Applying economic methodology:
Recognizing knowledge in economic models

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> It is clear that, if we want to make the assertion that, under certain conditions, people will approach [a state of equilibrium], we must explain by what process they will acquire the necessary knowledge. Of course, any assumption about the actual acquisition of knowledge in the course of this process will ... be of a hypothetical character.
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> ... the assumptions or hypotheses, which we have to introduce when we want to explain the social processes, concern the relation of the thought of an individual to the outside world, the question to what extent and how his knowledge corresponds to the external facts. And the hypotheses must necessarily run in terms of assertions about causal connections, about how experience creates knowledge.
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> Fredrich Hayek [1937/48, pp. 46–7]

Long ago I began teaching my students that they should consider knowledge to be like health rather than like wealth. That is, knowledge is not something quantifiable that you can have more of, instead, it is something that can be improved. Being a student of Karl Popper's philosophy of science, this distinction seemed obvious. But the quantity-based view of knowledge and learning is so commonplace that it is difficult for most economic model builders to consider any alternative.[1] In this article I shall explain why we should stop relying on the long-refuted quantity-based view of knowledge and learning.[2]

It might obviously be asked, how can we conceive of an alternative theory of knowledge and learning? One alternative view of knowledge and learning can be traced back at least as far as the Socrates of Plato's early dialogues. At root, this is the view of knowledge and learning is the one I have been teaching my students, namely, that knowledge is like health rather than like wealth. One learns by improving one's knowledge (viz, by eliminating one's erroneous knowledge) rather than by accumulating more knowledge (e.g., finding more confirming evidence in favour of one's knowledge).

In one sense we have a quality vs. quantity distinction here. Clearly, whenever knowledge is viewed as a quantity, it can be amenable to quantitative treatment and analysis. For example, consider George Stigler's famous 1961 article, 'The economics of information'. There he portrayed learning to be accumulating observations that allow better and better estimates of the parameters of the distribution of prices. The greater the quantity of observations, the smaller will be the standard deviation of the estimated mean. Quantifying knowledge this way makes it easy to conclude that knowledge is an economics issue. Namely, if one has to pay for the information (i.e., for the

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[1] After all, the quantity-based view of knowledge and learning has been around for 350 years and remains despite its being refuted 200 years ago. Specifically, the inductivist theory of knowledge and learning which philosophers attribute to Francis Bacon and its refutation to David Hume.

[2] According to the 350-year-old theory of knowledge, one *acquires* knowledge by making observations or, more generally, knowledge is accumulated experience. In other words, knowledge is nothing more than a summary of past observations or experience. Popper called the quantity-based view of knowledge and learning the 'bucket theory of knowledge' on the grounds that the more observations you make, the more knowledge you have. According the bucket theory of knowledge, not only is one's knowledge merely the contents of one's bucket, but one learns only by adding more to the contents of one's bucket. The problem of relying on the quantity-based knowledge was the subject of Chapter 1 of Boland [1982]. While that discussion was more concerned with understanding the philosophical aspects, here the discussion will be concerned more with the theoretical implications of the that discussion. Note also that throughout this paper I am discussing explanatory knowledge, that is, knowledge that yields explanations and understanding. I am not discussing so-called 'know-how', for example, knowledge of languages where one might quantify it by referring to the size of one's vocabulary.

observations), then better estimates will be costly such that an optimum is reached when the marginal improvements in the estimate will not be sufficient to justify the marginal cost of the next observation. At best, Stigler's view of knowledge is limited to just one type of knowledge, namely, knowledge of the true value of one variable. Assumptions about how one learns about the true shape of one's indifference map would seem to be more complicated. Nevertheless, rejecting the quantity-based theory does not necessitate rejecting Stigler's analysis, *per se*. But, it does beg the question about what we assume concerning how a decision maker interprets the quantity of information.[3]

Knowledge and learning in economic models

Historically, the key consideration for a role of learning and knowledge acquisition was the recognition that, to quote Marshall [1920, p. 540], 'perfect competition requires a perfect knowledge of the state of the market'. More recently, it has been the common recognition that to deal with less than perfect competition, the model builder must deal with how imperfect competitors deal with the incomplete information provided by the market. Coincidentally but independently, in 1959 three articles were published that approached the need for addressing the role of knowledge and learning from three different directions. Kenneth Arrow thought the problem of explaining price dynamics could be solved by recognizing the theory of the imperfect competitor involved presumed knowledge of the market demand curve and thus implied an answer to how to explain price adjustments. George Richardson was concerned with what we had to assume to achieve a market equilibrium. He noted that every decision maker needs not only what he called primary knowledge (e.g., knowledge of one's own utility function or production function) but also secondary knowledge about the other market participants. Secondary knowledge is usually not directly available and thus the individual must form what he called 'rational expectations' if any equilibrium is to be obtained. Ironically, he too noted that some form of imperfect competition needs to be included if we are to explain the process of achieving an equilibrium.

