metaphor is as relevant as showing Shakespeare (as one could) that a woman is not literally a summer's day.

Again, the hostility to the reception of mathematics in economics reflects a failure to understand the rhetoric of mathematics, and can be analyzed rhetorically. Likewise, the triumphs of classical economics or Keynesianism were rhetorical triumphs. The history of science, after all, is the history of persuasion, and rhetoric, a strand in our civilization deriving from the Greek alternative to philosophy, is the study of persuasion.

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This Conversation prompts the Editors to offer the papers and book reviews which follow to the ongoing inquiry into methodology and related themes.

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Linguistic structures articulate the notions and ideas that bind individuals within a common culture. Languages, and the concepts they symbolize, communicate shared views, and facilitate the crystallization of conscious thought. Mind depends upon the particular representation of meaning, for it is only through language that the cognitive frontier with the ineffable can be sustained. No living language remains a static edifice, however. It evolves organically, sometimes in surprising ways, as imaginative innovation and forgetful abandonment alter the material with which the business of intellectual activity proceeds. Only when a culture dies do its linguistic artifacts stand as the unalterable ruins of a civilization.

Scientific cultures and scientific languages are not exceptions. They house ideas, and in housing them, cultivate their meaning. Similarly, the languages of economics guide our thoughts about the economy, and mold our images of the economic process. This paper's thesis contends that a new idea's relationship to its historically antecedent culture influences its ultimate success, and examines a recent case of conceptual evolution in economics. This is the widespread adoption of the so-called "rational-expectations" hypothesis. My plan is to describe the general phenomenon of conceptual evolution as a basis for examining how the essentials of the rational-expectations hypothesis unified and reinforced older notions central to the practice of economics, and thereby contributed, independently of its empirical evaluation, to its reception. In particular, the hypothesis reinvigorated the revered concepts of rationality and equilibrium, and articulated them in theoretical terms which synthesized the economist's languages of explanation and of empiricism. Section I develops a view of the historical significance of conceptual evolution in science, section II precisely states the cognitive nexus constituting the rational-expectations hypothesis, and section III demonstrates its position in the culture of economists to explain how the hypothesis invaded the core of their discipline.

I. Conceptual Evolution in Science

Languages symbolically represent ideas and concepts, and the people employing a language articulate their own notions in terms of...
the linguistic structure at hand. Terms alone do not determine meaning; it is their combination within the language's syntax that provides the basis of organized thought. Avoiding the philosophical issues as to the capacity to communicate meaning through linguistic signals, it seems that most sharing of ideas requires language and that the languages we adopt become a central feature of the joint culture. Moreover, the conceptual vehicles through which discussions transpire are themselves special contrivances promoted for special purposes. Different languages need not contain the same concepts, and incommensurable languages need not even be capable of meaningful translation. Consequently, the particular mode of thought characteristic of a community not only reflects its character, but molds and shapes that character as well. Obviously, therefore, the construction, adaptation, and evolution of the languages of discourse are fundamental features of any intellectual history.

New concepts may penetrate a culture through the invention of new terms or the acquisition of new meanings by old terms. In either case, the conceptual fabric of the community may undergo a profound metamorphosis. Such ideational innovation may be a response to some recognized problem, or simply the de novo creations of imagination. Either case injects genuinely novel ideas that may provide new insights, provoke recognition of new issues, or resolve ancient controversies. At the very least, the intellectual content of a science may suddenly undergo a substantive and unprecedented alteration without direct reference to empirical evidence. Although the potential conceptual metamorphosis consequent upon the introduction of a new fad or fume idea may revolutionize a culture, acceptance is as necessary as suggestion.

