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A Transactional Approach to Economic Research

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INTRODUCTION

Debates on procedures of inquiry for economics usually focus on methodological techniques for evaluating the usefulness of a theory. This article focuses instead on improving economic theorizing through the explicit handling of the age-old, troublesome notion of reality.

From the very start we are involved in the argument between nature and man in which science plays only a part, so that the common division of the world into subject and object, inner world and outer world, body and soul, is no longer adequate and leads us into difficulties. Thus even in science *the object of research is no longer nature itself, but man's investigation of nature* (Heisenberg, 1958, p. 24)

Werner Heisenberg was referring to research in physics, but it applies to economics as well. *Reality* is humankind's view of it, inasmuch as humans are an integral part of all inquiry and observation. With a transactional context for theory improvement, the researcher's *personal* knowing process is an acknowledged part of any inquiry. This contrasts with *impersonally* applying scientific methods which inadequately deal with the subtle assumptions underlying how a problem is formulated and how data are collected and analyzed.

Mainstream economic research too often lacks a transactional view. Instead, it uses a convenient real world approach that removes the researcher from the inquiry process (contrary to Heisenberg's recommendation). Chua (1986) described this tendency in accounting research.

Ontologically, mainstream accounting research is dominated by a belief in physical realism – the claim that there is a world of objective reality that exists independently of human beings and that has a determinate nature or essence that is knowable. Realism is

closely allied to the distinction often made between the subject and the object. What is “out there” (object) is presumed to be independent of the knower (subject), and knowledge is achieved when a subject correctly mirrors and “discovers” this objective reality . . .

This ontological belief is reflected in accounting research as diverse as the contingency theory of management accounting, multi-cue probability learning studies, efficient capital markets research, and principal-agent literature. All these theories are put forward as attempts to discover a knowable, objective reality. This inference is based on the absence of any expressed doubt that the empirical phenomena that are observed or “discovered” could be a function of the researchers, their *a priori* assumptions, and their location in a specific socio-historical context. (p.606)

A transactional approach to economic research emphasizes the restrictiveness of the researcher’s assumptions and the need for continual “constructive skepticism,” as noted by Smith (1985).

More than in any particular method of inquiry, I think the hallmark of science is to be found in a constructively skeptical attitude toward knowledge. The more fundamental are the concepts and assumptions of a science, the easier it is to take them for granted and to abandon this skepticism. (p. 265)

A concern for constructive skepticism is evident in Leontief’s (1971) criticism of excessive abstract theorizing in economics.

True advance can be achieved only through an iterative process in which improved theoretical formulation raises new empirical questions and the answers to these questions, in their turn, lead to new theoretical insights. The “givens” of today become the “unknowns” that will have to be explained tomorrow. This, incidentally, makes untenable the admittedly convenient methodological position according to which a theorist does not need to verify directly the factual assumptions on which he chooses to base his deductive arguments, provided his empirical conclusions seem to be correct. The prevalence of such a point of view is, to a large extent, responsible for the state of splendid isolation in which our discipline nowadays finds itself. (p. 5)

This article proceeds in the following manner. The second section is an analysis of how reality is dependent on the context of purposeful experiences of human beings. The importance of past experiences in shaping the real world is illustrated by reference to the Ames Demonstrations in visual perception. The third section gives examples of diverse research illustrating the transactional view of relationships and how it can improve problem formulations. Included are studies of the exhaustion of natural resources, Peru’s underground economy, and foreign aid. The fourth section is a brief overview of experimental economics work illustrating the benefits to theory improvement from organizing feedback data in a skeptical and penetrating manner. In the fifth section, a transactional context for theory improvement is contrasted with Milton Friedman’s (1953) argument that predictive accuracy is the only relevant test of a theory and with his rejection as irrelevant the criticism that a theory’s assumptions may be unrealistic.

REALITY

A disconcerting part of the reality issue for many people may be a reluctance to question their obviously true experiences, such as walking to the mailbox. To question these realities could lead to a philosophical world wherein common life experiences verge on becoming fictional and everything must be doubted.

