

Derived Demand for a Cognitive Econometric Game and Policy-making with Econometric Models *

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I. Introduction

Adduced results from econometric models are used in economic policy formation by many governments and businesses throughout the world. Various models are used for planning economic growth, short-term stabilization policies, long-term development policies, business regulations, energy pricing and rationing, monetary policies and many other tasks. In all of these tasks econometric models are called upon to describe economic structures, anticipate economic events and simulate results of policy actions. The evident nonsuccess of economic policies in both modern and developing economies naturally calls into question the adequacy of current econometric models as policy-making instruments. Because this lack of success pervades large and small models constructed by many different economists, an even more fundamental question is raised: *Can successful policy-making models be constructed using currently prevailing rules for econometric model construction and evaluation?* The rules used in constructing and evaluating econometric models are known as the *language game* of econometrics. The purpose of this essay is to review the adequacy of the language game used in econometrics to guide construction of econometric models employed in policy formation.

Assessing the quality of the econometric language game is also vital to economists not engaged in policy formation, for, as Robert Basmann has noted, "*... the logical and empirical foundations of economic policy making and pure economic science are identical*" (Basmann 1972 a, p. 43; Italics are Basmann's). The importance of the question of the qualities of the econometric language game derives from the requirement that econometric models make scientific economic predictions and explanations. Models adequate for scientific prediction and explanation must be constructed using a language game which has definite logical requirements. The possibility that the language game of econometrics fails to meet the requirements follows from previous evaluations of particular econometric models; the possibility is expanded by the generalized nature of criticisms aimed at these particular models. Basmann (1972 a, 1972 b, 1975), Brunner (1969 a, 1969 b) and Hanna (1972) have evaluated certain facets of econometric models and their parent

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language game. These authors argue that the language game used in econometrics is inadequate for construction of explanatory and policy-making economic models.

One major weakness of the econometric language game is the imprecision and indefiniteness of its rules and terms. Basmann and Brunner have introduced the use of symbols from modern predicate logic for analysis of the econometric language and to add precision and definiteness to econometric discourse. In a recent article in this journal Basmann (1975) has published an introduction to the use of modern predicate logic in economics. The present article uses some language from predicate logic in order to add precision to the analysis. Symbols from this language are especially useful in discussing the concepts of prediction, explanation, and cognitive games¹.

II. Prediction, Cognitive Games and Rational Policy Formation

The concepts of scientific prediction and explanation, cognitive language games and rational policy formation have a definite logical relationship. Explicit knowledge of the relationship motivates non-arbitrary policy formation. Formation of non-arbitrary economic policy requires prediction of economic events.

The logical structure of scientific prediction has received much attention. In particular, it has been pointed out that the logical structures of *prediction* and *explanation* of observed phenomena are identical. This identity accounts for the identity of the logical and empirical foundations of economic policy-making and pure economic science. (Recall the quotation from Basmann cited previously.) The concepts of prediction and explanation are discussed in Hempel and Oppenheim (1948) and Hempel (1965); Hanna (1972) has used the concepts in discussing the language game of econometrics.

A proffered law of universal conditional form is an essential requirement for prediction and explanation of economic events. A universal conditional law is of the form $(z)[Pz \supset Qz]$, and is read, "for every z , if z has property P , then z has property Q ." The symbol " (z) " is called a universal quantifier and is read, "for every z "; Pz is called the antecedent or initial condition and is read, "if z has property P ." Qz is called the consequent of the conditional statement " $Pz \supset Qz$ " and is read, " z has property Q ." Basmann (1975) has given an introduction to use of these symbols in economic discourse recently in this journal. The *Weak Axiom of Revealed Preference* provides an example of a universal conditional law in economics: (For every set of price vectors (P^1, P^2) , commodity bundles (X^1, X^2) and income

¹ Symbols from modern predicate logic are not to be confused with symbols used in symbolic syllogism language or the symbols used in the algebra of sets. Although predicate logic may be new to some readers its use is justified by its added clarity and by previous uses by *Basmann*, *Brunner*, and most philosophers of science.

M¹) [*If* X¹ is revealed preferred to X², *then* under any combination of prices where both X¹ and X² can be purchased, the commodity bundle X² will never be revealed preferred to commodity bundle X¹.] (See Kogiku, 1971, p. 190.)

Here the universal quantifier is, "For every set of price vectors (P¹, P²), commodity bundles (X¹, X²) and income M¹," the antecedent is, "X¹ is revealed preferred to X²," and the consequent is, "under any combination of prices where both X¹ and X² can be purchased, the commodity bundle X² will never be revealed preferred to commodity bundle X¹." The words "*If*" and "*Then*" are the English language equivalents of the symbol " \supset " which is used as " $A \supset B$ " means "*If* A *then* B." In this particular law, the consequent is also of conditional form: *If* both X¹ and X² can be purchased, *then* X² will never be revealed preferred to X¹. It is important not to confuse statement of the consequent in conditional form with statement of the law. In scientific prediction, the proffered law of form (z)[Pz \supset Qz] is often called the "covering law." (See Hempel, 1965.)

A second requisite for prediction is a set of initial conditions which fulfill the antecedent conditions of the covering law. A particular instance of the initial conditions is denoted [P α , $\alpha \in z$], where " \in " stands for the relationship, "is an element of."

