
Time, Ignorance, and Uncertainty in Economic Models

Donald W. Katzner

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Preface

Time, wrote Alfred Marshall, is “. . . the source of many of the greatest difficulties in economics.”¹ To which, one might argue, he subsequently added uncertainty and, at least by implication, ignorance.² Over the years, these elements have, by and large, found expression, somewhat contrary to the meanings Marshall originally gave to them, in terms of the grand equilibrium paradigm that gradually, during the twentieth century, overtook the bulk of economic theorizing. Thus, time came to be represented abstractly as a subscript, t , in a periodic equation, or as the independent variable with respect to which numerical magnitudes would modify continuously in a differential equation. And uncertainty and ignorance were captured by the language of probability. But, even as it developed, there has always been an uneasiness with this state of affairs. For along with the acceptance of the equilibrium paradigm has been an undercurrent of thought reflecting the ideas, implicit in Marshall, that the time humans actually experience, and in which they live, that is, historical time, is not reasonably approximated by the time that structures the equilibrium paradigm, and that, due to the ignorance humans actually face (which arises, in part, from the reality of historical time), the epistemological basis underlying the construction

¹A. Marshall, *Principles of Economics*, 8th ed. (New York: Macmillan, 1948), p. 48.

²*Ibid.*, p. 347.

of probability might not, in the end, hold up.³ The question arises, then, of what contours and features economic analysis might exhibit if the equilibrium paradigm were discarded and historical time, nonprobabilistic uncertainty, and ignorance were fully taken into account.

However, with one major exception, not much progress has been made in developing models that would give concrete illustrations of the nature of economic analysis under such conditions. The one exception is the model of decision making in ignorance introduced by G. L. S. Shackle.⁴ Shackle not only argued eloquently that, for the reasons suggested above, the equilibrium paradigm is wanting in its relevance to reality,⁵ but his model, a modified version of which will be examined in detail in Section 4.3 below, represents, in spite of its flaws, a remarkably original attempt to introduce historical time, nonprobabilistic uncertainty, and ignorance into the analytical texture of decision making. But Shackle's work in general, and this model in particular, while enjoying some resonance in the economics literature,⁶ seem, nevertheless, to have largely been dismissed as ". . . an exercise in the economics of pure chaos or . . . an elegant nihilism of no practical relevance."⁷ Even

³*E.g.*, Marshall, *op. cit.*; F. H. Knight, *Risk, Uncertainty and Profit* (Boston: Houghton Mifflin, 1921); J. M. Keynes, "The General Theory of Employment," *Quarterly Journal of Economics* 51 (1937), pp. 209-223; G. L. S. Shackle, *Epistemics and Economics* (Cambridge: Cambridge University Press, 1972); and J. R. Hicks, "Some Questions of Time in Economics," in *Evolution, Welfare, and Time in Economics*, A. M. Tang, F. M. Westfield, and J. S. Worley, eds. (Lexington: D. C. Heath, 1976), pp. 135-151.

⁴*Decision, Order and Time in Human Affairs*, 2nd ed. (Cambridge: Cambridge University Press, 1969).

⁵*E.g.*, *op. cit.* See also G. L. S. Shackle, *Keynesian Kaleidics* (Edinburgh: Edinburgh University Press, 1974).

⁶*E.g.*, B. Loasby, *Choice, Complexity and Ignorance* (Cambridge: Cambridge University Press, 1976); D. Vickers, *Financial Markets in the Capitalist Process* (Philadelphia: University of Pennsylvania Press, 1978), Part 3; and D. Vickers, "On Relational Structures and Non-Equilibrium in Economic Theory," *Eastern Economic Journal* 11 (1985), pp. 384-403.