The uniqueness of meriting a name (e.g., *mailbox*) fosters thought that the thing has an independent existence. Naming isolates things and can easily lull the researcher into a self-actional mode of view. For centuries a self-actional view of science considered things as acting under their own powers. Classical mechanics then brought forth, according to Dewey and Bentley (1949), an interactional view “where thing is balanced against thing in causal interconnection . . . “ (p. 121).

A transactional view¹ focuses on awareness of the subtle ways the researcher participates in scientific inquiry. Ittelson (1960) articulated the importance of this point of view for research in visual perception.

Neither a perception nor an object-as-perceived exists independent of the total life situation of which both perception and object are a part. It is meaningless to speak of either as existing apart from the situation in which it is encountered. The word *transaction* is used to label such a situation, for the word carries the double implication (1) that all parts of the situation enter into it as active participants, and (2) that they owe their very existence as encountered in the situation to this active participation, and do not appear as already existing entities that merely interact with each other without affecting their own identity. (p. 13)

For example, consider a blue mailbox made of steel as an example of reality with an apparently independent existence. On an informal level of discussion, plainly the mailbox attribute “blue” cannot mean the same to a blind person as it does to a person of normal vision. The individual making the comparison is clearly part of the comparison process. Furthermore, steel necessarily involves a comparison of hardnesses. Finally, if the mailbox were in a basement, it would not really be a mailbox any longer.

The point is that reality in the transactional view (rather than the self-actional or interactional) exists in the context of purposeful human behavior. Such a viewpoint does not require the denial of a real world. Rather, it explicitly recognizes our *participation* in shaping the world that we see as real.²

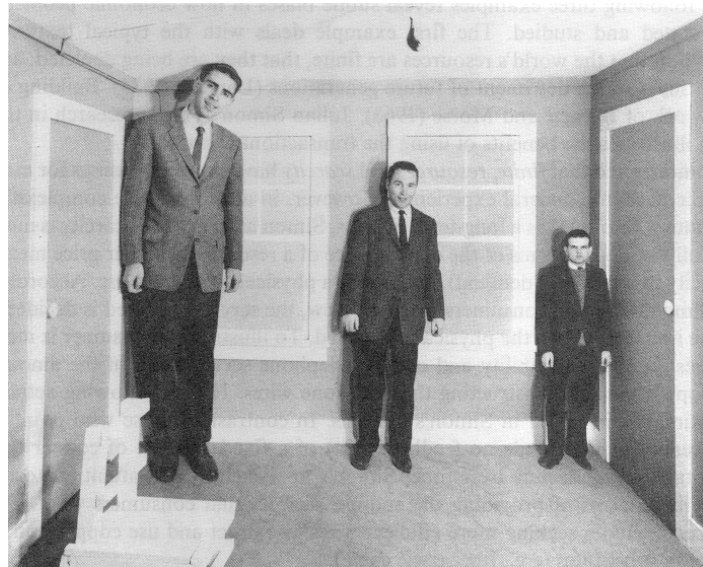
Through the integration of past experiences, individuals continually hypothesize and reliably confirm (or refute) how things work to meet their needs. It becomes convenient (economical of time and energy) to treat the vast majority of things as independent realities. However, as a scientist, one needs to guard against unconsciously ascribing independence when investigating if and how specific variables are related. Once independent reality is *apparently* observed and described, there is a tendency for it no longer to be the focus of constructive skepticism.

A misleading belief about scientific research is that a researcher is *objective* when confronting a problem and subsequently applying scientific methods to test hypotheses to predict what happens under specified conditions. Although empirical research is often viewed as a deliberate search for objective evidence, Leamer (1983) suggested that the researcher's personal biases are still present.

