9

Ad Hoc Theorizing about Price Dynamics: A Slippery Slope

> [I]t cannot be denied that there is something scandalous in the spectacle of so many people refining the analyses of economic states which they give no reason to suppose will ever, or have ever, come about. It probably is also dangerous.
> Frank H. Hahn [1970, pp. 1–2]

Let us now return to where we began, the theoretical problem presented by Arrow [1959]. In this chapter we wish to apply what we have learned so far to a critical evaluation of research programs based on Arrow's theoretical challenge. Recall that he said that our microeconomic theory explains an individual's behavior by presuming the individual is a price taker while at the same time presuming that the individual faces equilibrium prices. At best, our microeconomic theory is incomplete; at worst, it is a contradiction. If we wish to complete the theory of the behavior of all individuals who are presumed to be equilibrium-price takers, we need to explain the process by which prices are adjusted to their equilibrium values.

The most common explanation of price adjustment is based on the theory of an imperfectly competitive firm. An imperfectly competitive firm is thought to be facing a downward sloping demand curve which refers to the demand at many prices rather than just one price. Explaining prices using such a firm begs the question of how a firm knows the entire demand curve it faces [see also Clower, 1959]. A few economic theorists have interpreted this correctly to be a matter of learning methodology [e.g. Gordon and Hynes, 1970] along the lines suggested by Hayek [1937/48]. Unfortunately, most economic theorists have viewed Arrow's problem as one of deciding what to assume when building a mathematical model of the market equilibrium [e.g. Hey, 1981; Fisher, 1981].

1.   The Analytical Problem of Price Adjustment

We begin by considering a typical model of a market equilibrium. Think of a single market of the usual variety where the demand curve is downward sloping and the supply curve is upward sloping and where all participants are price takers. Let us follow the lead of many current textbooks and represent this market with two equations, one for the demand, D, and the other for the supply, S, as follows:

$$D = f(P, R), \qquad [9.1]$$

$$S = g(P, K), \qquad [9.2]$$

where P is the going market price (which might not be the equilibrium price), R somehow represents the exogenous income (or wealth) distribution, and similarly K represents the exogenous allocation of capital to the producers. In each case, the equation represents, respectively, the demand and supply quantities that would maximize utility and profit for the price, P, and the givens, R and K.

Model builders who want to know only the equilibrium price will simply equate D and S and solve for P given R and K. That is, formally, a third equation is added:

$$D = S. \qquad [9.3]$$

Beyond the peculiar pleasure some people get from such analytical exercises, not much is learned from the solution unless there are reasons given for why equation [9.3] should be true. We have reasons for why equations [9.1] and [9.2] are true – all individuals are optimizing and the two equations are merely logical consequences of such simultaneous optimization.

Traditionally, and as we discussed in Chapter 7, we rely on some unspecified price adjustment process to correct for any discrepancy in equation [9.3]. By the term 'price adjustment' we usually mean how fast and in what direction the price changes. Speed of adjustment is usually represented by a derivative and its sign (positive or negative) represents the direction. So, as time, t, advances the price adjustment process is represented as follows:

$$dP/dt = h(D - S) \qquad [9.4]$$

where it is presumed that whenever equation [9.3] is true, dP/dt equals zero; and where it is also presumed that a greater difference between D and S means a faster change in P such that a positive difference means a rising price. These presumptions are represented as

$$h(0) = 0 \ \text{ and} \qquad [9.5]$$

$$d(h(D - S))/d(D - S) > 0. \qquad [9.6]$$

Years ago, some model builders might have been satisfied to just assume *ad hoc* that [9.4], [9.5] and [9.6] are all true, and thereby presume to have 'closed the model', that is, to have completed the reasoning for why equation [9.3] is true. But, it is not difficult to see that there is nothing here that tells us how long it would take for the price, P, to equal the price for which equation [9.3] is true (given equations [9.1] and [9.2]). If the condition [9.6] is specified such that the price never rises fast enough to cause the positive difference between D and S to become a negative difference before the equilibrium is reached, $(D - S)$ and dP/dt might both approach zero only as t approaches infinity. In other words, it may easily be that the equilibrium is never reached in real time.