Scientific economic predictions and explanations require both a covering law and a corresponding set of initial conditions. By itself the covering law is a universal conditional statement and is incapable of predicting a specific event such as [Q α , $\alpha \in z$], at a specific time and place. It is an analytic statement. Likewise, a particular observed state, [P α , $\alpha \in z$], can predict a given state, [Q α , $\alpha \in z$], only in conjunction with a covering law of universal conditional form. Without the covering law, the observed initial conditions cannot logically predict or explain a particular observed phenomenon. Thus, scientific economic predictions and explanations are conclusions deduced from the logical conjunction of universal conditional laws (covering laws) and particular observed initial conditions. Deduction of Q α requires conjunction of (i) the observational premise, [P α , $\alpha \in z$] (see Basmann [1975] for an elucidation of observational premises), and (ii) a covering law, (z)[Pz \supset Qz].

The concept of a cognitive language game stands in definite relationship to the concept of scientific prediction and explanation. A language game is a set of rules which specify whether or not a particular statement is admissible as a statement within the language. The language game is separate from the language *per se* and is designed for discourse about the language. Mathematics is an example of a language with a well-developed language game, metamathematics. Confusion of the language game with the language often results in contradictions. (See Nagel and Newman, 1974, for illuminating discussion of mathematics, metamathematics and contradictions arising when they are confounded.) The distinction is an important one to maintain when discussing econometrics and its associated language game.

Cognitive language games are a subset of generalized language games. A language game must meet two primary criteria if it is to be a cognitive language game. The first requisite of a cognitive game is that it separates hypotheses having positive empirical content from hypotheses without empirical content. Thus, the language game must be able to distinguish falsifiable from non-falsifiable theories; a falsifiable theory is one which precludes a definite observable state of affairs. The concept of scientific prediction provides explication of the concept of falsifiable hypotheses. Observation of $(P\alpha \ \& \ Q\alpha, \ \alpha \in z)$ is often said to verify its covering law, $(z)[Pz \supset Qz]$. A law which can be verified, but not falsified, is nonetheless devoid of empirical content. It does not preclude any observable state of affairs and therefore can explain everything; hence, its information content is null. (See Popper, 1972, chapters IV, V, VI.)

Of course, there are varying degrees of falsifiability and verifiability. Karl Popper has pointed out that “the amount of empirical information conveyed by a theory, or its *empirical content*, increases with its degree of falsifiability.” (Popper [1972], p. 113; Italics are Popper’s. Additional discussions of verifiability and falsifiability are found in Hempel [1965]; Popper [1972], chapters IV, V, VI; and Popper [1957], section 29.) The important point here is that a language game is a cognitive one only if it can distinguish falsifiable from non-falsifiable theories. As will be apparent in the next section, current econometric practice does not yet require a language game which classifies theories according to *degree* of empirical content.

For a particular economic law to be falsifiable it must be empirically interpreted. R.L. Basmann (1975) has recently published a discussion of empirical interpretation of economic theories which is commended to the reader. Summary of his discussion here will clarify the essential points of falsifiability and empirical interpretation. If a particular covering law, $(z)[Pz \supset Qz]$, is logically conjoined with a particular observed initial condition, $[P\alpha, \ \alpha \in z]$, then $[Q\alpha, \ \alpha \in z]$ is predicted. Statements $[P\alpha, \ \alpha \in z]$, $[Q\alpha, \ \alpha \in z]$, and $[\sim Q\alpha, \ \alpha \in z]$ are observational premises (Basmann, 1975, pp. 170–174). The statement $(z)[Pz \supset Qz]$ is a universal economic premise (Basmann, 1975, pp. 167–169).

Observation of $[\sim Q\alpha, \ \alpha \in z]$, read “it is not the case that α has property Q” falsifies the proffered law. That is, observation of $(P\alpha \ \& \ \sim Q\alpha, \ \alpha \in z)$ constitutes the falsifier of the law, $(z)[Pz \supset Qz]$. (The symbol “&” is read “and.”) The falsification follows because a contradiction is deduced from conjunction of the universal conditional law (entered as a temporary assumption; Basmann, 1975, p. 161) and the observational premises, $[P\alpha, \ \alpha \in z]$ and $[\sim Q\alpha, \ \alpha \in z]$. The deduction schema is as follows:

1. $[P\alpha, \alpha \in z]$	Observational premise
2. $[\sim Q\alpha, \alpha \in z]$	Observational premise
3. $(z)[Pz \supset Qz]$	Temporary assumption
4. $Q\alpha$	1, 3, $\supset E$
5. $Q\alpha \ \& \ \sim Q\alpha$	2, 4, $\& I$
6. $r \ \& \ \sim r$	5, $\sim E$
7. $(z)[Pz \supset Qz] \ \therefore r \ \& \ \sim r$	3-6, $\supset I$
8. $\sim(z)[Pz \supset Qz]$	7, $\sim I$

It is not essential to follow each step of the deduction schema. The conclusion is clear: Conjunction of $[P\alpha, \alpha \in z]$ and $(z)[Pz \supset Qz]$ predicts (or explains) $[Q\alpha, \alpha \in z]$; if $[\sim Q\alpha, \alpha \in z]$ is observed, the law $(z)[Pz \supset Qz]$ is falsified. *The most fundamental requirement of a cognitive language game is that it distinguish falsifiable from non-falsifiable theories.*