The econometric art as it is practiced at the computer terminal involves fitting many, perhaps thousands, of statistical models. One or several that the researcher finds pleasing are selected for reporting purposes. This searching for a model is often well intentioned, but there can be no doubt that such a specification search invalidates the traditional theories of inference. The concepts of unbiasedness, consistency, efficiency, maximum-likelihood estimation, in fact, all the concepts of traditional theory, utterly lose their meaning by the time an applied researcher pulls from the bramble of computer output the one thorn of a model he likes best, the one he chooses to portray as a rose. (p. 36)

How the problem is perceived, the initial selection of variables likely to be important, the first hunch at how these variables might be related, and the criteria used for evaluating the evolving hypotheses do not arise in an unbiased fashion. The researcher's web of experiences have formed an assumptive world that is an unavoidable, integral part of inquiry. The importance of recognizing this must be emphasized, since thinking can be easily biased by assumptions of which the researcher is not at all aware.

That assumptions are an integral part of the knowing process was demonstrated by the visual perception work of Adelbert Ames, Jr. and colleagues in the 1940s and 1950s (Ittelson, 1951, 1960, 1968). Prior to Ames, visual perception research considered objective things out there as giving signals to the subjective person who decoded these signals, thereby perceiving the external reality. Ames and his associates used a transactional framework wherein the individual was an active participant in the visual awareness process.³



(Reprinted with permission from *Scientific American*, April 1959, p. 58.)

Figure 1. Ames's Distorted Room

One of the Ames Demonstrations which is frequently pictured in psychology textbooks is the Distorted Room. It shows an observer looking through a peephole with one eye at a specially constructed room. The distorted room seems to have a level floor, right-angle construction, and rectangular windows (normal construction), but it does not. In the Ames room, people appear to be radically different in height (Figure 1) although they actually are about the same height.

An observer's extensive life experience with rooms has so imbedded an assumption of normal construction that the shape of the room is not questioned. The room's walls recede from bottom to top and the ceiling is larger than the floor. The "short" person is actually twice as far from the peephole as the "tall" person.⁴

Even when told of the construction of the distorted room before looking at it, observers' perceptions are not altered. Experiments with small-sized distorted rooms showed that if observers practice throwing a ball and touching parts of the room with a stick, they slowly begin to recognize the distorted shapes. But by only thinking about it, observers could not break free from their assumptive worlds. Individuals alter deeply imbedded assumptions through feedback.

A TRANSACTIONAL APPROACH TO ECONOMIC PROBLEMS

The following three examples reveal subtle biases in how economic problems are stated and studied. The first example deals with the typical textbook assertion that the world's resources are finite, that they are being depleted, and that this is to the detriment of future generations (London, 1984). Building on the work of Barnett and Morse (1963), Julian Simon's (1981) research in this area illustrates the benefits of using the transactional approach.

Simon noted that *finite*, *resource*, and *scarcity* have simple meanings for most people based on general experience. However, in addressing the complexities of natural resources as a long-term process, Simon asserted that scarcity is more usefully viewed in terms of the cost or price of a resource (a higher price means scarcity in relation to demand), and not as a physical stock measure. According to Simon, from the consumers' point of view, the service rendered is decidedly more important than the physical units used. To illustrate, a consumer is more interested in the reliability and cost of telephone service than in the amount of copper used in constructing the telephone wires. Human knowing activity is intimately involved in Simon's analysis. In contrast to those who point to the reality (which needs no feedback test) of a fixed amount of copper that inevitably must decline over time, Simon's approach directs attention to the ongoing process of providing the end-use services that consumers want. The process includes seeking more efficient ways to extract and use copper and to develop substitutes (e.g., fiber optic cable).

What do the long-term data look like for natural resources, such as copper, when displayed as a price index in terms of wages or of consumer prices? Over the long term, relative prices for copper have declined, suggesting that the problem of resource

depletion may not be as it is widely portrayed. This basic information is not even raised as relevant, and indeed is missing, from the standard textbook description of the natural resource problem.