Science, like other intellectual activities, follows these general principles of linguistic development. Nevertheless, its specifically empirical criteria of veracity generate special conditions for acceptance. The use of empirical evidence to evaluate a newly contributed idea need be neither obvious nor straightforward if the emerging linguistic variant cuts to the evidentiary core of the science. It may transform the basis for accepting a "fact" as scientifically meaningful, and erode judgements that favor existing doctrines. The issues may be resolved by reference to evidence previously unexamined or even discredited as scientifically peripheral. In such cases controversies cannot be resolved by reference to apodictic evidence. Such occasions are blessedly uncommon, but their existence is sufficient to inject legitimate noneventiary criteria as explanatory factors in the adoption of, and subsequent attachment to, novel theoretical innovations. Thus, the language of a science may evolve, even through that evolution, scientists may accept different propositions without strict evidentiary enrichment. Scientific knowledge may grow independently of empirical "facts." Clearly, facts must not refute new theoretical propositions, but these new propositions may be accepted even if their quantitative explanatory power is no greater than their predecessor's.

Since noneventiary considerations may contribute to the appeal of a theory (or to the language in which it is phrase), other criteria must be invoked to explain its success. These other criteria refer to the logical coherence with which previously disconnected phenomena are explained, to the internal consistency of the justification of empirical technique, or to the formal precision with which propositions are articulated. Interest in new techniques, new concepts, or new hypotheses can be shaped by the manner in which they receive the approval or disapproval of a person's stock of intellectual equipment. By reinforcing existing attitudes they may implicitly appeal whether or not they solve any existing problem. Such sustaining innovations may eventually attract supporting empirical evidence, but it is not that evidence, per se, which made them initially interesting.

Reference to Lakatos's (1974) distinction between core propositions and protective-belt propositions enables greater attention to be paid to how noneventiary considerations influence scientific decisions. The "core" propositions are the most basic and enthusiastically held tenets of the theory, whereas the "protective belt" contains more controversial, more expendable components of the theoretical edifice. This distinction helps explain why some conceptual innovations succeed by reformulating the core.

New formulations can garner acceptance by articulating core concepts more rigorously, by introducing new concepts that logically unite previously unrelated phenomena, or by casting them in a language whose logical generality is more extensive. Each of these tactics enhances the purely formal prestige of the explanation by demonstrating its generality and internal coherence. New hypotheses employing them may consequently enjoy an implicit advantage. The new language may simply phrase the paradigm's important insights more clearly.

A second channel by which conceptual advances can dislodge antecedent theories is to render previously neglected theoretical issues consistent with facts presumably explained already by other mechanisms. The number of facts "explained" need not change, but the new development may offer explanations that may be more tidy, perhaps more elegant, or perhaps even more intuitively appealing. Aesthetic considerations may sway persons to employ new linguistic schemes when, on objective empirical grounds alone, the transfer is unjustified. In some sense, the new scheme may illuminate events without explaining anything that was not already explained.
Third, novelty can extend either the language of pure theory, or the language of empirical technique so that the conceptual, cultural, and philosophical foundations of each are coherently placed on firmer, more intimately unified grounds. For example, possession of a theory more than a tool, if it is to function as a science, requires adherence to the propositions it tests, then their conceptual compatibility reinforces both. Innovations that logically and linguistically unify the practice of applied empirical technique with the conceptual basis of theoretical propositions may, therefore, triumph without explaining anything that had not been explained previously. Clearly, however, the explanation may be quite different.

Fourth, novel hypotheses, innovatively expressed, may simultaneously articulate an unanticipated critique of existing methods, offer a solution, and suggest previously unimagined avenues for future research. Expressing a hypothesis in new terms may uncover unknown problems, highlight anomalous evidence, and naturally resolve the exposed difficulty. New terms with new definitions may generate new means of thinking that render the old style passe.

Through any of these mechanisms new ideas and the new languages expressing them can conquer a scientific enterprise. Since invention and acquisition of new concepts need not be logically governed (which is not to suggest that adherence to the propositions they express is irrational), however, their penetration of a scientific community may be a sudden contagion. Without apparently compelling empirical reason, new ways of thinking, or new methods of analysis, may work a scientific revolution. They may subsequently acquire commanding evidentiary support, but this cannot explain the early attention incrementally lavished upon them. Rather, it is the conceptions themselves, and their manifestation of core attitudes that implicitly establish the new hypothesis as an object of serious consideration.