The second requirement for a language game to be a cognitive one is that it separate relevant testing statements from non-relevant ones. The essential feature of this requisite is to distinguish whether $P\alpha$ or $\sim P\alpha$, whether $\alpha \in z$ and whether $Q\alpha$ or $\sim Q\alpha$. This is equivalent to saying that the language game has a valid interpretative system for the theory under discussion. The language game must have an interpretative system which (i) distinguishes which observations are relevant to the model being tested, and (ii) prescribes exactly which classes in the theory contain the relevant observations. (See Basmann, 1975, pp.170-174 for a more complete discussion of interpretation systems. Most books on modern predicate logic contain chapters on interpretation systems.) Only observation of $(P\alpha \ \& \ \sim Q\alpha, \alpha \in z)$ constitutes a refutation of the law $(z)[Pz \supset Qz]$. Thus, the second requirement is that the language game provide rules for distinguishing relevant falsifiers and confirming observation of them. A language game which distinguishes hypotheses with empirical content from hypotheses without content, but does not provide for identification of relevant testing statements is not a complete cognitive language game. Cognitive language games meet both the empirical-content and relevant-testing criteria.

Successful economic policy formation requires accurate description of the economy, predictions of economic events, and prediction of results from policy implementation. Such activities depend on the availability of a proffered economic law of universal conditional form; transparently, the law must be reliable in the sense that it has withstood the testing process better than rival alternative theories. Testing rival theories in a decisive way requires that they are tested within the framework of a cognitive language game; for only testing within a cognitive game warrants that the proffered theory predicts certain states, precludes others and has been subjected to relevant testing procedures. Economic theories developed outside such a framework may predict any state whatsoever and are hardly reliable

instruments for making decisions regarding property rights, jobs and national economic policy.

Assessing the predictive qualities of a particular econometric model is a manifold process. The model is examined with reference to the quality of the economic theory framing the model, the accuracy of data used in the estimation process, the relevancy of the testing procedures applied to the model and alternative models, and the accuracy of data used for prediction statements. Definitive statements about a model with regard to each of these facets presuppose that the model was constructed and tested within the auspices of a cognitive language game.

The vital role of cognitive language games in the predictive testing of econometric models necessitates explicit examination of the econometric language game. Our examination reveals opportunities for improving the language game in its cognitive qualities and also lets us assess the adequacy of some current econometric models as policy-making instruments.

III. The Cognitive Emptiness of the Current Econometric Language Game

Examination of the econometric language game must ordinarily proceed indirectly because the language game has not been formally written. Explicit language games such as metamathematics can be examined directly. Karl Brunner has studied several aspects of the econometric language game. His studies include dissection and analysis of the language game used in discussing the assumptions of economic theories (Brunner, 1969a), and investigation of the roles of theory construction, estimator bias, statistical tests and specification error in the language game (Brunner, 1969b). These essays reveal that while the language game of econometrics has terms for discourse about empirical content and relevant testing procedures, it does not provide bases for actually screening econometric models according to their empirical content and it does not provide prescriptions for deciding the relevancy of tests. Joseph Hanna (1972) has distinguished the concepts of forecasting and description. His analysis shows that the language game of econometrics only allows for referential discourse with respect to the descriptive and forecasting qualities of the models. It is deficient with respect to the prediction and explanation requirements. Oscar Morgenstern has taken the lead in examining the econometric language game from a different facet. His analyses of data accuracy and data requirements constitute a seminal contribution to ratiocination of the econometric language game (Morgenstern, 1963).

Perhaps the most inclusive and explicit examination of the econometric language game has been made by Robert Basmann (Basmann, 1972a, 1972b, 1974 and 1975). The deficiencies of the econometric language game are disclosed most perspicuously by examining the cognitive qualities of the econometric models

produced by application of the language game. The perspicuity derives from the ubiquitous cognitive emptiness of the models examined.

Basmann (1972a, 1972b) has published analyses of the cognitive qualities of a leading exemplar of modern econometric models—the Brookings—S. S. R. C. Econometric Model of the United States (Duesenberry, Fromm, Klein, Kuh [eds.], 1965. Hereinafter the model is referred to as BUSEM, the editors' mnemonic denomination of it.) Basmann adduces precise evidence for two primary points: (1) BUSEM is devoid of empirical content due to the lack of precision in its statement and the absence of explicit initial conditions, (2) The quantitative foundations are weak due to the inclusion of non-measurable variables in the mathematical statement of the model; hence, relevant testing statements are unavailable. The reply to these analyses by Fromm and Klein (1972) and subsequent reports on BUSEM claim that the model does have both empirical content and relevant testing statements but fail to demonstrate these claims². (See Fromm & Taubman [1968]; Duesenberry, Fromm, Klein, [1969]; Fromm, Klein and Schink [1972]; and Schink [1975].)