A transactional approach to inquiry emphasizes and nurtures an open-minded awareness of complex relationships. Ongoing feedback from observation is essential in guiding advances in theory and in reformulating the problem as inquiry proceeds. An example of how observation can lead to a reformulation of the problem and a shaping of the direction of inquiry can be seen in some recent work on the underground economy.

Historically, underground economies were often viewed as detrimental because they apparently enabled people to avoid paying taxes and to circumvent a government's laws. Since 1980, Hernando De Soto (1989) has led a team of economic researchers in studying Peru's underground economy. His research showed that it was not feasible for people of modest means to follow legal procedures to build a house or start a business. Legally setting up a sewing business in Lima took 289 days, two bribes, 11 permits, and cost about 32 times the monthly minimum living wage.

De Soto's detailed field studies revealed that the underground or informal economy was vastly more efficient than the formal sector. The informal sector evolved as a reaction to a legal system which cemented the status quo for members of the political bureaucracy or those already having the means to bribe the politically powerful. Those currently without wealth or political power who want to work to improve their life must disobey the law. De Soto's work documented the robust, wealth-creating ability of Peru's citizens, in spite of an oppressive legal system. He argued that the relevant problem is Peru's dismal, overall economic performance; and he recommended that attempts to advance the economy should focus on changing the legal institutions to protect the property rights and aid the voluntary cooperation of citizens in economic exchange. In short, legalize the informal economy as a way to improve Peru's economic performance.

A third example is the work of P. T. Bauer. He spent a lifetime working in data analysis and field studies of the economics of developing countries. His conclusion is diametrically contrary to the widely held view that people of Third World countries benefit from government planning coupled with foreign aid. Bauer's work butted against a fortress of strongly held beliefs. In the main, he stressed his field observations of what has apparently worked in practice and what has not. For example, he found that the infusion of foreign aid did not go to the poor. Rather, it went to ruling governments and, Bauer contended, this not only supported the very policies which were detrimental to the poor, but also served the narrow self-interests of the already powerful. In contrast, he pointed to the successes connected to voluntary responses to economic opportunities with limited government intervention in resource allocation and without any infusion of foreign aid.

Whether or not one is persuaded by Bauer's arguments and analysis of data, he made a compelling point about the self-evident defense of foreign aid.

Altogether, the mainstream advocacy of aid rarely addresses itself to its actual operation, and notably not to its efficacy in terms of its proclaimed objectives. The advocates do not examine whether aid actually promotes development or improves the lot of the poor. Nor do they examine its adverse repercussions. (1981, p. 90)

At a fundamental level, Bauer pointed to the subtle way that language can bias a research inquiry.

Foreign aid is the transfer of taxpayer's money to distant governments and to the official international organizations. The use of the term aid to describe these transfers pre-empts criticism, obscures issues and prejudices results.

Who could be against aid to the less fortunate? Aid is good, more aid is better. (1984, p. 42)

Intensive empirical work, such as De Soto's and Bauer's field research, has not received nearly the degree of academic research effort that has been devoted to theory development presented in the logic of mathematics. A contributing factor may be the prevailing attitude among economists of an independent reality. As such, identified phenomena become stand-alone puzzles for which logic can provide the correct configuration of the pieces.

Serious pitfalls to progress result from the lack of attention to the role of assumptions in creating realities. Such assumptions range from the acknowledged and self-evident to the subtle and unrecognized. This inattention interferes with linking theory development to skeptical, hard-nosed analysis of feedback data.

In the extreme, fundamental flaws in a model go unchallenged because data which speak against strongly held assumptions are unwittingly filtered out. As in the Ames distorted room, right-angle construction of floors and ceiling is self-evident and real-world people in the room automatically change size to conform to this strongly held belief. Similarly, Simon's analysis of natural resource depletion, De Soto's field studies of Peru's economy, and Bauer's appraisal of foreign aid show the importance of avoiding automatic acceptance of strongly held beliefs, of seeking insights through feedback data, and of continual reassessment of the problem being studied.