Economics occasionally experiences rapid conceptual transformation. Both the marginalist and Keynesian revolutions wrought major alterations in the language of explanation, and in the hypothesis pursued. More recently macroeconomics has undergone another significant adjustment. This is the rise to prominence of the rational-expectations hypothesis. This paper contends that, although the ecometric evidence supporting the hypothesis has been developed, the conceptual apparatus contained in its formal statement contributed powerfully to its reception by buttressing the fundamental notion of macroeconomic equilibrium, and by unifying the intellectual foundations of macroeconomics with those of econometrics. As such, the recent success of the rational-expectations program can be explained, at least in part, as a case of the kind of conceptual evolution described here. Accordingly, we now proceed to establishing the basic ideas implicit in its formalization.

II. Rational Expectations and Macroeconomics Analysis

Macroeconomics has been transformed in the last dozen years by the rational-expectations hypothesis and its associated econometric practices. Not only are the practical implications of macroeconomic policy analysis altered, but the theoretical concepts and econometric techniques supporting them have all undergone significant change. The very style of analysis is no longer what it was. Since this paper examines how the conceptual innovations associated with formal statement of the hypothesis contributed to its success, our immediate task is to explicitly isolate them. Later, in section III, the significance for macroeconomics of these ideas is discussed.

Intuitively, rational expectations is supposed to assert only that individuals efficiently synthesize the information available to them, and thereby achieve optimal forecasts from the relevant or "true" model. Efficiency yields correctness, and correctness is optimal. Without greater refinement, however, the notions of truth, relevance, and efficiency remain operationally vacuous. Muth's (1961) great contribution lies in formalizing these ideas in a theoretically precise and econometrically reasonable way. Moreover, as we shall see, his particular technique forged a conceptual link between the modeling of expectations and the practice of statistical inference, a link which synthesizes the language of both endeavors and thereby contributes to its intellectual elegance.

The first tactic in rendering the hypothesis precise is to presume that all information is captured by measurable real variables. In macroeconomic models these usually take the form of statistical aggregates such as the quantity of money, price indices, or levels of employment. Consequently, the information on which agents are presumed to act coincides with that available to the macro-economist. Second, these data are interpreted as random variables. Accordingly, the history of the system can be depicted as a stochastic process, and the parameters guiding it naturally emerge as the parameters describing the random variables. This removal of the implicit modeling strategy from logically deterministic schemes to logically deterministic schemes of stochastic structures is perhaps the single most important attribute of the rational-expectations hypothesis. This step fundamentally transforms the conceptual equipment with which theoretical issues are posed. The orthodox mathematical style of macroeconomic models, which conceived of the economy as obeying a system of real-valued difference equations, is, at one stroke, replaced by the language of stochastic systems.

2 Einstein's (1905) early work on special relativity falls in this category. He raised unsuspected problems with notions of simultaneity, and proposed an alternative geometry for handling them. Significantly, the routine experience of gravitation was so well handled by Newtonian methods that it was several years before evidence distinguishing relativism from classical behavior was developed.
Additional assumptions reflecting the rational-expectations hypothesis, per se, flow naturally from this conceptualization. The rational individual is conceived to adopt the mean of the observed distribution as his or her subjective expectation of future values of a random variable. Given the apparatus within which the choice is presumed to be made, no alternative could rationally dominate. This is not all, however, for if the individual's information really suffices for inferring the "true" model, then the error terms must be distributed nonautoregressively about their mean. Otherwise, serial correlation among the residuals (indicates systematic variation not captured by the model), and so it cannot be "true." Thus, expectations are rational only if the error terms are orthogonally distributed with mean zero. No other circumstance satisfies the "correct-model" presumption in the stochastic rational-expectations world.

This image of rationality leads directly toward a refurbished version of macroequilibrium. Since a system of stochastic difference equations replicates the economy's behavior, equilibrium is no longer manifested by the simultaneous solution of a system of deterministic equations. Rather, in rational-expectations equilibrium, the parameters controlling the system must be compatible in the sense that they are not changing. Thus, although the values of the random variables change, on average the system has achieved a steady state; the future values of the variables must be orthogonally distributed around the currently expected value.

