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The Role of Empirical Analysis in the Investigation of Situations Involving Ignorance and Historical Time

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Empirical analysis is the employment of observed facts to shed light on a particular problem. It involves, in general, the gathering of appropriate data, the organizing and summarizing of that data, and the interpretation of the results of the organizing and summarizing process in reference to the issues raised by the original problem. The data may be numerical in character or consist of collections of verbal descriptions. In either case, the techniques for organizing and summarizing are similar.

Although the problems to which empirical analyses are addressed can spring from a variety of sources, many arise in connection with theoretical models. Theoretical models, after all, are built to explain what is seen or to predict future events. Such models are metaphorically taken to approximate the generating mechanism that determines, subject to error, the observations. From this perspective, then, observations can be interpreted either as the solution points of static models consisting of simultaneous equations, or as lying along equilibrium or nonequilibrium paths produced by dynamic models containing differential or periodic (including difference) equations.

Most empirical analyses today are set in a context in which the relevant data are numerical in character and are explained, as described above, by a theoretical model and error. In addition, it is frequently assumed that the error has its own generating mechanism, and that this latter mechanism is based on some law of probability. The purposes of these empirical analyses often include one or more of the following overlapping goals: describing the observed phenomenon, estimating or fitting particular functional forms to the data, predicting future observations, testing specific theoretical hypotheses in particular, and empirical confirmation or falsification of theoretical constructions in general.

Difficulties arise, however, when examining situations in which either an actor under study, say a decision-maker, or an investigator pursuing an inquiry (or both), views time as historical and confronts ignorance in a significant way. Historical time has the quality that each moment of it is attached to a distinctive history and is, therefore, unique. This uniqueness precludes the possibility of replication of decision situations and contemplations of future economic outcomes. Ignorance is a fact of humanity which comes about because of man's limited ability to know certain things. Recognizing both historical time and human ignorance in a situation (and such situations may, in fact, be the more important ones in Economics) produces a true uncertainty that renders the assumption of a probabilistic error-generating mechanism untenable. Nor can theoretical models have the same explanatory meaning in the presence of this uncertainty. The formulation of probability functions and the standard interpretation of theoretical models simply presumes more information than is available. It follows, then, that empirical analysis under conditions of ignorance and historical time has a rather different flavor from that which it has when these elements are absent.

This paper is concerned with the role and content of empirical analysis in the simultaneous presence of both ignorance and historical time. It begins with a description of the historical-time environments in which ignorance appears, and then proceeds to a discussion of the nature of empirical analysis in such situations.

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I

All economic events in our world take place in historical time. Historical time, moreover, is unidirectional and irreversible; it flows in a single continuous stream along which every moment is unique. The distinctive history that each moment carries necessarily imparts its own peculiar knowledge, and this knowledge may be perceived differently by different people. When considered in their relevance for economic decisions and behavior, successive moments in real historical time bring with them their own unique institutional structures and environments, and their own totality and distribution of resource endowments. They also come with their own unique implications for perceptions of the future possibilities that time, at each moment, conceals from view. Historical time can never be started over again as in, for example, the ordinary stability analysis of a Walrasian system, because it is impossible for history to repeat itself without change. A model that is constructed at a given moment and that recognizes historical time, then, whether employed by an actor in the making of a decision, or by an outside investigator studying those decisions, generally diverges from all other models having the same purpose but constructed at other moments.

In the environments of present concern, ignorance arises, in part, because time is historical and reality is overwhelmingly complicated. As historical time passes, the present separates the past from the future. Only the present and the past, however, are capable of observation and description. By looking at present and past events, both the decision-maker and the investigator can gain perceptions of what is presently happening and what has previously occurred. These perceptions may find expression in the form of a theoretical model "explaining" that which is and was seen. But it is important to recognize that perceptions are only perceptions, and no more. They are fraught with errors and gaps. The same is true of intellections and knowledge. The world is just too complex to be able to know and to understand everything. Moreover, as suggested above, knowledge, intellections and perceptions are unique to each individual: Everyone thinks different thoughts and knows different things. Thus the decision-maker and the investigator always remain partially ignorant of the past. Even after all information available about prior events is taken into account, after all imaginable inferences are drawn, at least a kernel of impenetrable ignorance remains. And this ignorance cannot be assumed away in the formulation of a probabilistic event-generating mechanism or in the standard application of a theoretical model because the decision-maker and the investigator have no idea of what they do not know.