EXPERIMENTAL ECONOMICS

Field research data typically constitute a composite test of a theory; observations capture a composite of behavior, environment, and institution.⁵ In contrast, economic experiments, by controlling for environment and institution, facilitate the study of if and how variables are related and, to quote Smith (1989), "narrow the interpretation of inconsistency between predictions and observations so that the burden of inconsistency is borne by the behavioral assumptions of the theory" (p. 154).

In seeking insights to improve theory, a transactional way of thinking alerts researchers to look for, recognize, and deal with blind spots, which, unavoidably, are the result of their assumptive worlds. To this end, the organization of feedback data is crucially important.⁶

In the following highlights of experimental work, the main point is to appreciate the innovative process of blending feedback data with theory appraisal. This way of thinking contrasts with the typical way that competing economic theories are debated on logical grounds alone.

Beginning economics students learn that, in an efficient economic system, resources are continually moved to their best use. The pricing mechanism is a key for accomplishing this objective. If a seller can sell one more unit of output at a price exceeding its cost, the seller will do so. A buyer will purchase a unit if the worth to the buyer exceeds the price paid. Supply and demand quantities are balanced via an equilibrium market price. To most economists, this theory has become an axiom and warrants no further inquiry. However, experimental economists continually research the market pricing process because much can be learned from experiments, even those that confirm a theory. Types of benefits from experiments can be summarized as follows:

1. Testing can lead to theory improvement by analyzing feedback data and by identifying the boundaries of a particular theory's usefulness.
2. At times, a policy maker must decide on a course of action when two or more theories support different conclusions. Experiments under simple conditions may show that one theory performs decisively better than another. This shifts the burden of proof to the proponents of the underperforming theory (Plott, 1987).
3. Institutions can be created in the laboratory and their efficiency measured.⁷

In the basic economic experiment, the researcher has a measure of control over the supply and demand for units of an artificial commodity. Participants are offered a schedule of monetary payouts for purchase or sale of units with the researcher. With this induced value approach (Smith, 1976), participants do not have knowledge of others' payout schedules. A profit motive exists if one can buy (sell) a unit in the market for less (more) than the agreed-on payout.

Conventional theory asserted that competitive markets needed a wide dissemination of knowledge across a large number of participants. Many experiments in double-auction markets (e.g., the New York Stock Exchange, where buyers and sellers exchange oral bids and offers) demonstrate quick convergence to equilibrium prices (profitable trading opportunities exhausted) with only a few participants (Smith, 1986). Further experiments (Ketcham, Smith, Williams, 1984; Plott, 1982, 1986) addressed the institutional variable of different types of markets. For example, a single auction has only one side making a market (bids or offers) while the other side accepts or waits. In a posted-price market, the market makers post their bids (if buyers) or offers (if sellers), and these remain fixed during the subsequent trading period.

Economic efficiency is lower, and prices are higher, in a posted-offer compared to double-auction market. An apparent advantage exists in being a market maker who does the posting in a posted-price market, but in avoiding that role in a single auction.

Under different environmental and institutional arrangements, measurements are made not only of efficiency, but also of the dynamics of trading over time. The effects of trading rules, and the path of price movements over time, provide observations of minor aberrations unexplained by current theory. As in the physical sciences, analysis of minor inconsistencies in economic data should lead to theory improvement.

Knowledge about the inefficiency of posted-price markets has been applied to a variety of policy-making situations. The Interstate Commerce Commission was confronted with an argument from railroad companies concerning barges that operated on inland waterways in competition with railroads. Railroads wanted barge owners to post their freight rates, arguing that this would spur increased competition and aid the smaller barge owners. Experiments in laboratory environments, which captured the salient features of the actual environment, demonstrated that the railroads' proposal would decrease efficiency and actually penalize the small barge owners (Hong & Plott, 1982). In sum, experimental feedback data can lead to insights that could not be obtained in a sterile environment of one logical argument versus another.