Econometric models like BUSEM have the logical form of consequents, Qz , of universal conditional economic laws, (z) [$Pz \supset Qz$]. Complete demonstration that BUSEM (or any econometric model) has empirical content must include precise description of the classes Qz and $\sim Qz$, statements of the antecedent conditions, Pz , along with their logical relation to Qz and presentation of the interpretative system used to separate relevant from non-relevant testing statements. Assertion that a model has empirical significance implies three existential premises:

- (1) There is at least one acceptable state [$Q\alpha, \alpha \in z$] which has a distinct complement [$\sim Q\alpha, \alpha \in z$].
- (2) There is a set of initial conditions, Pz , which logically imply Qz .
- (3) There is a rule of demarcation for nonarbitrary assignment of observations into exactly one of the classes Qz or $\sim Qz$.

The only valid evidence for the truth of an existential premise is exhibition of the thing asserted to exist. In the case of BUSEM, demonstration of its empirical content requires display of items (1), (2) and (3). It is on this point that BUSEM and most other econometric models fail. That an econometric model possess empirical content is the most fundamental requirement for its use in predicting economic events, and consequently for its adequacy as a policy instrument. Basmann's criticism that BUSEM lacks empirical content is a cardinal one; analysis of the criticism shows that it can be applied to nearly all econometric models.

² The explicit reply to *Basmann* (1972a) by Fromm and Klein (1972) merely restates claims about BUSEM; no factual evidence is adduced. The subsequent reports on BUSEM cited in the text do not attempt demonstration that the model actually has empirical content, nor do they take account of the fundamental criticisms leveled at it.

One evidence that the econometric language game is not a cognitive one is that it does not require proof of existential premises like (1), (2) and (3) above. The universal conditional economic law, (z) $[Pz \supset Qz]$, deductively implies that a particular class is empty. The asserted empty class is $[P\alpha, \sim Q\alpha; \text{for every } \alpha \in z]$. Necessary conditions for the econometric language game to be a cognitive one are directly related to the asserted empty class. The language game must include rules requiring each econometric model to display Pz and Qz as well as differentiating them from their complements $\sim Pz$ and $\sim Qz$. Additionally, the language game must require presentation of logical relation between Pz , Qz , $\sim Pz$ and $\sim Qz$. Finally, the language game should require the model builder to include a valid interpretative system for distinguishing the class membership of observational premises. These requirements are discussed by Basmann (1975) in their relation to formulating empirically significant economic theories. Here we recognize their general validity as requirements of the econometric language game, especially when the models constructed in the game are used for policy-making.

The econometric language game does not currently require display of the solution to the economic model being estimated; it does not even ask if a solution has been completed. Consequently, the language game does not require presentation of the falsifier class $[P\alpha, \sim Q\alpha; \alpha \in z]$. Many econometric models are stated in a form which precludes differentiation of Qz from $\sim Qz$. It is on this issue that Basmann criticizes the precision of the statement of BUSEM (Basmann, 1972a). Economic models are written in the general form

$$(1) f(X, A, b) = 0$$

where X is matrix of economic variables,

A and b are matrices of constants to be estimated from observations on X .

Every equation system like (1) is possessed of exactly one of the following properties:

(a) a finite number of consistent solutions, $X = g(A_j, b_j)$

$j = 1, \dots, n,$

(b) no solution,

(c) infinitely many solutions $X = g(A_i, b_i), i = 1, 2, 3, \dots$

Only in the case (a) is the system capable of empirical content. If there is no solution, the consequent Qz precludes all states of affairs. If there are infinitely many solutions no observable states are excluded³. This is precisely the point raised

³ The number of solutions can be made finite by inclusion of certain restrictions; e.g. ratios of certain pairs of variables may be required to be positive. Such restrictions are part of the adduced law (z) $[Pz \supset Qz]$ and should be discovered by deductive exploration of the properties of the model. Their inclusion as parts of the law should be remembered.

against BUSEM by Basmann. Its authors do not demonstrate that it has a finite number of consistent solutions; hence, the consequent Qz which BUSEM represents does not (knowingly) exclude any observable state of affairs. These remarks apply to every econometric model where the solutions are not displayed. Proving the existence of exactly n solutions is necessary but not sufficient. Only the solutions themselves will clearly delineate allowable and precluded observable states. If the delineation names observable states of affairs as precluded, then it may be said that the proffered economic law has empirical content. The addition of a stochastic vector to equation (1) establishes the allowable variation in determining whether $Q\alpha$ or $\sim Q\alpha$, $\alpha \in z$. If the equations (1) are all linear there must be exactly one unique solution for the model to possess empirical content. Many econometric models are linear, in which case the corresponding demonstrations of empirical content are simplified. The econometric language game fails to require presentation of the falsifier statements. One aspect of the failure is allowance of models stated without adequate deductive analysis and solution.