The most interesting of the three articles was the one by Robert Clower who showed that a monopolist who is ignorant of the true nature of the market's demand curve must make assumptions and moreover that these assumptions can easily lead to a sub-optimal equilibrium that contradicts the traditionally accepted theory of the monopolist. To understand Clower's model of the ignorant monopolist, one has to adopt Hayek's view of the process of decision making. Using Hayek's terms, the firm is thought to form a plan, as a first step. That is, the firm decides what the price is expected to be before going to the market to sell its produce. Based on the expected price, the firm decides how much to produce — the 'how much' is usually assumed to be the amount which would maximize profit. The next step is to go to the market with the consequences of its prior decision, that is, with its planned quantity and price. The last step depends on the outcome of its trip to the market. If its expectations were correct, then it will sell all that was produced (and this would be the case even if the price was underestimated). If the firm overestimated the market clearing price, then it will be left with unsold goods. How does one interpret such socially provided information? That is, how does the monopolist learn from such refuted expectations? To answer this question, the quantity-based theory of knowledge and learning is absolutely useless.

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[3]   For a more detailed discussion of how a decision maker might be assumed to interpret the relationship between observations and knowledge claims, see Boland 1982, Chapters 7 and 11; 1986, Chapter 11; 1992, Chapter 11.

How does the producer interpret refuted expectations? Interestingly, Clower's simple model dealt with this question. He posited a monopolist behaving as Hayek seems to suggest with the minor exception that the monopolist instead of forming an expectation of a simple market price, forms an expectation as to the elasticity of the market demand curve (in effect, an expectation of the monopolist's expected marginal revenue). Clower refers to the monopolist as 'an ignorant monopolist' simply because the monopolist does not know the market's true demand curve. And thus to make up for the ignorance of the market's true demand curve, Clower's monopolist must make an *a priori* assumption about the market's true demand curve. To make his point, however, Clower has his monopolist assuming that the demand curve faced is linear when in fact the true demand curve is not. As a consequence of this false assumption, the monopolist mistakenly interprets each subsequent failed expectation as evidence of a parallel shift in the linear demand curve. Assuming a stable configuration of cost and demand curves, the firm can easily reach an 'equilibrium' where the expected marginal revenue is not the true marginal revenue and hence the firm is not truly maximizing profit (see Figure 1).
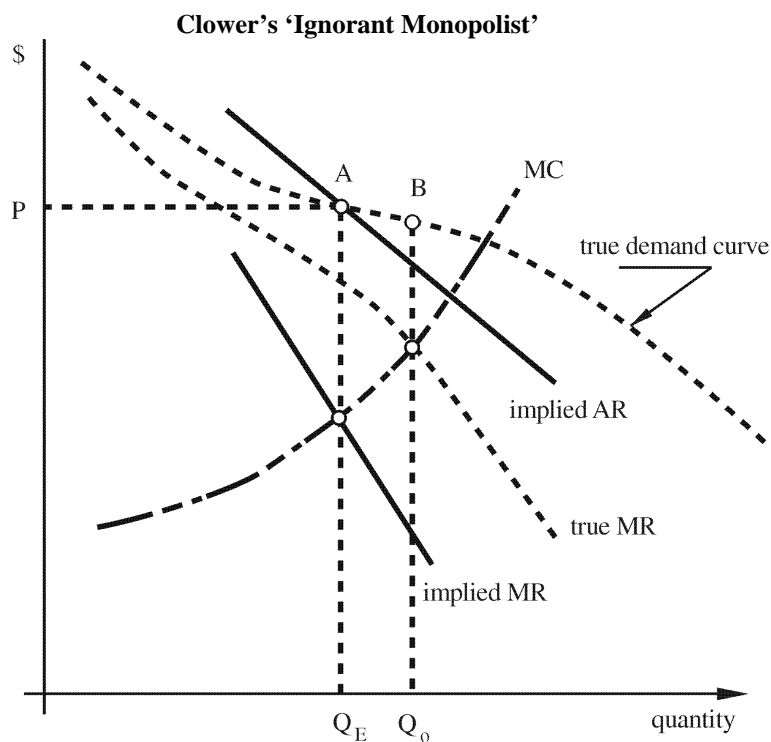

Clower's 'Ignorant Monopolist'

Figure 1

The reason for my discussing Clower's article is that his ignorant monopolist tries to learn from the available disequililbrium information provided by the market but to do so, the information needs to be interpreted and such interpretation depends on the assumptions made by the decision maker. Moreover, what is also recognized is that the decision maker must have some way of dealing with disappointed expectations concerning price or elasticity and thus must be equipped to deal with such errors. In other words, information from a disequilibrium market needs to be interpreted and such an interpretation depends on fallible assumptions. If the assumptions are false, then contrary to

what our usual behavioural assumption would have us believe, there is no reason to think that the firm is truly maximizing.