Experimental economics is limited to problems in which the important variables can be manipulated in a laboratory environment. The laboratory needs to capture, for practical purposes, those features of the field environment having a crucial impact on how the model works (Smith, 1982). In some cases, though, experiments are the only way to manipulate relevant variables. Experiments can induce supply and demand schedules which are quantitatively known to the experimenter. In nonlaboratory markets, these data are never available. Consequently, the need to maintain relatively simple environments in the lab provides an offsetting benefit by gaining control of a variable which could not be controlled in the field.

For example, ever since Adam Smith, economists have asserted that human behavior could usefully be modeled as if an individual were a calculating rational economic person. In an experiment on bargaining theory with important implications for both law and economics, Hoffman and Spitzer (1985) demonstrated that this assumption can oversimplify behavior at times. "Fairness" was an experimentally controlled variable. One group of subjects "legitimately" earned the right to extract a larger portion of a bargaining surplus because they first won a game of skill. Another group won this right by the random flip of a coin. The former tended to extract a high "rational" share of the surplus, but the latter tended to share equally. By experimentally challenging a standard assumption of economic theory, this research opened an important new line of thinking.

CONCLUSION

Many economists give lip service to the basic view that all working hypotheses are tentative and are not to be etched in stone. They also claim to recognize that science is not a search for absolute certainty or ultimate truth. Unfortunately, much academic research is rooted in convenient assumptions which expedite abstract, mathematical models of the world "out there" with little regard for the complex dependencies among

the researcher, the perceived problem under inquiry, the selection of variables, and the design and interpretation of feedback data.

Cantril, Ames, Hastorf, and Ittelson (1961) concisely stated the point.

Science is an activity designed by man to increase the reliability and verifiability of his assumptive world . . . real progress in any science involves an awareness of our assumptive worlds, a consciousness of their inadequacy, and a constant, self-conscious attempt to change them so that the intellectual abstractions they contain will achieve increasing breadth and usefulness. (p. 9)

The transactional approach, diagrammed in Figure 2, focuses on the assumptive world in place of an independent reality. The assumptive world or knowledge base is an individual's existing stock of well-accepted theories about how best to operate in the environment. The visual perceiving-knowing research demonstrates the deep reach of the assumptive world, which originates with past experiences.