⁷C. Rogers, *Money, Interest and Capital* (Cambridge: Cambridge University Press, 1989), p. 234. Rogers is actually dissenting from such claims. See also A. Codrington, *Keynesian Economics: The Search for First Principles* (London: George Allen & Unwin, 1983), p. 61; S. A. Ozga, *Expectations in Economic Theory* (London: Weidenfeld and Nicolson, 1965), p. 223; and G. Winston, *The Timing of Economic Activities* (Cambridge: Cambridge University Press, 1982), p. 15.

the incorporation of nonprobabilistic uncertainty itself into economics has been set aside on the grounds that it would “. . . deprive economic analysis of all definite content. . . .”⁸ Part of the problem may be that, although it has both been improved⁹ and inspired offshoots,¹⁰ Shackle’s model has not yet been subjected to an analytical workout on the order of that comparable to the hoops through which standard models in the economics literature are currently propelled. Another possibility might be that the model has not yet been explicitly extended and applied as the basis for rigorous models of the general microeconomy and its components, or for the microfoundations of models of the macroeconomy. That is to say, the Shacklean model has not yet been pushed, in a formal sense, to the same heights as traditional models of decision making under certainty and probabilistic uncertainty, and thus the analytical potential of the Shacklean approach to economics in general is, to a considerable extent, uncharted and murky.

The central concern of the present volume relates, in the manner just described as lacking, to the character of formal economic analysis when historical time, nonprobabilistic uncertainty, and ignorance are fully integrated into its fabric or, in other words, when that analysis is pursued from the Shacklean perspective. What, under these latter conditions, would economic models look like? What kinds of epistemological, methodological, and analytical problems would have to be dealt with to build them? How could rigorous analysis within their frameworks proceed? In short, if the equilibrium paradigm and all that springs from it is to be rejected, what might be put in its place? The book addresses these questions by first exploring a modified version of Shackle’s model in considerable analytical detail, and then employing it to construct models of the firm, the consumer, and the micro- and

⁸M. Milgate and J. Eatwell, “Unemployment and the Market Mechanism,” in *Keynes’s Economics and the Theory of Value and Distribution*, J. Eatwell and M. Milgate, eds. (New York: Oxford University Press, 1983), p. 279. See also J. Hirschleifer and J. G. Riley, *The Analytics of Uncertainty and Information* (Cambridge: Cambridge University Press, 1992), p. 10; and R. E. Lucas, Jr., *Studies in Business-Cycle Theory* (Cambridge: MIT Press, 1981), p. 224.

⁹E.g., D. Vickers, *Money Capital in the Theory of the Firm* (Cambridge: Cambridge University Press, 1987), Ch. 12.

¹⁰E.g., J. L. Ford, *Economic Choice under Uncertainty: A Perspective Theory Approach* (New York: St. Martin’s, 1987).

macroeconomies. By investigating the above questions in the process of constructing and exploring particular models, the emphasis of subsequent chapters is more on the actual doing of economic analysis in the context of historical time, nonprobabilistic uncertainty, and ignorance than on methodologically discussing how to go about doing it. Hopefully a better comprehension of the kind of theorizing that might be produced from the Shacklean vantage point will emerge. That approach, clearly, will never receive acceptance, or even a sympathetic hearing, until we first fully understand exactly what it can do.

It is important to emphasize that the ensuing offering attempts to present something rather different from traditional economic inquiry. Indeed, in moving to an analytical environment of historical time, nonprobabilistic uncertainty, and ignorance, a clean methodological break is made with that tradition. This is not to say that nothing in traditional theory is relevant for, or appropriate to, the Shacklean approach. For, in point of fact, a number of ideas on the pages that follow are borrowed directly from traditional investigations. But it does raise a potential obstacle for the reader. People, after all, come to works they read with a given mind-set (*i.e.*, they read in historical time). That mind-set is determined by their own historical backgrounds and it colors their understandings of what they read. They are conditioned to expect certain things and often, and quite naturally, read those things into what they see on the printed page, even if it was not the author's intention to put them there. Thus it can be difficult, when submitting a radically different perspective for a reader's consideration, to present it in a manner that enables him to escape from his existing mind-set and take off in a new direction. In writing this book, although I have been aware of the problem, I cannot say that, even with substantial effort, I have been able to overcome it.