Modern attempts to include knowledge and learning

The current interest in game theory analysis seems to offer a new opportunity to address the question of relationship between knowledge and rational decision making with an obvious purpose. Some game theorists are content to merely assume that knowledge and learning can be addressed in a Bayesian manner (e.g., a player starts with an apriori probability assessment and use new information to update the assessment). However, some other game theorists think such an expedient as Bayesian learning can be problematic [see Bicchieri 1993, Mariotti 1995]. The question in all the modern models is whether the process of learning can be reconciled with the achievement of an equilibrium in a consistent manner. Too often the achievement is assured only with excessive or otherwise unrealistic assumptions concerning the nature of knowledge possessed by the individual decision maker.

Game theorists can also be found embracing Herbert Simon's notion of bounded rationality that is based on the notion that acquisition of perfect knowledge would require learning abilities that no real human can have. But, if one is building an equilibrium model, bounded rationality with imperfect learning may also be problematic.

Towards including realistic learning in economic models

It may be too early to say, but I suspect that progress will not be obtained even with game theory analysis until quantity-based notions of knowledge (such as that presumed by the use of Bayesian learning) are abandoned in favour of an improvement-based conception of knowledge and learning. Whether one's conception of knowledge matters depends directly on the model one is trying to build. Equilibrium models are particularly troubling. I will finish my discussion with three diagnostic questions that can be used to determine when the issues discussed here can matter. For each question, I will try to indicate what I think should have been learned from this discussion.

1. Does learning matter?

The keystone for building models where learning matters is the rejection of the quantity-based theory of knowledge and learning in favour of the Socratic view of knowledge and learning (where one learns by discovering one's errors). That is, we must reject any theory that equates learning with the accumulation of data and instead adopt the view that learning is error correction. If we adopt the Socratic view, the first step is to recognize that every individual decision maker holds one or more theories about the various elements of the decision situation faced. Moreover, and most important, these theories are possibly false.

To adopt the view that knowledge is manifested in theories is not as demanding as might first seem. Today, almost everyone accepts the notion that decision making is a *process* rather than an instantaneous *event* and thus every decision involves expectations formation. Expectations are nothing more than theoretical conjectures. At minimum, what the Socratic view does is to extend the notion of theoretical conjectures to all of the knowledge requirements of decision making.

Extending the notion of theoretical conjectures to all knowledge requirements means that, for example, the consumer is not assumed to know *a priori* what his or her true utility function is. Instead the consumer is assumed to conjecture what he or she would expect to be his or her reaction to consuming a particular bundle or switching from

one particular bundle to another. By positing that a consumer has a particular type of utility function we, as model builders, are in effect merely assuming that the consumer conjectures that such a utility function is what would be confirmed if he or she had the time to try out all of the infinity of possible bundles. While the quantity-based theory would see the consumer to be accumulating data with each purchased bundle to confirm the *a priori* conjecture, such a view of learning is incapable of dealing with refuting data. Since the Socratic view explicitly considers refuting data as potential learning opportunities, how the decision maker deals with refuting data has to be made an essential part of the explanation of the decision maker's behaviour that we are modeling.

2. What role do probabilities play in the decision maker's learning process?

Note that so far nothing has been said about the common notions of 'uncertainty', 'risk' or 'probabilities'. It might be said that the introduction of any of these common notions is a direct consequence of the model builder's attempt to avoid giving up the quantity-based theory and yet still be recognizing the fallibility of a decision maker's knowledge or expectations. Again, the issue missing in any model based on the quantity-based theory is that there is no way to deal with refuting data. By fuzzing up the issue with probability-based notions of fallible knowledge, model builders are inadvertently making explicit learning recognition virtually impossible. Specifically, if people learn by discovering and correcting their errors, probability notions make learning arbitrary or at least make it very difficult to know when one has made an error.[4] I stress here that the problem is not with probability notions but with the quantity-based theory of knowledge and learning.

The Socratic view of knowledge and learning does not preclude the use of probability notions. It does, however, require that the model builder be explicit about how the decision maker incorporates probability notions in his or her decision making process. For example, what kind of evidence would cause the decision maker to determine that his or her knowledge of the situation is in error? What theory does the decision maker hold concerning data handling? Does the decision maker think one can answer non-stochastic questions with statistical analysis?