Matters are even worse with respect to the future. Because the future cannot be known until it has arrived, neither the decision-maker nor the investigator is able to obtain much information about coming events. Knowledge of natural laws and knowledge of human intentions is hardly knowledge of future economic outcomes. In Shackle's words [12, p. 3], "What does not yet exist, can not now be known." Nor do human beings have the capacity to see novelty in advance. Even the totality of all possibilities is unknowable: The unexpected can and does occur. Thus the decision-maker and the investigator are in real ignorance about the future. But this does not mean that, based on their faulty and incomplete perceptions of the present and the past, they cannot guess and imagine possible future contingencies. And such guesses and imaginings may serve as the springboard for decisions and analyses in the present as well as for speculations about future happenings.

Clearly, then, the decision-maker and the investigator arrive at each moment of, respectively, decision and analysis with a unique background and with unique thoughts derived from that background. The environment in which the decision-maker decides and the investigator analyzes is also unique because it, too, has its own singular history. In other words, the decision-maker and the investigator have their own perceptions of the moment with regard to history, their own perspectives of the moment concerning the things that they take as given, and their own epistemic abilities of the moment to bring to bear on the issue at hand. The same background, the same environment, and the same decision or analytical opportunity can never occur again.

The existence of a residual ignorance of the present and the past and of a more pervasive ignorance of the future mean that the decision-maker and the investigator are confronted by genuine uncertainty in the carrying out of their respective activities. Although knowledge removes some (but never all) uncertainty about the present and past, since (as noted above) no knowledge of the future is ever available, the future is always uncertain. To use the idea of probability to describe present, past, or future events (or errors), however, is to assume certain knowledge about those events. Furthermore, the knowledge that the assumption of probability requires rests, in part, on the possibility of replication. But because historical time rules out replication (since it implies an inability to hold other things equal or constant through time), and because the presence of ignorance precludes the possession of knowledge of future outcomes and sufficient knowledge about the present and the past, the application of probability in dealing with these issues has to be discarded.

At first, in the construction of a model for a given period in the past (which may come up to and include the present), the investigator (or the decision-maker who is investigating prior history for purposes of making a decision in the present) can proceed much as if he were exploring a situation in which ignorance did not exist. A differential or periodic equation model could be built up, its time paths studied, and one time path identified with observed reality for the period. If, for example, the investigator is studying the behavior of a decision-maker, then the investigator might say that the decision-maker behaved "as if" his behavior were determined according to the investigator's model. Then, by extending the model beyond the intended period, the investigator could examine some of the possibilities that might transpire at subsequent dates. However, it must be understood that once the time period for the initial explanation is enlarged, the investigator is actually examining a different world. The presumption is that it would be necessary to construct a separate model or explanation of the second world and that this will not be the same as that of the first. In addition, as time passes, the investigator may have more information available for his study, his own background may have changed, and the environment in which he is doing his study may have modified. For these reasons, too, the model he now builds to explain what he sees may well be different from the original. In particular, when exploring an historical process or the movement and change of a phenomenon over time from some date in history to the present, as time moves on to reveal the unpredictable novelty that enters the fabric of life, the model explaining that phenomenon must necessarily undergo significant alteration.