As is common these days, the level of discourse throughout the volume includes the use of mathematical symbolism and reasoning. I see this as an appropriate means of analytical expression, the application of which in economics has been given numerous justifications dating at least to Cournot.¹¹ However, to aid readers who prefer to avoid detailed

¹¹See D. W. Katzner, "In Defense of Formalization in Economics," *Methodus* 3, no. 1 (June 1991), pp. 17-24.

mathematical argument where possible, I have identified material that can be skipped without seriously impairing their ability to understand what is going on. It should also be noted that, due to the broad spectrum of topical coverage, it has not been possible to develop a system of notation in which each symbol always appears with the same meaning everywhere from one end of the investigation to the other. Only within chapters, and occasionally across successive chapters, is such symbolic consistency maintained. In each chapter, then, all symbols are defined where they are introduced. Moreover, the theorem-proof style of exposition is employed where convenient.

It was Douglas Vickers who, some years ago, suggested that I take up an inquiry into the effect on economic modeling of introducing historical time, nonprobabilistic uncertainty, and ignorance. With two exceptions, the following chapters appear in the same order in which I engaged the issues they address. Each of these chapters was initially written and, in all cases but two (not the same two as the aforementioned exceptions), published as an independent paper.¹² In this process, Vickers played a major role. The following pattern, with some variation here and there, repeated itself over and over again: after preliminary discussions with him concerning the kinds of issues to be entertained and the means by which those issues might be faced in a given paper (chapter), I would work out a way of dealing with the subject (e.g., build a particular model) and write a draft of the paper. Next Vickers would comment on the draft, pointing out errors, weaknesses, omissions, and alternatives. Then it would be back to the drawing board to rethink and rewrite. Further commentary by Vickers with each instance succeeded by my rewriting would ensue. Sometimes a result that we were both happy with would emerge after two or three tries. Occasionally, as many as a dozen or more iterations were required. (Often Vickers would write his own paper on the same subject and, in discussions of it, our roles would reverse.) A similar procedure was used in reworking and combining these papers into the present book. (Vickers wrote his own book too.)¹³ Thus, at all stages, Vick-

¹²Publication of the original version of Chapter 10, however, has been delayed.

¹³D. Vickers, *Economics and the Antagonism of Time: Time, Uncertainty, and Choice in Economic Theory* (Ann Arbor: University of Michigan Press, 1994).

ers has been a driving force and a significant contributor. Not many authors are fortunate enough to have this kind of support and I am deeply grateful for it. I can only absolve him of the responsibility for any errors that have survived, and hope that the final result is worthy of such effort.

Numerous other individuals have also given their time and energy to various parts of the manuscript at various stages of its development. The help of some has already been acknowledged in the previously published versions of those chapters heretofore in print. Although the limitations of space do not permit the listing of all who remain, I would especially like to thank Andy B. Anderson, Philippe De Ville, David J. Foulis, and Frank Wattenberg for their assistance. Of course, my intellectual debt to G. L. S. Shackle is both, at the same time, rather heavy and quite obvious. Thanks are also due to the *Eastern Economic Journal*, Edward Arnold, M. E. Sharpe, Routledge, and Springer Verlag for their permission, explicitly acknowledged later on, to freely use published materials below. Finally, I would like to thank George E. Zinsmeister for help with the preparation of the diagrams.

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CHAPTER 1

Introduction: Alternatives to Equilibrium Analysis

*Here is Edward Bear, coming downstairs now,
bump, bump, bump, on the back of his head,
behind Christopher Robin. It is, as far as
he knows, the only way of coming downstairs,
but sometimes he feels that there really is
another way, if only he could stop bumping
for a moment and think of it.*

A. A. Milne, *Winnie-the-Pooh*

Economists, too, often seem to yearn for another way. It is not only the uneasy feeling that assumptions may be “unrealistic,” or techniques “inadequate” or “improper,” but sometimes even the approach itself can appear to be a straitjacket that lacks the necessary flexibility to deal appropriately with the problems at hand. The evidence of discontent is considerable and growing: numerous articles and books have been written that detail complaints.¹ Numerous sessions at conventions take up these questions.² Thus, for example, Georgescu-Roegen [8, p. 319] sees

¹ *E.g.*, Katouzian [18], Klamer and McCloskey [22], McCloskey [26], [27], Ward [41], Woo [44], and the collections of essays edited by Bell and Kristol [4] and Wiles and Routh [42].