Explicitly presenting Qz and $\sim Qz$ constitutes only part of the task of demonstrating empirical content. Statement of the initial conditions Pz is also required. The statement must be sufficiently precise that it can be determined whether Pz or $\sim Pz$. For the statement of Pz to be sufficiently precise it must have two properties: (1) It can be determined within definite bounds of observational accuracy whether $P\alpha$ or $\sim P\alpha$, $\alpha \in z$, and (2) Pz logically implies Qz in the sense that Pz conjoined with definitions of z and appropriate axioms suffices to deduce Qz . The absence of explicit initial conditions, Pz , automatically denies empirical content to an econometric model. It also automatically renders the model useless as an instrument for prediction of economic events. This point may be clarified by reference to the *Weak Axiom of Revealed Preference*. The consequent of the *Axiom* is also of universal conditional form: "If prices are such that both X^1 and X^2 can be bought, then X^2 will never be revealed preferred to X^1 ." The *Axiom* is of universal conditional form (z) [$Pz \supset (Rz \supset Sz)$], which is read, "for every z , if z has property P , then if z has property R , then z has property S ." This is logically equivalent to (z) [$(Pz \& Rz) \supset Sz$], which may be read, "for every z , if z has property P and z has property R , then z has property S ." Prediction of an observed state, $S\alpha$, is only valid if it is ascertained that both $P\alpha$ and $R\alpha$. Observation of $P\alpha$ or $R\alpha$ alone is insufficient for prediction of $S\alpha$. When $P\alpha$ is not formulated and stated with the required precision it is impossible to formulate the falsifier [$P\alpha \& \sim Q\alpha$, $\alpha \in z$] or to predict specific economic states, $Q\alpha$. One of the most pervasive properties of econometric models is the absence of statements of the initial conditions.

Econometric models as representations of the consequent Qz are of the conditional form [$Rz_1 \supset Sz_2$], which may be translated, "if independent variables z_1 have property R , then dependent variables z_2 have property S ." Even where the statement [$Rz_1 \supset Sz_2$] is precise enough to distinguish it from $\sim[Rz_1 \supset Sz_2]$, care must be

taken not to confuse this consequent with the full economic law, $(z) [(Pz \ \& \ Rz_1) \supset Sz_2]$, required for economic prediction. Application of the empirical-content requirement from a cognitive game would prevent such confusion. However, as seen by examining BUSEM and other large models, the current econometric language game does not require application of either of the two fundamental requisites of cognitive games.

The econometric language game is also deficient with respect to the requirement for screening relevant from nonrelevant testing statements. The role of the relevancy screening property of cognitive games is the determination of relevant pairs $(P\alpha, Q\alpha), (P\beta, Q\beta), \dots$, to serve as verifications of the universal conditional law and $(P\alpha, \sim Q\alpha), (P\beta, \sim Q\beta), \dots$, to serve as falsifiers of the law⁴. In the absence of statements of Pz , it has not been necessary for the language game to develop the relevancy screening requirement. The relevancy screening requirement has the form of an interpretative system for the classes in the model.

The absence of antecedent conditions, Pz , from econometric models has made it impossible to formulate universal conditional economic laws and use them for prediction and policy evaluation. Current econometric models are descriptions (more or less complete; more or less accurate) of various sectors of the economy. The testing statements, which have evolved along with these descriptions are tests of the accuracy of these models as descriptions of the economy. Forecasting statements and hypotheses about parameters in equation systems are classes of testing statements which subsume the types of tests currently applied to econometric models. These tests are adequate for testing the descriptive qualities of econometric models. However, comparisons of the accuracy of forecasts by various econometric models do not qualify as potential falsifiers of proposed universal conditional laws. The logical use of forecasting statements is to assess the accuracy of a particular Qz as a description of the economy. To disclaim the accuracy of a particular description does not constitute falsification of a proposed economic law. Brunner (1969 b, pp. 67–72) has raised this point in his generalized discussion and Basmann has used it in his evaluation of BUSEM (1972a). More precisely, forecasting statements and stochastic hypotheses are only logically capable of testing whether the consequent, Qz , fits relevant data or not; this is not equivalent to actually determining whether $(P\alpha \ \& \ Q\alpha, \alpha \in z)$ or $(P\alpha \ \& \ \sim Q\alpha, \alpha \in z)$, which is the role required of relevant tests. Thus, forecasting tests and parameter tests are operations used in searching for a suitable consequent (of an economic model), Qz ; they are incapable of (logically) denying that consequent. This point is well understood and appears in econometrics text books (see Kane, 1968, for

⁴ A lucid example of an application of the screening is presented in *Battalio, Kagel et al. (1974)*. While not cast in an econometric setting, the essential points of the relevancy screening are exhibited in detail.

example). That the language game of econometrics has accepted forecasting statements and stochastic tests on parameters as relevant tests is evidence that it lacks the second requirement of a cognitive game.

The properties of the econometric language game determine the usefulness of econometric models. The current econometric language game limits the possible uses of econometric models; nonetheless, current models do provide bases for some important developments. Examination of current econometric models could guide development of theory constructions so that they become empirically significant. Current models show that many pure economic theories are too rudimentary to justify serious (and expensive) empirical examination (Basmann, 1975). Empirical immaturities of the pure theories are revealed in econometric attempts at studying them. Econometric models divulge the basic empirical weaknesses of pure theories.

Econometric models also provide means for analysis of data accuracy requirements. Analysis of econometric models reveals the observational accuracy required for distinguishing Q_z from $\sim Q_z$. Such analyses provide for carrying out the econometric enterprise economically. They also add to econometric models a role in encouraging empirically interpreted theories.