To illustrate the kind of model that an investigator might construct, consider the Shackle-Vickers model of decision-making in ignorance. In this model, the decision-maker has certain choice options, each of which is associated with its own possible outcomes contingent on unknown future events. For each option, let the decision-maker determine an incomplete collection of all future outcomes that he can imagine as resulting from the selection of the option. Although the residual hypothesis (defined as the class of all remaining outcomes that the decision-maker is unable to imagine and symbolically represented as the null set) is not an element of this collection, it is still a subset of it. Since the decision-maker is assumed to define a potential surprise function over all subsets of the collection of imagined outcomes, it follows that potential surprise is characterized for both imaginable and unimaginable outcomes. Specifically, the potential surprise of a subset A is the surprise the decision-maker imagines now that he would experience in the future were an outcome in A actually to occur. Each potential surprise function is translatable into a potential surprise density function defined over the incomplete collection of future outcomes expressed in terms of utility values. And using the density function, it is legitimate to speak of the potential surprise of a single utility outcome. Although similar in certain respects, potential surprise and potential surprise density functions are different in both conception and in their attendant characteristics from probability and probability density functions.

The decision-maker is also assumed to define, for each choice option, an attractiveness function over the collection of all pairs consisting of an outcome and the potential surprise value identified with that outcome. The attractiveness function is not a utility function: The attractiveness of any pair reflects its power to secure the decision-maker's attention and has nothing to do with the decision-maker's preferences. The attractiveness function is taken to have sufficient properties so as to permit its maximization subject to the potential surprise function associated with the same choice option. Under the assumptions of the Shackle-Vickers model, there are actually two maximizing pairs and these serve to characterize the choice option. Finally, decisions are made among the various choice options by comparing, according to a decision index devised by the decision-maker, the two pairs that characterize each.

All of the elements of the Shackle-Vickers model -- the choice options, the imagined future outcomes that emerge from them, the potential surprise function, the attractiveness function, and the decision index -- are unique to the moment of historical time at which the decision is made, unique to the decision-maker and, except for the set of all choice options and the decision index, unique to a particular choice option. Moreover, the concept of potential surprise function has application beyond its definition over possible outcomes of decision options. One can conceive of an individual contemplating his potential surprise for imagined outcomes associated with all kinds of happenings and behaviors that he observes in reality.

II

In discussing the role of empirical analysis under conditions of ignorance and historical time, it may be helpful to start by identifying some kinds of inquiry that, although legitimate in the world to which probability relates, are not possible when ignorance is present. Perhaps the most obvious of these is probabilistic prediction. Such prediction requires the use of a theoretical model and past data to discern trends probabilistically, and then the extrapolation and projection of those trends into the future. One way to do this when using a static simultaneous equations model is to estimate the coefficients of reduced-form equations of the model from the data. Predictions of values of the dependent variables are obtained from these estimated equations by projecting values of the independent variables over the future period under consideration. But in order to execute any such procedure in a way that is faithful to the traditional probabilistic methodology, it is necessary to know first that the model describing yesterday is valid for tomorrow (in particular, that novelty will not appear) and second the probabilistic law governing error. Such knowledge, although obtainable when studying, for example, the drawing of red and white balls from an urn, does not exist for the decision-maker and investigator facing the ignorance and historical time described in Section I. Their uncertainty about the future, then, completely rules out any possibility of probabilistic prediction.

A second line of inquiry that has to be abandoned in the presence of ignorance and historical time is the determination of whether a particular decision made by an actor under study turns out to be "correct" in light of the outcome that follows it. For situations in which the notion of probability is applicable, to be able to judge the correctness of a previous decision requires that the forces determining the outcome, given the decision, are accurately described by a known probability density function, and that both the density function itself, as well as the criteria of judgement, have not changed from the time of decision to the time of outcome. In this setting the correct decision is one that maximizes the expected "value" of the criteria of judgement. The reason why evaluations of correctness cannot be undertaken when time is historical and ignorance exists is because decisions rest on information about the present and the past, and on the contemplations of possibilities as they are envisaged at the decision date. Outcomes are determined independently by unknowable events that occur in the future. Since there is no causal link between the two that can actually be known to the decision-maker (though such causal links do exist and may be imagined), and since the criteria of judgement need not remain fixed, the idea that he is able to make correct or incorrect decisions has no relevance for evaluations of the outcome of the the decision process. In time, the decision-maker can certainly come to regret his decision. But, although the possiblity of regret can be contemplated in advance, there is no way for him to anticipate the fact of its occurrence at the moment of decision.