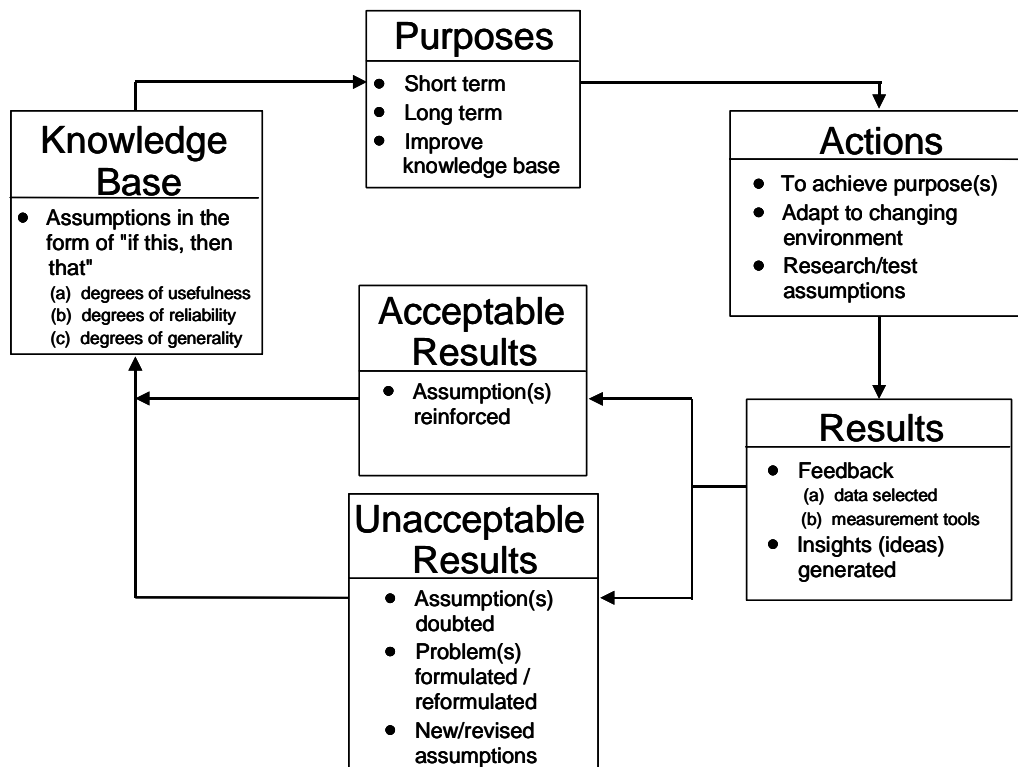


Figure 2. Knowledge and Action System

Whenever an obstacle to purposeful action is encountered, an individual isolates the boundaries as a problem and constructs working hypotheses concerning if and how selected variables within the problem situation are related. Feedback data are sought to test the usefulness of the new, tentative theory. When many tests of a new theory support it, the theory is integrated as part of the individual's knowledge base.

Two aspects of theory improvement can be identified: (1) obtaining adequate solutions to currently perceived problems, and (2) gaining insights which, in turn, lead to formulations of new, more significant problems. Typically, it is feedback data which stimulate heretofore unrecognized insights.

Milton Friedman's (1953) "as if" methodology of positive economics represents a more limited context for theory improvement than the transactional view.

Viewed as a body of substantive hypotheses, theory is to be judged by its predictive power for the class of phenomena which it is intended to "explain" . . . The only relevant test of the *validity* of a hypothesis is comparison of its predictions with experience. (p. 8)

It can be argued that in many instances of complex economic phenomena, much can be learned by organizing and studying data as if certain assumptions applied. This learning opportunity need not be abandoned, even when particular assumptions are proved to be inaccurate on close scrutiny. The difficulty lies in generalizing Friedman's approach as a preferred methodology for economic theory improvement. Practitioners of Friedman's positive economics all too easily construct theory by transforming strongly held beliefs from their assumptive worlds into unrealistic assumptions. They contend that their theories should be viewed as descriptions as if the assumptions were true. The argument is then made that prediction is the ultimate proving ground and, consequently, criticism of assumptions is not relevant. A skeptical attitude toward particular assumptions is labeled as a misguided attempt to test the realism of assumptions. In addition, any criticism that the selection of assumptions may erroneously fix, at an early stage, the formulation of the problem is presumably deflected by Friedman's qualifying phrase "for the class of phenomena which it is intended to 'explain.'" The practical result, however, may often be to severely restrict both potential reformulations of the problem and the process of feedback-theory improvement.

Consider the following theory's superb record for prediction about when water will freeze or boil. The theory postulates that water behaves *as if* there were a water devil who gets angry at 32 degrees and 212 degrees Fahrenheit and alters the chemical state accordingly to ice or to steam. In a superficial sense, the water-devil theory is successful for the immediate problem at hand. But the molecular insight that water is comprised of two molecules of hydrogen and one molecule of oxygen not only led to predictive success, but also led to "better problems" (i.e., the growth of modern chemistry).

The transactional approach strives for theory improvement that not only improves predictive accuracy, but also nurtures further insights as to if and how variables are apparently related to the phenomena under inquiry. Strict adherence to Friedman's myopic goal of prediction can be counterproductive, because predictive accuracy may well be restricted to only a highly limited range of relevant experiential needs while hindering what should be the scientist's healthy skepticism. If economists give more attention to transactional epistemology, economic theorizing should improve.

Acknowledgements: The author appreciates the useful criticisms provided by Ernest Welker, Joyce Hall Murray, Vernon Smith, Julian Simon, and William Ittelson.