2.   *Ad Hoc* Closure of the Analytical Equilibrium Model

The task, as many model builders see it, is to specify [9.4]–[9.6] (or something that analytically serves the same purpose) such that [9.3] is true in real time. This is usually stated as a problem of explaining the 'speed of adjustment' [e.g. Fisher, 1983]. These are really two separate issues even though they are often treated as the same task. The first concerns the question of the speed of price adjustment and the second concerns the question of whether equation [9.3] is true. To see these issues to be the same is misleading. But before we consider this troublesome issue, let us consider some of the ways in which the model of a market equilibrium is thought to have been closed.

The classic means of closing the model is to assume that the market is run by an auctioneer. There are two different conceptions of the auctioneer – the 'scientist' and the 'warden'. The scientific auctioneer does not trust the inherent stability of the market and so, before opening the market, surveys the demanders and suppliers and then calculates the price at which equation [9.3] will be true. When the market opens, the auctioneer just communicates the equilibrium price. The warden-type auctioneer communicates the current price and entertains the bids of demanders or suppliers who wish to alter the price. They wish to alter the price because they are not able to maximize their profit or utility at

the current price. This auctioneer does not allow transactions to take place until everyone can accept the price. Here the auctioneer's job is to suspend trading until such an agreement is established. While both concepts of an auctioneer are sufficient to close the model, the warden-type auctioneer is usually assumed.

There are many criticisms of the auctioneer approach. An obvious one is that these conceptions are unrealistic even for markets which are truly auctions. Usually it is argued that the assumption of an auctioneer is merely *ad hoc*. That is, it is used solely to close the model (by establishing the truth of equation [9.3]). Contrarily, it could be claimed the assumption actually makes the model incomplete. If the auctioneer is necessary to run the market, we might ask whether there is a market for auctioneers and who runs that market. Perhaps the auctioneer services are provided costlessly; but that would seem to require an explanation of why the auctioneer works for nothing. We have either a missing price or a missing market, otherwise, the explanation of why equation [9.3] is true is thereby incomplete. If we proceed without the missing market or price then we are accepting a model which violates the requirements of methodological individualism. The determination of the market price depends on the exogenous functioning of the auctioneer but the auctioneer is not a natural phenomenon. The auctioneer is an unacceptable exogenous variable.

Other *ad hoc* price-adjustment mechanisms have been proposed. Two of the most well known are called the 'Edgeworth Process' and the 'Hahn Process'. The Edgeworth Process simply says that a trade will take place if and only if both traders know it to be beneficial [Fisher, 1983; see also Shackle, 1972]. While this satisfies equation [9.5] it does not ensure that they will trade *whenever* it is beneficial. For obvious reasons, without an auctioneer, there is no reason why every market participant has sufficient information to know all possible beneficial trades that might exist. The most that can be guaranteed is that *if* a trade takes place, it must be that the traders had good reason to complete the trade.

The Hahn Process is described as follows.

> Imagine certain prices to be 'called' and suppose that at those prices trading leads to the following result: if good *i* was in excess demand before trading, then after trade there is no market participant who holds more of this good than he desires to hold; if good *i* was in excess supply before trading, then after trade no market participant holds less of this good than he desires to hold. ... This, on the face of it, seems a reasonable postulate. Trading having taken place, prices change according to the customary rule: the prices of goods still in excess demand after trade rise, those of goods still in excess supply, fall (unless the good is free). Then once again prices are 'called' and trade takes place.
> [Hahn and Negishi, 1962, p. 463]

To this, Fisher adds,

> Markets are sufficiently well organized that willing buyers and willing sellers can and do come together and consummate a trade very quickly relative to the rate at which the disequilibrium adjustment equations operate.... This requirement, while severe, seems to be a moderately reasonable one on information flows in a competitive economy; it is much less severe than the corresponding requirement in the Edgeworth Process.
> [Fisher, 1983, p. 31]

Compared to the Edgeworth Process, the Hahn Process is claimed to be superior since the Hahn Process does not *require* beneficial trades to take place whenever they are possible. The participants are not required to know of all possible beneficial trades. The Hahn Process only ensures that *after* a trade takes place all demanders or all suppliers (but not necessarily both groups) are satisfied.