² *E.g.*, “Has Formalization in Economics Gone Too Far?” *Methodus* 3 (June 1991), pp. 6-31.

This chapter is reproduced, with considerable additions, corrections, and other modifications, from my “Alternatives to Equilibrium Analysis,” *Eastern Economic Journal* 11 (1985), pp. 404-421.

the economic “method,” largely transferred from classical mechanics, as the primary source of a malaise in Economic Science. Hicks, in addition to repudiating received theory (including his own work) by changing his name [13, p. 365], laments that much of economic theorizing is, to its detriment, “out of time” [14]. And Hutchison [15, p. 88] speaks of a “crisis of abstraction” brought on by assumptions that oversimplify and result in analysis that is irrelevant for interpreting economic reality. To understand many of the issues involved, it is necessary to introduce some concepts.

1.1 Preliminaries

In the present context, the *purpose* of analysis is to explain or make sense of what is happening in the world. This notion of analytical objective is meant to be sweeping, intentionally including such possibilities as the exploration of hypothetical policy options and prediction. Moreover, regardless of whether explicitly stated, each analysis comes fully equipped with both methodological and epistemological supports. The *methodology* of an analysis is the conceptual means by which the analysis is put together. Its *epistemology* elucidates how the analysis does its explaining or, in other words, how it is able to produce knowledge.

Traditionally, epistemology has been based on the presumption of a dichotomy between observations of reality and thoughts about those observations. From the *rationalist* perspective (Descartes), knowledge is gained by first thinking or theorizing about reality and then fitting what is seen into the thoughts or theories already secured (reality is made to correspond to thoughts). Alternatively, the *empiricist* (Locke) would argue that one obtains knowledge by looking first, and then building thoughts and theories to understand what has been seen (thoughts are made to correspond to reality). Thus these approaches dichotomize thinking and seeing, and produce knowledge or truth by taking one to be the “cause” or “essence” of the other. In this sense, traditional epistemology may be called *essentialistic (reductionistic)*.

There is, however, an alternative epistemology that does not recognize the dichotomy between observation and thinking.³ Unlike ratio-

³Resnick and Wolff [31] and Rorty [34].

nalism or empiricism, no single unique procedure generates knowledge. Knowledge, rather, comes from discourse that recognizes the interrelatedness of observation and thinking, and hence the nonunique and *nonessentialistic* character of truth. On this view, the ability to organize and understand the patterns of happenings in the world rests on deeply penetrating interdependencies. Here the challenge to economists is to consider whether and how such a pervasive interaction between events and contemplations of them impinges on established modes of economic analysis.

The notion of essentialism also arises with respect to methodology. A methodology is *essentialistic* if explanation obtained through its use elucidates the conceptual phenomenon in question as the outcome of a single cause or set of causes, that is, in terms of an “essence.” Contrariwise, a *nonessentialistic* or *nonreductionistic* methodology bases explanation on the idea that each and every conceptual phenomenon exists only as the combined result of the interactions of all other conceptual entities. Conceptual phenomena, then, cannot be said to have single causes since they are understood to codetermine each other. They are distinct but not independent.

The mainstay of the current approach to economic analysis is, of course, the notion of equilibrium. In its static form, equilibrium is simply the outcome of the timeless interaction of forces, the resolution of simultaneity. In dynamic contexts, it appears in the guise of either the stationary or the steady state. Most contemporary economic theorizing, henceforth referred to as *equilibrium analysis*, takes place through the construction of (usually mathematical) models in which equilibrium, in one of these forms, is studied. And most empirical investigations are propped up by such a construct. Thus the methodology of today’s equilibrium analysis is the essentialistic methodology of model building in which all variables and relations among them are assumed to be (at least probabilistically) known and stable over time. And, though rarely mentioned in specific applications, the epistemology of current equilibrium analysis is either rationalism (*e.g.*, Robbins [32]) or empiricism (*e.g.*, Friedman [7]).