Author Note: In personal correspondence (April 3, 1990), Milton Friedman wrote to me that "... I have read your final section, I have no quarrel with it, and it has no quarrel with me..." I take that to mean that Friedman accepts my criticism that researchers can easily misuse his methodology. In addition, he believes that his own attention to empirical research has adequately dealt with the issue of disregarding the realism of assumptions.

NOTES

¹ John Dewey and Arthur Bentley (1949), in their argument for a transactional approach, noted that with transactional inquiry, "systems of description and naming are employed to deal with aspects and phases of action, without attribution to 'elements' or other presumptively detachable or independent 'entities,' 'essences,' or 'realities'" (pp. 121-122). Dewey and Bentley's *Knowing and the Known* (1949) has some similarity to Karl Popper's *Conjectures and Refutations* (1965), as both reject certainty and promote a process of learning from errors as part of problem solving.

² David Fischer (1970) dealt with historians' belief in an independent and objective "real world".

The *fallacy of essences* begins with the old idea that everything has something deep inside it called an essence, some profound inner core of reality. According to this view, facts about a man, a nation, an age, a generation, a culture, an ideology, or an institution are significant in the degree to which they display the essence of the entity in question.

This most durable of secular superstitions is not susceptible to reasoned refutation. The existence of essences, like the existence of ghosts, cannot be disproved by any rational method. But it *is* possible to demonstrate a belief in essences, like a belief in ghosts, involves an empiricist in certain difficulties. This has been done at some length by Karl Popper, who persuasively suggests that the progress of empirical knowledge requires, not a search for essences, which cannot be found by any empirical method, but rather a search for patterns of external behavior. The essentialist's significant facts are not windows through which an observer may peek at the inner reality of things but mirrors in which he sees his own a priori assumptions reflected. (p. 68)

³ In contrast to the endless arguments in the literature concerning knowledge and the role of assumptions, a personal exposure to some of the Ames Demonstrations is a unique, insightful experience. The Exploratorium in San Francisco is open to the public and has working demonstrations of the Distorted Room and the Trapezoidal Window.

⁴ William Ittelson and Franklin Kilpatrick (1951) summed up the role of assumptions in visual perception as follows:

It seems that the subject relates to the stimulus pattern a complex, probability-like integration of his past experience with such patterns. Were it not for such integrations, which have been labeled assumptions, the particular perceptual phenomena would not occur. It follows from this that the resulting perceptions are not absolute revelations of "what is out there" but are in the nature of probabilities or predictions based on past experience. These predictions are not always reliable, as the demonstrations make clear. (p. 53)

The idea of economizing assumptions in visual perception as being formed through repetitions of successful purposeful actions was noted more recently by Ramachandran and Anstis (1986).

We believe perception of apparent motion is controlled in the early stage of visual processing by what is in effect a bag of tricks, one the human visual system has acquired

through natural selection during millions of years of evolution. Natural selection is inherently opportunistic. It is likely that the visual system adopted the proposed visual short cuts not for their mathematical elegance or aesthetic appeal, as some would suggest, but simply because they worked. (p. 102)

⁵ For experimental economics, Smith (1989) described *environment* as the collection of all agents' characteristics that, in reduced form, are the supply and demand schedules. *Institution* defines the messages (e.g., bids for buyers) and related rules for action. *Behavior* deals with agents' choices of messages or actions.

⁶ The importance of avoiding early fixation on intuitively pleasing working hypotheses and of stressing open-minded analysis of feedback data was well articulated by Chamberlin (1965). See also Plott (1986) for a description of how research on posted-price markets led to significant new lines of inquiry.

⁷ The literature on business firms' dividend policy invariably views firms on a stand-alone basis. An alternative view (Madden, 1987) would integrate shareholders' appraisal of managements' performance via a shareholder vote on the dividend payout. Recently, at the Economic Science Laboratory of the University of Arizona, preliminary work has started on experimentally evaluating shareholder control over dividend payouts.

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