphasizes the role of a predictable legal framework, but this does not directly address the orderliness of the market process itself.) The British economist G.L.S. Shackle gives us some indication of how we might proceed in arriving at such an explanation.\(^7\)

Firstly, we must explicitly recognize that in a world of change or genuine “beginnings there is no complete inferential knowledge of the content of time-to-come” (Shackle, 1973, p. 55). Lindahl’s ambition to model the world at \( t_0 \) so that it contains in nuce the world at \( t_1 \) is not faithful to reality and, even more damning, is incoherent in a world of real time. Of course, if this criticism is accurate, then a theory of economic processes based on the plan revisions of agents cannot be deterministic. There is no general theory of how agents respond to disappointments (Shackle, 1973, pp. 40–1).

Secondly, it is also important to realize that the novelty emerging from real-time economic processes cannot be completely unconstrained. For choice to be meaningful individuals must have some idea of “what can follow what” (Shackle, 1979, p. 20). Without some understanding of instrumental causal relations it is impossible to interfere in course of events to bring about a preferred result. This

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\(^6\) Further discussion of exact coordination is in O’Driscoll and Rizzo (1996, pp. 80–85).

\(^7\) The following analysis of Shackle benefitted greatly from Currie and Steedman (1990, pp. 154–76).
understanding is based on how individuals “have seen the world to work” (Shackle, 1973, p. 62). Memory thus constrains expectations of future causal connections.

So Shackle is staking an intermediate claim between mechanism and absolute indetermination. Both the chooser and the economist “must view the world as a pattern of natural barriers rather than narrow and prescribed tracts. What can take place, he must suppose, is bounded but not prescribed” (Shackle, 1979, p. 20). This is an economic application of the intermediate philosophical position laid out by Bergson.

The implications of Shackle's view for interpersonal coordination are quite intriguing, although not adequately pursued by Shackle himself. The order of the market in real time must be flexible. It cannot inhibit change; in fact, it is an aid to the discovery of new knowledge. Therefore, this order involves only a certain degree of harmony or coordination of plans. These plans are, by necessity, imprecisely defined and map out paths that will, it is hoped, lead to profitable discoveries. Coordination is coordination in the pursuit of knowledge (Loasby, 1990).

(v) To make sense of the process of plan revision in response to disappointments we must break down the process into its component parts. In Hayek's formulation, plans rest on expectations of external events and the actions of other individuals. Usually such expectations are single-valued and thus, when they are correct, plans will dovetail exactly. Single-valued expectations are not only a simplification, however, they are an oversimplification. Individuals typically have an array of expectations each with an associated likelihood. (This is not to argue that they assume these arrays are exhaustive.) But if expectations are multivalued then the array might be ‘correct’, but plans may nonetheless fail to mesh exactly. The individual's plans are based on the best available view of the future – but that is never perfect. So when all systematic errors are eliminated an imperfect equilibrium will be attained.

Hahn (1984, pp. 55–6) uses a convenient terminology in which to discuss the components of plan revision. Hayek's expectations can be seen as generated by Hahn's ‘theories’ and Hayek's plans by Hahn's ‘policies’.8 A theory enables the individual to make forecasts on the basis of current data. A policy incorporates these forecasts in decisions about specific acts or a series of intended acts. Hahn's ‘theories’ and ‘policies’ are rigid, deterministic methods of generating specific expectations and plans. Within these frameworks there are changes in actual expectations and actual plans when the 'exogenous messages' received by essentially non-entrepreneurial agents change. This is not 'learning', Hahn admits. It is simply a mechanical adjustment to changed data.

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8 This connection was suggested by Loasby (1990, p. 46).
The question remains: If agents truly learn, as they will in real time, then can economists say anything about how plans are revised? Is there a nonmechanical or nondeterministic order that persists throughout the process of revision? We suggest that the answer is in the affirmative. Fundamentally, this is because without such an order individuals would be at a loss to forecast the ever-changing plans of others. If this were true, then market economies would exhibit little order or regularity, which is manifestly contrary to fact.

One of the most promising attempts to integrate real time and a process of plan revision is implicit in Loasby’s (1990, esp. pp. 51–4) brilliant adaptation of Lakatos’s (1970, pp. 91–196) methodology of scientific research programs to model the mindset of the economic agent. The scientific research program (SRP) consists of a ‘hard core’ of metaphysical concepts or other basic concepts and propositions about the world. These are treated as irrefutable by the methodological decision of the scientist or agent. The hard core does not appear ready-made but is the product of a largely unexplored process of knowledge acquisition in time (Lakatos, 1970, p. 133, n. 4; Weintraub 1985, p. 112–14). Therefore, the hard core is the bequest of the past to current research efforts; it is a kind of collective memory, as it were.

The hard core is protected from refutation by a ‘protective belt’ of observational or other auxiliary theories and initial conditions. Therefore, a proposition in the hard core may be insulated from refutation by a ‘fact’ by questioning the observational theories that make the fact credible. This is part of the ‘negative heuristic’ of the SRP.

There is also a ‘positive heuristic’ or set of instructions on how to generate specific hypotheses within a SRP. In Loasby’s adaptation, these hypotheses are the theories and policies discussed by Hahn. Forecast-theories are generated and later revised within the SRP. Thus, not only do expectations change but the method by which they are arrived at do also. Policies (and derivatively plans) will change partly as a result of changed expectations and expectational theories, but also partly as the result of a better coordination of means to ends.

The rules provided by the positive and negative heuristics guide the process of discovery. These rules do not generate a deterministic system for two reasons: (1) the list of heuristics is neither complete nor completable, and (2) the heuristics do not contain in nuce the discoveries yet to be made. Both the heuristics and the discoveries are emergent characteristics of the research program.

The research program is a structure that is compatible with the attributes of real time. In the first place, it provides a historical view of knowledge acquisition. The facts predicted by hypotheses (viz., theories and policies) of the SRP are novel in a limited way. They cannot be inconsistent with those facts or constructions in the hard core of the program. So the scientist’s or agent’s expectation of future

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9 See also the detailed treatment in Harper and Earl (1996, pp. 306–28).
discoveries is constrained by the past. Furthermore, the process of search for discoveries is itself constrained by the existing positive and negative rules for going forward. To the extent that the research program is successful it enables the agent to *anticipate* 'novel' facts, but only after the hypotheses are formulated in a temporally coherent process. Thus because the emergence of new hypotheses cannot be predicted, there will be an endless flow of fresh discoveries. As a consequence, the revision of plans cannot be deterministic as both the early Hayek and Lindahl suggested. Neither is it unbounded, however. The concept of a 'research program' provides a promising flexible structure that economists can use to describe plan revision and coordinating activity in real time.

9.6. Conclusion

During the twentieth century, mainstream economic theory largely ignored the possibility of an economics in real time. This occurred in large part because its practitioners sought to emulate the success of Newtonian physics. Nevertheless, as our selective overview has shown, there were strains of thought which provided the basis for a real-time reconstruction of economic theory. As we pass into the twenty-first century, it remains to be seen whether the real-time challenge will be heeded. There is a certain urgency to this because it is really the challenge of putting life back into economic theory. The way economists respond will determine whether we have an economics of automats or an economics of real, enduring human beings.

References


Loasby, B.J., 1990, Equilibrium and Evolution (Manchester University Press, Manchester).