3. Does the model involve decision errors?

Once one recognizes the fallibility of all knowledge — particularly, knowledge that is necessary in the process of decision making — one must also recognize the necessity of addressing the possibility of decision errors. To address the possibility of decision errors one must first deal with how the decision maker becomes aware of an error and then deal with how the decision maker responds. This task is made much easier if we recognize that at least some decision makers are aware of the fallibility of their knowledge and thus they treat every decision as a test of their knowledge. In the case of a consumer, the consumer is never certain that the choice made is the one which maximizes utility. The strategy employed by the consumer will depend on the theories held by the consumer. In the simplest case, the consumer may assume his or her indifference map is convex to the origin and that his or her choice has no effect on the price. In this case, the consumer merely searches along the budget line first by trying out two widely spaced points and then testing the theory by buying a point midway between them. If the consumer's theory is correct, the third point will likely be better than the first two. In such a sequence of trial and error, the consumer can narrow the

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4   The inherent methodological difficulties with testing probability-based models are examined in Boland [1989]. Also, various ways to model how decision makers learn are examined in Chapter 11 of Boland [1992] by addressing how decision makers respond to failed knowledge and expectations.

choice down to the one that according to the convexity assumption would be the utility-maximizing bundle. If the consumer's theory is false (either the map is not strictly convex or prices are not fixed), the consumer may not be able to narrow the choice. In the case of such a failure to maximize, the consumer would have to determine the source of the error. Such a determination is beyond the textbook theory of the consumer. Obviously, if the consumer thinks his or her behaviour has an effect on the given prices, then a much more complicated decision strategy would have to be involved.

Modeling error awareness can also be easy or difficult. The easy case occurs in the trial and error sequence when the consumer finds that the third point is not preferred to the first two. Similarly, going to the market expecting one price level and finding the price is different involves direct awareness of an error. Knowing what is the source of the error is a more difficult question. Clower's ignorant monopolist represents a problem for error awareness. Specifically, if the market is cleared for the expected prices, there is no additional information available to indicate that the assumptions made by the decision maker are false and thus that maximization is not actually being achieved. The extent to which a decision maker must make assumptions prior to participating in a market leaves the question of error awareness rather troublesome. And again, the textbook (viz., the quantity-based) theory is not very helpful.

Bibliography

Agassi, J. [1975] 'Institutional individualism' *British Journal of Sociology*, 26, 144–55

Arrow, K. [1986] 'Rationality of Self and Others in an Economic System', *Journal of Business*, 59 (supplement), s385–99

Arrow, K. [1994] 'Methodological Individualism and Social Knowledge' *American Economic Review, Proceedings*, 84, 1–9

Arrow, K. [1959] 'Toward a theory of price adjustment', in M. Abramovitz (ed.), *The Allocation of Economic Resources* (Stanford: Stanford University Press), 41–51

Bicchieri, C. [1993] *Rationality and Coordination* (Cambridge: Cambridge Univ. Press)

Blaug, M. [1980] *The Methodology of Economics* (Cambridge: Cambridge Univ. Press)

Boland, L. [1978] 'Time in economics vs. economics in time: the 'Hayek Problem'' *Canadian Journal of Economics*, 11, 240–62

Boland, L. [1979] 'Knowledge and the role of institutions in economic theory' *Journal of Economic Issues,* 8, 957–72

Boland, L. [1982] *The Foundations of Economic Method* (London: Geo. Allen & Unwin)

Boland, L. [1986] *Methodology for a New Microeconomics: The Critical Foundations* (Boston: Allen & Unwin)

Boland, L. [1989] *The Methodology of Economic Model Building: Methodology after Samuelson* (London: Routedge)

Boland, L. [1992] *The Principles of Economics: Some Lies My Teachers Told Me* (London: Routledge)

Boland, L. [1997] *Critical Economic Methodology: A Personal Odyssey* (London: Routledge)

Clower, R. [1959] 'Some theory of an ignorant monopolist' *Economic Journal*, 69, 705–16

Hayek, F. [1937/48] 'Economics and knowledge' *Economica*, 4 (NS), 33–54 reprinted in *Individualism and Economic Order* (Chicago: University of Chicago Press), 33–56

Mariotti, M. [1995] 'Is Bayesian rationality compatible with strategic rationality?' *Economic Journal*, 105, 1099–1109

Marshall, A. [1920] *Principles of Economics*, 8th edition (London: Macmillan)

Richardson, G. [1959] 'Equilibrium, expectations and information' *Economic Journal*, 69, 225–37

Stigler, J. [1961] 'The economics of information' *Journal of Political Economy*, 69, 213–25