The econometric language also provides for development of models which describe economic events. This provision is due primarily to reliance on regression techniques in current methodology. Description of economic events can be useful both in current research and in historical analysis. The effects of the 1975 tax cut on GNP in the United States can be described econometrically. Using historical estimates of consumption and investment functions, deviations from normal paths can be estimated. A model could estimate the change in GNP due to the tax cut and perhaps describe some of the mechanism by which the change occurred. The current econometric language game could foster a *forecast* or an *econometric description* of the 1975 tax cut and associated changes in U. S. GNP.

Nonetheless, predictions or explanations of effects from the tax cut are impossible using the current language game. Requirement of use of definite, logically valid economic laws for policy-making and policy analysis is omitted from the game. A tax cut of major proportion provides opportunity to refute or verify any proffered economic law whose antecedent conditions are met by the tax cut. If the language game were a cognitive one it would warrant testing competing alternative theories using econometric techniques. But, as pointed out in this paper, fundamental ingredients for such testing are missing from current econometric practice, with the consequence that opportunity for subjection of economic theories to basic scientific tests are bypassed in favor of descriptive models and verbal arguments about rival theories and models. For example, the current language game is incapable of guiding an empirical study designed to show whether expansion from the tax cut is due to monetary expansion associated with the extra disposable income or to basic

spending increases via fiscal policy. The current game can only foster descriptions of the process; tests of the type outlined are impossible in the current practice.

Basmann's evaluation of BUSEM focuses on another fundamental imperfection of the econometric language game. The essence of the criticism is that BUSEM contains names for variables that are not measurable quantities. Statistical properties of estimators for parameters in a model containing non-measurable quantities are indeterminate. This has definite implications for both the empirical content and testing relevancy properties of the econometric language game. Inclusion of nonmeasurable variables in a system like (1) precludes the system from possessing a finite collection of consistent solutions. Furthermore, it eliminates the usefulness of statistical tests based on correlations (see Basmann's example in 1972a, section 4, Fromm and Klein, 1972, p. 60, and Basmann, 1972b, p. 106.)

IV. Nontechnical Aspects of the Econometric Language Game

There are other facets of the econometric language game deserving analysis: These are not directly related to the two primary requirements of cognitive games, but they do influence the conduct and evaluation of econometric research. The econometric language game includes certain forms of dialectics for discussing econometric problems. The classes "emotive response stimuli" and "psychologistic reasonings" generally subsume the various forms of dialectics used in econometric discourse. Brunner (1969a, 1969b) and Basmann (1972b, 1975) have discussed some members of these classes in detail.

Use of emotive response stimuli in the econometric language game may divert attention from basic flaws and anomalies in the econometric enterprise under discussion. Emotive stimuli take many forms. In the BUSEM reports they take such forms as appealing to consentient opinions of leading econometricians (Duesenberry *et al.*, 1965, pp. 3, 9), pointing out that the project is an ongoing one and not to be analyzed deeply yet (Fromm and Klein, 1972, p. 52; Fromm & Taubman, 1968, pp. ix-x; Duesenberry *et al.*, 1969, pp. ix-xi), claiming that future forms of the model will be improvements (Fromm & Klein, 1972, p. 54), asserting that the spirit of what is to be accomplished is more important than parameter estimates (Fromm & Klein, 1972, p. 54), and personal statements regarding critics (Fromm & Klein, 1972, pp. 52, 60). These examples do not exhaust the forms of emotive response stimuli⁵, but they do represent a spectrum of this dialectic category. The principal usefulness of emotive response stimuli lies in the inducement of agreement among critics by appealing to what is "reasonable" or "impor-

⁵ A recent article by *Howrey, Klein and McCarthy* (1974) contains several, among them one explicitly denominated, "Tender Loving Care (TLC)." The entire article distills to the claim, "Cooper did not exhibit TLC in a recent econometric analysis."

tant.” Emotive response stimuli seem less pervasive and easier to identify than psychological reasonings.

Psychologicistic reasonings represent intuitive approaches to the problems of science. The role of intuition in the creative conduct of empirical science is indispensable (Bronowski, 1965, chapter 1). Problems are selected, clarified, and tactics for their solutions are suggested by intuition. Fruitful discussions among scholars and scientists are usually carried out in intuitive and psychologicistic terms. Economics and econometrics also benefit from this creative process. However, acceptance of intuitive or psychologicistic responses to purely technical problems forbodes violation of the *Law of Noncontradiction* (Basmann, 1975) and of the *scientist's fundamental habit of truth* (Bronowski, 1965). Contradictions in mathematics caused by psychologicistic reasonings are pinpointed in Cohen and Hersch (1967), Whitehead and Russell (1970), and Nagel and Newman (1974).

The econometric language game, like metamathematics, should solve only technical problems. However, in the econometric language game psychologicistic reasonings usually represent intuitive solutions to purely technical problems. They frequently appear as discussions about the relevancy, plausibility or truth of assumptions underlying an economic theory or (conjectured) theorems in econometrics. Brunner's discussion of their uses in economic theory is an illuminating one (Brunner 1969a). In econometrics the uses of psychologicistic reasonings have persisted as solutions to currently unsolved mathematical puzzles. Their use is manifest in discussions of “moments” of system estimators prior to demonstration of existence or non-existence of moments, discussion of relative efficiencies of alternative systems estimators, attributing properties of limiting distributions of estimators to their small-sample counterparts, and persistent use of undefined numbers as tests of statistical significance (specifically, use of student's t distribution when testing parameters in exactly identified structural equations). Psychologicistic reasonings appear in the BUSEM literature regularly in discussions about consistency of the model. The consistency of any model is a purely technical property to be investigated using relevant theorems from mathematics. (See in particular footnote 1 on page 1 of Duesenberry *et. al.*, 1969, and compare with Fromm and Taubman, 1968, p. 123.) Intrusion of psychologicistic reasonings and emotive response stimuli into the econometric language further remove it from the class of cognitive language games. Psychologicistic reasonings should be confined to discussions and never accepted as demonstrations of theorems.