With hindsight, of course, the decision-maker may conclude that some decisions would have produced better results than others. These conclusions, however, are speculations only. For looking back, a model covering the period during which the decision was made and the outcome emerged could be constructed, and the decision itself could be judged in terms of that model. But it is not possible to assert, even in the context of that model, that an alternative decision would definitely have been better. To establish such an assertion would necessitate returning in time to the point of decision, inserting the decision alternative in place of the original decision, and watching to see what different forms of newness would arise and how the outcome would be affected. Therefore, even if the criteria for evaluating decisions remains the same, because time is irreversible and replication impossible, evaluations of decisions with respect to outcomes can only be highly informal and speculative.

It might be thought that in analyzing situations involving ignorance and historical time the replacement of probability functions with potential surprise functions could prove useful. Empirical analysis could then focus on discovering the actual potential surprise or potential surprise density counterparts to the analogous probability functions for the problem at hand. Although, as will be argued in the next paragraph, such replacement is not helpful in rescuing probabilistic statistical analysis from its probability environment, it should be noted here that the empirical determination by an outsider of an individual's potential surprise or potential surprise density function (which might be employed in place of corresponding probability functions) from observed data of the present and past is a third line of inquiry drawn from the context of probability that becomes invalid upon translation into a world of ignorance and historical time. (Recall that in the Shackle-Vickers decision model, the decision-maker possesses potential surprise or potential surprise density functions defined with respect to decision outcomes. Alternatively, an investigator could also have such functions in mind when thinking about the error that might arise in postulating a relation among certain variables.) The reason why a potential surprise function, say, cannot be so determined is because, as pointed out above, there can be no causal link knowable to the decision-maker or the investigator between present and past data on the one hand, and speculations about the future on the other. To say, based on knowledge of the present and past, that the surprise one anticipates feeling were an outcome in A to occur (or, in other words, that the potential surprise of A) is s, does not mean that if an outcome in A actually happens one will, in fact, feel s. By the time the outcome in A comes to pass, things will have changed. In addition, a person's potential surprise function is a very personal matter. Present and past data, along with the perception of historical trends that may be suggested by them, are three of many things that go into its making. Also included are personal experience; psychological elements such as habits, biases, and the emotional state of the individual; political and social pressures coming from colleagues; and even how well the individual is feeling when he is calculating potential surprise values. To pass from all of these things to the potential surprise function involves an unexplainable leap in the mind of the individual from the partially perceived present and past to an independently generated and unknowable future. The individual, himself, cannot say how he does it. Moreover, the elements that go into the construction of his potential surprise function, along with the process of construction itself, change from moment to moment as historical time moves on. Thus, for example, in the process of making a decision, the perceptions and other subjective inputs that the decision-maker brings to bear may modify. Hence the potential surprise function that the decision-maker employs at the moment of decision can be quite different from that which he would have had if his perceptions and other subjective inputs had remained as they were when he first began thinking about the decision he should make. In general, although the individual is perfectly capable of stating what his potential surprise function is, an outsider is unable to reconstitute it by observing the present and the past.

The last inappropriate line of inquiry to be described here (potentially derived by analogy to probabilistic analysis) is the use of distributional techniques to analyze data. Because replication is impossible, any statistical method of analysis that relies on the idea of repeated sampling from a distribution has to be discarded. In particular, standard statistical (inferential) sampling procedures such as hypothesis testing, estimation, and determining confidence intervals can no longer be used. Even if the probability distribution upon which these methods rest were replaced by a potential surprise distribution, the methods themselves would still not hold up because the notion that each element of data is taken from the same distribution, i.e., the notion that repeated observations are produced by an event-generating mechanism that is unchanging over (historical) time, lies at the core of each sampling procedure.