The superiority of the Hahn Process is somewhat hollow in the sense that trades are assumed to take place yet how individuals decide to trade is not explained. Furthermore, the presumptions that everyone faces the same price and that the market is 'sufficiently well organized' begs more questions than are answered. To a certain extent, these presumptions are merely the auctioneer in a disguised form. Even worse, in the Hahn Process the adequacy of the speed of adjustment is just assumed, yet it is the speed of adjustment that we want explained.

Such *ad hoc* visions of a market setting form the usual basis for specific models of explanations for why equation [9.3] can be true. All sorts of additional mathematical conditions are imposed on the postulated settings and mechanisms to prove that, under those conditions, equation [9.3] will be true at some point in time. But while some mathematical economists find such puzzle solving games to be interesting, they never seem to get to the essential issue (although the issue is sometimes appreciated [see Fisher, 1983, Ch. 9]). The essential issue is that whatever setting or mechanism is proposed, it must be the result of a process of individual optimizations and not be exogenously imposed on the market.

There have been many other such *ad hoc* adjustment mechanisms proposed but none are capable of addressing the issue from a methodological individualist perspective. Why would individuals be

constrained to behave as postulated in each case? Do individuals choose to behave according to the postulated adjustment process? Why do all individuals choose to behave in the same way? How would individuals ever have enough information to make such choices?

3.   Toward Closure through Ad Hoc Ignorance

As suggested by Arrow [1959], there may be a way to explain the price adjustment by considering the price setting mechanism embodied in the traditional theory of the imperfectly competitive firm. But to see this we have to think of the firm as setting its price to generate a demand that just equals the profit-maximizing quantity it will produce at that price. Consider again Figure 1.1 where the profit maximizing output for the demand curve shown is Q_1; the firm will, in this case, set the price at P_1. This is the textbook view of the price-setting monopolist. Unfortunately, it has one major flaw if it is to be used as an explanation of price *dynamics*, in the sense of adjusting prices toward the equilibrium price. For any given demand curve, if the firm already knows the curve, there are no dynamics. Knowing the curve, the firm will just jump to the one point immediately. Here, any dynamics will be in the form of the comparative statics resulting from exogenous changes in the demand curve or cost curve, rather than in the form of the endogenous behavior of the price setter. If there is to be any endogenous adjustment dynamics, the firm must be ignorant of either the demand curve or the cost curve or both. Usually, it is the demand curve that is in doubt since the firm is unlikely to know what everyone in the market is going to demand.

   The question then is to specify how ignorant the firm has to be to explain the process of reaching the equilibrium as one of learning the details of the market's demand curve. There are many ways to deal with this [e.g. Robinson, 1934/69; Clower, 1959; Boland, 1967]. It could be assumed that the firm does not know its demand curve but only has a conjecture and a rule of thumb. Each time it goes to the market it tries a price and a quantity, then waits to see how much was bought. If not all the output is bought, little will be learned since the market has not cleared. If the whole output is sold at the trial price, the firm has learned one point on the demand curve although it may not be the optimum since it does not know the true elasticity of demand for its good. In effect, each trial price is a test of a conjectured elasticity of demand. Assume the price has been set according to the rule derived from the necessary condition for profit maximization, namely that marginal cost (*MC*) equals marginal revenue (*MR*). By definition of *MR*, average revenue