Economists searching for another way, then, may be uneasy with equilibrium analysis for (among other possibilities) one of the following three reasons. First, they might believe that the methodology and

epistemology of equilibrium analysis are sound, but that the emphasis on equilibrium is misplaced. Second, they may be uncomfortable with the essentialistic nature of both the methodology and epistemology on which equilibrium analysis rests. And finally, while subscribing to either rationalism or empiricism and to essentialism in methodology, they may feel that the particular essentialistic methodology of equilibrium analysis is flawed.

But what are the options if equilibrium analysis is rejected? Under such conditions, how might economic inquiry proceed? There are, of course, other ways of looking at the world and, therefore, other analytic structures and paradigms within which to understand it. But, not surprisingly, the worldview adopted, and the paradigmatic framework invoked as a result, can imply an analysis based on very different axiomatic foundations from those that inform the equilibrium approach. Thus, in order to establish a background and perspective from which the argument of subsequent chapters can be evaluated and compared, it will be useful at this point to present, in briefest outline, the general nature of some alternatives. Without attempting to be exhaustive, then, the remainder of this chapter compares and contrasts three substitutes, each of which responds, respectively, to the dissatisfaction of those economists who reject equilibrium analysis for one of the three reasons listed above. After an initial description of the workings of typical equilibrium analysis, discussion turns to so-called *disequilibrium analysis* in which both the essentialistic methodology and epistemologies of equilibrium analysis are retained, but in which interest concentrates on out-of-equilibrium situations. Next to be taken up is an approach, identified as *mutually interactive analysis*, that is based on a nonessentialistic methodology and epistemology focusing on the mutually interactive character of all aspects of reality, including the analysis of reality itself. Finally, a perspective is presented whose epistemologies are identical to those of equilibrium analysis, and whose methodology, though still essentialistic, emerges from the notions that (i) the nature of time is “historical,” as opposed to the “logical” time required in the methodology of equilibrium analysis, and (ii) human beings investigate issues, and make and attempt to execute decisions, under conditions of sufficient ignorance that they are unable to even calculate the probabilities normally required in many traditional approaches. This last

analytical vision is referred to as *nonequilibrium analysis* and is the center of attention in the remaining chapters of the present volume.

Before proceeding, however, it is well to be clear about the distinction between logical and historical time. Since more will be said about these concepts later on, only a brief introductory discussion is presented here. Following Winston [43, pp. 32-38], who uses the adjectives “analytical” and “perspective” in place of, respectively, “logical” and “historical,” the difference between these concepts has to do with the way in which time is perceived to order events. When pairwise comparisons of events are made such that any one event, regardless of whether it is considered to occur in the past, present, or future, is said to take place before, after, or simultaneously with any other, time is expressed in its *logical* form. Logical time, then, is not a manifestation of the real time in which human beings live. Rather, it provides only a means for the sequencing of events through time without regard to the actual experiencing of them as past events, present events, or future events. It is because one may move back and forth through a sequence of such timed or dated events hypothetically, but never experientially, that Hicks [14] invoked the previously cited phrase “out of time,” meaning “out of actually experienced time,” to describe analysis placed in logical time. In the *historical* approach to time, however, all events are placed in one of the three categories of past events, present events, and future events. Here time orders sets containing many events at once, rather than sets having only single events, and the basis of that ordering is solely experiential: past events come before present events, and present events come before future events. For this reason, historical time is sometimes called “real” time and analysis based upon it was referred to by Hicks [14] as analysis “in time.”

At a fundamental level, the significance of the distinction between logical and historical time is related to, though not necessarily completely dependent on, the assumed ontological status of mankind. Generally speaking, there are two different interpretations of human existence. On the one hand, individuals may be perceived as being totally constituted by the material pieces (*e.g.*, neurons and other cells, molecules, atoms, etc.) of which they are made up. From this vantage point, to be referred to here as *philosophical materialism*, if enough were known about the properties of these material pieces (including the ways