V. Conclusions

Comparison of the current econometric language game with the requirements of a cognitive game shows that the econometric language game is deficient in two fundamental respects. The game does not screen models with empirical content

from those without empirical content. Nor does it distinguish relevant from irrelevant testing statements. The accuracy of these criticisms is verified both by examination of the models produced within the game and by direct analysis of the game itself. Primary sources for the deficiencies are the lack of precision in the language used for econometric discourse and the relatively small amount of resources allocated to construction of cognitive theories and solution of data problems. In particular, intrusion of emotive response stimuli and psychologistic reasonings as approaches to purely technical problems impede application of concepts of empirical content. Furthermore, the models produced within the framework of the language game are generally devoid of empirical content as seen by comparing them with cognitive requirements.

It is unfair to demand that econometric models provide predictions of economic events and assessment of policy strategies, for they are logically incapable of meeting such demands. This incapability derives from two sources. First, econometric models as currently produced are stated with little or no reference to the antecedent conditions which imply the economic states described in the models. The logical conjunction of a universal conditional economic law and observed initial conditions required for scientific prediction cannot be made. Second, the description of the consequents of the proffered laws are generally not precise enough to determine which, if any, economic states are excluded from occurring. It is impossible to know which states are implied or not implied by proposed policy actions. Of the three requirements of econometric models in economic policy formation—describing the economy, predicting economic events, predicting consequences of alternative policies—only qualities sufficient for description of the economy are apparent in the econometric language game. The quality of these descriptions is doubtful due to the inclusion of nonmeasurable variables and data of unknown accuracy in the description (estimation) processes.

Use of econometric models for assessing data requirements and evaluating empirical content of pure economic theories will increase the demand for empirically significant theories. It should also raise the price of such theories. Perhaps a cognitive econometric language game and empirically interpreted econometric models are complementary commodities. If so, use of econometric analysis to stimulate empirically useful theories will also increase demand for a cognitive language game. As with the development of empirically useful theories, development of a cognitive econometric language game depends on the demand created by economic observers and competent economic empiricists.

References

- Anderson, John M., and Henry W. Johnstone, Jr.* (1962): *Natural Deduction: The Logical Basis of Axiom Systems*, Wadsworth Publishing Co., Inc.
- Basmann, R. L.* (1972a): "Argument and Evidence in the Brookings-SSRC Philosophy of Econometrics," in *Brunner, K., (ed.)*