Consequently, the rational-expectations hypothesis is an assumption of equilibrium. The only possible source of "unexpected" variation is an exogenous random shock.

The premise that the long-run values of the variables can be knowledgeably inferred from the past and reliably projected into the future, has several significant ancillary properties. Not only can the observed mean be interpreted as the long-run equilibrium value, but this same number also functions as the (by the restriction that future errors must be orthogonally distributed with mean zero) the future long-run equilibrium value. Moreover, the actual equilibrium variation has no effect on the equilibrium consequence. Actual events, therefore, can only temporarily dislodge the system from its long-run equilibrium. That equilibrium is itself effectively insulated from permanent manipulation. As demonstrated elsewhere (1983), assuming the system is in rational-expectations equilibrium is the stochastic analogue of the perfect-information postulate. The actual state of the system at any date is not known, but the average position is known.

Although introduced by Muth in 1961, the rational-expectations hypothesis remained largely neglected for a decade. In the early 1970s, however, it was recognized that Muth's idea could be interestingly employed in macroeconomics. Milton Friedman's (1968) reliance on a natural rate-of-unemployment concept, in which the macroeconomy is only temporarily dislodged from its "permanent" long-run Phillips curve by deliberate countercyclical monetary policy, laid the groundwork for the rational-expectations models of the 1970s. Similar examination of the labor market microfoundations, especially those of Lucas and Rapping (1969) and Phelps (1970), led toward the image of a vertical long-run Phillips curve with temporary short-run Phillips curves leading away from it. Thus, macroeconomic theory was prepared for the series of influential articles by Lucas (1972, 1973, 1975, 1980), Barro (1976, 1977), Sargent (1973), and Sargent and Wallace (1975, 1976) which built the rational-expectations macroeconomic program. This work synthesized Friedman's long-run natural rate of employment with Muthian rationality to develop new modeling techniques invoking the language of stable stochastic processes, and also transformed the acceptable standards for econometric policy analysis. Sargent and Wallace (1975), for example, represent actual output as the sum of the known long-run equilibrium value and a random error term. By the rational-expectations hypothesis, these residuals need not be nonautocorrelated and distributed with mean zero. Since deliberate attempts to influence income are thereby dismissed as disruptive random shocks, active countercyclical monetary policy loses its vitality. Only the "unanticipated" component of monetary policy is effective, which translates into the debit of money illusion and labor fouling. Clearly, in rational-expectations equilibrium, the optimal monetary policy is the Friedman Rule.

Dramatic as this transformation of macroeconomic theory has been, the penetration of the rational-expectations idea into the core of economic practice has not been limited to the interpretation of empirical evidence. It has also been the basis of a powerful critique of macroeconomic method. The heart of this critique addresses the empirical basis of policy analysis. It asserts that the familiar practice of estimating a structural model and then simulating the consequences of policy alternatives is indefensible since it ignores the reactions of agents to the policy pursued. Such uses of econometric models neglect the feedback from policy instruments to model structure. Lucas and Sargent (1981) are forthright:

...our intent is to establish that the difficulties are real: that modern macroeconomic models are of no value in guiding policy.


They urge, instead, a "rational" equilibrium model of the business cycle in which responses to the anticipated component of policy decisions are contained within the model. Such anticipation permits counterfactual responses, so that only the random (unanticipated) component can generate the desired results:

...equilibrium models can be formulated which are free of these difficulties and which offer a different set of principles to
identify structural econometric models. The key elements of these
models are that agents' rational expectations (individuals rationally anticipate systematic interven-
tionist policies so that only random influences affect actual outcomes. Lucas (1975, 1977, 1980) has consistently upheld this equilibrium-modeling position, but has encountered criticism, most notably from Tobin (1980), and Sias (1982). Thus, the econometric issue is not yet resolved.

This brief history of macroeconomic applications of the rational-expectations hypothesis, and of the conceptual techniques supporting it, suggests rapid conceptual evolution from Keynesian to New Classical languages and attitudes over the last dozen years. This new style has been accompanied by empirical evaluation, but the relevance of econometric practice, and the manner of organizing evidence has not gone untouched. That the relevant facts in this case depend on the conceptual images of the practitioner cannot be denied; the practice of macroeconomics both theoretical and applied, has been permeated by the rational-expectations hypothesis.