III

With all of these limitations on empirical analysis under conditions of ignorance and historical time, what role can empirical inquiry play in helping to understand situations in which both ignorance and historical time are present? There are at least three possibilities. The first role is to describe history, that is, to collect and summarize historical data. The gathered data can be in either verbal or numerical form, and summaries of the latter kind of data can be expressed in terms of means, variances, trends, tendencies, patterns, and so on, as long as these summary numbers are not interpreted in reference to (e.g., as moments of) probability distributions.

When the data are quantified, one may even "estimate" the parameters of equations in the context of historical description. Suppose, over a previous period of time, an investigator (or decision-maker) observes a scatter of data which seems to suggest a linear relation between two variables. The investigator can certainly fit a straight line to the scatter by minimizing the sum of squared residuals. This, by itself, is a nondistributional approach to estimating the parameters of the relation because it does not require the assumption that the residuals follow a law of probability. Of course, the estimates so obtained (which are properly called "least squares" estimates) cannot be examined to determine if they are "best, linear, and unbiased" since these latter properties have meaning only when a probability distribution is present. In any case, the fitted line can be taken by the investigator to be part of his perception of the history of the two variables.

The second use of empirical analysis by an investigator (or, again, a decision-maker) facing ignorance in the context of historical time is as the springboard for nonprobabilistic predictions. Nonprobabilistic predictions are derived from the trends, tendencies, patterns and estimated equations developed to describe history by projecting them into the future without any presumptions concerning probability distributions. As such, these predictions may be employed to guide the investigator's understandings of possible future observations of the phenomena under scrutiny.

The third role for empirical analysis in situations of ignorance and historical time is the nonstatistical, empirical falsification and corroboration of theoretical propositions and models for specific periods of history. The extent to which a model, say, is consistent with historical fact can be investigated by informally comparing the model and its properties to the actual history of the period -- verbal or numerical. Alternatively, when models of behavior, such as the Shackle-Vickers model described earlier, are at issue, the investigator can question the actors to see if the theory has, or has had, any relevance for what they do.

These three roles for empirical analysis are very important both to be able to understand and to take action in historical-time situations of ignorance. Clearly, the main goal of the scholar is comprehension, that is, explanation of the observed world, including behavior, action and events in it. And comprehension is not complete without both theoretical and empirical analysis. Moreover, if an individual bases actions or decisions on prior events or, as in the Shackle-Vickers decision-making scheme, on imagined future outcomes (which depend, in part, on prior events) then empirical descriptions of history are crucial to his decision-making. For they are the only source for the development of his perceptions of the past, and these perceptions figure significantly in the formulation of his potential surprise function.

In conclusion, the preceding argument clearly raises questions about the nature of economic analysis when ignorance and historical time are taken into account. Because certain, rather common, investigative perspectives and techniques can no longer be employed; because, that is, both empirical exploration and theory construction have to be recast in different hues, one might legitimately ask what the structure of economic analysis would look like under these conditions. The issue has many facets and can be raised in a variety of ways: How, for example, is Walrasian- or general-equilibrium-type analysis relevant, if at all, to understanding a world with ignorance and historical time? Is the partial-equilibrium approach of Marshall, who was indeed aware of both ignorance and historical time, better suited to handle the particularities they introduce? More generally, to what extent is the use of abstraction itself an appropriate means for building explanation and understanding in such a context? Perhaps the emphasis should focus more on historical forms of inquiry. If so, does more attention need to be paid to the realism of premises? What is the right mix of historical analysis and abstraction? How do the two methods interact to shed light on a specific subject? And so on. Scholars attempting to deal with ignorance and historical time necessarily face questions of this sort in their work.

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