- (1972b): “The Brookings Quarterly Econometric Model: Science or Number Mysticism?,” in *Brunner, Karl* (ed.).
- (1974): “Exact Finite Sample Distributions for Some Econometric Estimators and Test Statistics: A Survey and Appraisal,” Chapter 4 of *Intrilligator, M. D.* and *D. A. Kindrick*, *Frontiers of Quantitative Economics*, Vol. II, North-Holland.
- (1975): “Modern Logic and the Suppositious Weakness of the Empirical Foundations of Economic Science,” *Schweizerische Zeitschrift für Volkswirtschaft und Statistik*.
- Battalio, R. C., J. H. Kagel, R. C. Winkler, E. B. Fisher, Jr., R. L. Basmann, L. Krasner* (1973): “A Test of Consumer Demand Theory Using Observations of Individual Consumer Purchases,” *Western Economic Journal*, XI (1973), 411–428.
- Bronowski, J.* (1965): *Science and Human Values*, Harper & Row, Publishers, Harper Torchbooks.
- Brunner, K.* (1969): “‘Assumptions’ and the Cognitive Quality of Theories,” *Synthese*, 20, (1969), 501–525.
- (ed.), (1972): *Problems and Issues in Current Econometric Practice*, College of Administrative Science Monograph No-AA-6, The Ohio State University.
- (1969b): “Some Reflections on Current Econometric Practice,” in *Essays in Honor of Richard Buchner*, Zurich.
- Cohen, Paul J.*, and *Reuben Hersh* (1967): “Non-Cantorian Set Theory,” *Scientific American*, Vol. 217, No. 6, December, pp. 104ff.
- Duesenberry, J. S., G. Fromm, L. R. Klein, and E. Kuh* (1969): *The Brookings Model: Some Further Results*, Rand McNally & Company.
- (1965): *The Brookings Quarterly Econometric Model of the United States*, Rand McNally and North-Holland.
- Fromm, Gary, & L. R. Klein* (1972): “The Brookings Econometric Model: A Rational Perspective,” in *Brunner, K.* (ed.).
- Fromm, Gary, Lawrence R. Klein and George R. Schink* (1972): “Short-and-Long-term Simulations with the Brookings Model,” in *Hickman, Bert G.* (ed.), *Econometric Models of Cyclical Behavior*, Vol. I.
- Fromm, G.*, and *P. Taubman* (1965): *Policy Simulation With an Econometric Model*, Brookings-North-Holland.
- Hanna, Joseph T.* (1972): “On the Cognitive Content of Econometric Models,” in *Brunner, Karl* (ed.).
- Hempel, Carl G.* (1965): *Aspects of Scientific Explanation and Other Essays in the Philosophy of Science*, The Free Press.
- (1965): “Aspects of Scientific Explanation,” in *Aspects of Scientific Explanation and Other Essays in the Philosophy of Science*.
- Hempel, C. G.*, and *P. Oppenheim* (1948): “Studies in the Logic of Explanation,” in *Hempel, C. G.*, (1965) *Aspects of Scientific Explanation and Other Essays in the Philosophy of Science*.
- Hickman, Bert G.* (1972): *Econometric Models of Cyclical Behavior*, 2 volumes, *Studies in Income and Wealth*, No. 36, National Bureau of Economic Research.
- Howrey, E. P., L. R. Klein and M. D. McCarthy* (1974): “Notes on Testing the Predictive Performance of Econometric Models,” *International Economic Review*, 15 (June, 1974), No. 2, 366–383.
- Kogiku, K. C.* (1971): *Microeconomic Models*, Harper and Row.
- Morgenstern, Oskar* (1963): *On the Accuracy of Economic Observations*, Princeton: Princeton University Press.
- Nagel, Ernest, and James R. Newman* (1974): *Godel’s Proof*, New York University Press.
- Popper, Karl R.* (1972): *The Logic of Scientific Discovery*, Hutchinson & Company, Ltd.
- (1951): *The Poverty of Historicism*, Harper & Row, Publishers, Harper Torchbooks.
- Schink, George R.* (1975): “The Brookings Quarterly Model: As An Aid to Longer Economic Policy Analysis,” *International Economic Review*, Vol. 16, No. 1, pp. 39–53.
- Whitehead, A. N.*, and *B. Russell* (1910): *Principia Mathematica* to * 56, Cambridge at the University Press.

Zusammenfassung

Die abgeleitete Nachfrage nach einem kognitiven ökonomischen Spiel und Wirtschaftspolitik mit ökonomischen Modellen

Der mangelhafte Erfolg ökonomischer Modelle in der Herleitung erfolgreicher wirtschaftspolitischer Regeln ist den Mängeln der vorherrschenden Kriterien für Modellkonstruktion und -evaluation zuzuschreiben. Die logischen und empirischen Fundierungen der Wirtschaftswissenschaften sind identisch und sehr spezifisch. Die herkömmliche Ökonometrie fördert Vorgehen, welche unökonomisch und den Zielen der Wirtschaftswissenschaften und Wirtschaftspolitik nicht förderlich sind. Die gewichtigsten dieser Schwächen sind den in der gegenwärtigen Ökonometrie vorherrschenden unüblichen Konzeptionen für Hypothesenformulierung und -prüfung zuzuschreiben. Wenn neue Kriterien für die ökonomische Praxis im Rahmen traditioneller Konzeptionen wissenschaftlicher Prognosestellung, Erklärung und Hypothesenprüfung entwickelt werden, so wird sich daraus ein entsprechender Bedarf für empirisch testbare ökonomische Theorien sowie eine Qualitätsverbesserung der wirtschaftspolitischen Praxis ergeben.

Résumé

Demande dérivée d'un jeu économétrique cognitif et mise en œuvre d'une politique à l'aide de modèles économétriques

L'échec enregistré par les modèles économétriques dans leur contribution à l'élaboration de politiques économiques couronnées de succès provient des insuffisances inhérentes aux critères adoptés en matière de construction et d'évaluation des modèles. Les fondements – logique et empirique – de la science économique sont identiques et très spécifiques. Telle qu'elle est en usage, l'économétrie encourage l'application de procédés non économiques et antiproductifs dans la poursuite des buts de la science économique, ainsi que dans l'élaboration et la mise en œuvre d'une politique. Les imperfections les plus marquantes sont attribuables aux conceptions inhabituelles en matière de formulation et de vérification, qui prévalent en économétrie. Lorsque les critères applicables dans la pratique de l'économétrie seront reconsidérés en fonction des concepts scientifiques traditionnels en matière de prévision, d'interprétation et de vérification des hypothèses, il en résultera logiquement une demande de théories économiques interprétables empiriquement, accompagnée d'un progrès dans l'élaboration de la politique économique.

Summary

Derived demand for a cognitive econometric game and policy-making with econometric models

Failure of econometric models to aid creation of successful economic policies derives from deficiencies in prevailing standards for model construction and evaluation. The logical and empirical foundations of economic science are identical and very specific. Mainstream econometrics fosters practices which are uneconomical and counterproductive to the goals of economic science and policy making. The most serious of these defects are attributable to the unusual conceptions of hypothesis formulation and testing extant in econometrics. When rules for econometric practice are reorganized along traditional conceptions of scientific prediction, explanation and hypothesis testing there will be a consequent demand for empirically interpretable economic theories as well as improvement in economic policy making.