The next section of this paper shows how the peculiar method of formulating the hypothesis reinforced its ability to assume a core position in the field. It managed this by resuscitating older notions, and by unifying of the ideational fabric of economic thought.

III. Language and the Hypothesis's Implicit Appeal

The rational-expectations hypothesis is one solution to the rational-expectations macroeconomic critique, and the hypothesis, in conjunction with natural-rate notions has certainly attracted empirical investigation, but it remains unclear that the triumph of the rational-expectations approach can be fully explained by these considerations alone. This is so partly because the rational-expectations critique does not precede development of the hypothesis, and partly because interest in rational-expectations models preceded their econometric investigation. An alternative interpretation of recent events suggests that the language in which the hypothesis is operationally cast, and the particular form it assumed in that language implicitly enhanced its status in the eyes of many economists, and thus planted the seed from which the rational-expectations research program grew.

Casting the theoretical basis of models in terms of stochastic processes expectations approach. It synthesizes the conceptual and logical underpinnings of theoretical and applied macroeconomics, and thus unifies the communicative style of both. They are simultaneously phrased by the same formalizing techniques so that the relationship between empirical evidence and application of that evidence to theoretical propositions can be naturally and directly specified. Knitting theoretical propositions with the yarn of stochastic processes enables practitioners of rational expectations to explain observed variation not as distinct equilibria with distinct parametric antecedents, (or worse disequilibria), but as the natural vibration implicit within a constant equilibrium. Thus the parameter estimates achieved econometrically mesh precisely with the theoretical concepts they test.

The rational-expectations hypothesis accomplishes more than this, however, in developing conceptually unified and logically coherent models. (Adaptive-expectations models, after all, can also be phrased in terms of stochastic processes.) It yields internally consistent theoretical constructions; individuals predict according to models, and the model they employ is the economist's model. This is the source of the "rational" nomenclature, for it is, in the strictest sense, irrational to adhere to a model as "true" if it depicts the forecasting problem in a way logically incompatible with the procedures of the model's construction. This identification between a model's predictions and its characterization of economic forecasting by agents adds weight to claims that its theoretical propositions and empirical practices are logically coherent. The rational-expectations hypothesis is one way of accomplishing this apparent coherence, but it is not the only way of establishing genuine coherence. After all, the depicted predictions of agents need not coincide with those of economic models, especially if it can be argued that the information available to individ-

uals varies from that accessible to the economist. It is, however, a most clever model-constructing device.

The strong, almost technical conditions, of Muthian rationality go even further in theoretically reinforcing the axiomatic conditions of econometrics. Such further conceptual conjunction flows from the presupposition that rational agents possess the "true" or "correct" model of the economy.

Contending that a rational model contains agents whose expecta-
tions correspond to the model's predictions, and that those agents have the "true" model of the system asserts considerable confidence in the veracity of one's own theory. Within the language of stochastic modeling it implies that residuals be orthogonally distributed with mean zero. These two conditions occupy crucial positions both in the rational-expectations evaluation of macroeconomic policy, and in linear regression analysis. Each is necessary for least squares linear regression techniques to yield the best linear unbiased estima-
tors, and when invoked as attributes of rationality, they bear the test by which the validity of individual's expectations can be established; thereby forming the technical bridge to macroeconomic policy rationality. Such felicitous coincidence of properties of the language of applied empirical method and the terms of theoretical explanation conceptually binds these activities within the same linguistic nexus, strengthens the link between theory and evidentiary
evaluation of theory, and facilitates a coherent style of thought. By making the conditions of statistical inference simultaneously express the theoretical concept of rational agents in logically consistent models, the rational-expectations hypothesis and the special apparatus through which it is formalized, makes it approach internally elegant the theoretician and natural to the econometrician. That it attracted substantial empirical attention and theoretical refinement during its ascent poses no surprise given the clever way, on strictly nonempirical grounds alone, that it recasts the problem.

The rational-expectations equilibrium notion also contributes to the warmth with which the hypothesis has been embraced. Since it implies that the system has reached an ergodically constant state, it poses no threat to established empirical techniques and can, indeed, be interpreted as supporting them theoretically. At a deeper level, the hypothesis revitalizes equilibrium analysis of the macroeconomy, for it tolerates variation of the relevant variables within an equilibrium rather than interpreting such variation as either displacement of or from equilibrium. In deterministic models changes in the state of the system must be interpreted as either a change in the equilibrium state, in which case empirical evaluation of the equilibrium may have limited use in forecasting, or as disequilibrium, in which case equilibrium attributes may not transfer to the observed case. Partly because of such macroequilibrium difficulties, much of the microfoundations literature addressed problems of coordination and dynamic adjustment in the absence of traditional market clearing. With the success of the rational-expectations hypothesis, however, the dominant characterization of the macroeconomy reverts to the constantly equilibrium state. Articulating the notion of equilibrium in this way is supportive of equilibrium analysis. If it is natural to vibrate in equilibrium, observed variation no longer suggests disequilibrium. Rather, it can be claimed that the new equilibrium techniques are sufficiently supple and powerful to meaningfully describe observed fact. Lucas (1978, 1980) has even been so bold as to extend this idea as the basis for an equilibrium model of the business cycle.

Thus, by shifting macroeconomic discourse to the language of stable stochastic processes, adherents of the rational-expectations hypothesis erected a theory which, in its very nature tolerated variation, and which, moreover, joined the ideas of rationality and equilibrium in the same conceptual terms. This awesome accomplishment is a considerable theoretical innovation, conceived in Lakatos's framework, the formal statement of the hypothesis introduced a terminological conjunction which expressed two of the most deeply entrenched concepts in economics. By jointly assuming the mantle of rationality and equilibrium, and by doing it in a way that enhanced their defensibility, the rational-expectations hypothesis borrowed to the core of economic thought, and firmly established both its own credentials and those of its language.

Still another aspect of the macroeconomic use of the hypothesis attracted attention. This is its practical policy implications. These models elegantly express a view of the economy as essentially well-behaved and inherently coordinated. As such, in the hands of masterful practitioners, it dramatically revives classical contentions regarding macroeconomic policy. Through it the familiar laissez-faire view of decentralized decision-making condenses into stochastically successful aggregation. Older notions of policy propriety have been rejuvenated by hypothesis which has graced them with latter-day sophistication and coherence.

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**Knowledge and Rationality in the Austrian School: an Analytical Survey**

Richard N. Langlois

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**Introduction**

This paper undertakes an examination of the "Austrian" approach to economic knowledge. This is at once a simple task and a difficult one. It is simple in that the theme of knowledge is an easy thread to find in all the writings of this school. But it is a difficult task in that the thread is at times so thick and complex that it can easily lead one through every area the Austrians have touched.

In order to avoid wandering into dark and lonely corners unnecessarily, we need to recast the issue somewhat. Fundamentally, I would argue, the Austrian writers -- despite their many differences -- are united by their attempt to grapple with the same conceptual puzzle: how is economic theory to deal with the fact that the economic agent resides in an open-ended world?

That economic agents, and for that matter economists, live in an open-ended world is hard to dispute. Yet, economic theory, especially in its neoclassical manifestations, finds this an extremely troubling idea. It is difficult to analyze the optimum allocation of resources if there are always new resources, techniques, markets, or even tastes yet to be discovered or created. Now, one may legitimately choose to construct closed theories (models) in which all knowledge is ultimately given. For instance, one might argue that all theories (models) necessarily convey only part of the truth, and that there are circumstances in which the assumption of fixed-and-given knowledge is not inappropriate. Similarly, one might argue that economic theory progresses by successive approximation, and thus that "perfect knowledge" is only a starting point from which to move to more "realistic" assumptions about the knowledge agents possess. What sets the Austrians apart is that, for the most part, they rejected both of these arguments and chose to pursue theories in which the open-ended character of the world makes itself unmistakably felt.

In what follows I will survey the Austrian school -- in what I hope is an