(*AR*), and demand elasticity (*e*), the following is always true:

$$MR = AR[1 + (1/e)]. \qquad [9.7]$$

When we recognize that by definition *AR* is also always the price (*P*), and we assume that profit will be maximized for a correctly estimated *e* (i.e. *MR* = *MC*), then the rule of thumb for setting the price for any given level of output will be as follows:

$$P = MC[e/(1 + e)]. \qquad [9.8]$$

The firm is presumed to learn by trial and error to set the correct price for each level of output tried, by learning to correctly estimate the elasticity, *e*. But unless there are very many trials it still may be the case that not much will have been learned. Of course, if the price were instead determined in a market, whenever the expected quantity (or price) is incorrect, the price will adjust to clear the market for the quantity tried. Here each trial will yield additional information. Still, we need to be told how many trials it will take to learn the true demand curve. Worse than this, a market-based means of providing sufficient information for the convergence of the learning process only brings us back to the question about how the market price is adjusted to clear the market whenever the firm's expectations are incorrect.

4.   Exogenous Convergence with Forced Learning

Usually, as we have repeatedly noted, the process of learning is presumed to be inductive in situations such as this and thus take an infinity of trials to ensure convergence. That is surely more time than is allowed before the demand curves would shift. As many see it, the real learning situation is one of estimating a demand curve that is stochastically shifting [e.g. Gordon and Hynes, 1970, pp. 375ff]. Their reason is that we could never learn fast enough to avoid the effects of shifts. Again, this is just another expression of the implicit belief that the only learning process is an inductive one. Since this belief is not usually considered a problem in contemporary model building exercises, we will postpone its full consideration until Chapter 11. For now let us just see how it is used to close the model of price adjustment.

   The difficult question here is, how many observations would it take to ensure that the equilibrium price will be set by the imperfectly competitive price setter? If we cannot answer this, we cannot be sure that equation [9.3] will ever be true. There are three ways in which this question is made to appear irrelevant. The first two are the Rational

Expectations Hypothesis and Hayek's implicit assumption that the market is stable with respect to both price-adjustment and quantity-adjustment behavior. Both have already been discussed to some degree above. The third way is a form of argument similar to Social Darwinism. In all three cases, the convergence process is exogenously given and it is merely left up to the individual to conform. Let us examine these tactics.

Recall that the Rational Expectations Hypothesis merely assumes that the current economic theory being used to explain the economy's behavior is the one which has been inductively established as true. The presumed inductive basis for the current theory is thus exogenous to the individual's decision process. It is left to the individuals to use the information available to form expectations that are consistent with the current theory. When they do form consistent expectations, the economy will be in equilibrium. Assuming there is a reliable inductive learning method, we could see how individuals are forced to form such expectations when they use the same information that would be used to establish the current theory. Here, the force of inductive logic is being invoked, but no proponent of the Rational Expectations Hypothesis could ever demonstrate that a reliable inductive logic exists.

In effect, Hayek was taking the same position when arguing for the superiority of the competitive market system over centralized planning. Unlike the Rational Expectations Hypothesis, his argument did not take *successful* inductive learning as an exogenous means of assuring the convergence to an equilibrium, or of assuring that equation [9.3] is true. He implicitly assumed that all demand curves are downward sloping and all supply curves are upward sloping so that the correct information is automatically learned in the process of trial and error. But, as should be obvious now, this argument merely assumes equations [9.4]–[9.6] are true as exogenous facts of nature. If individuals do learn when they are disappointed after going to the market, then they will learn the correct direction in which to respond. And, whenever an equilibrium is reached, it is well defined by the presumed stable market configuration of demand and supply curves. *If* the individuals are ever going to learn the value of the equilibrium price they will be forced to learn the correct one. Unfortunately, this is much like the Edgeworth process in that it does not ensure convergence without perfect information and it does not explain how such knowledge would ever be acquired.

This brings us to the third way of forcing convergence exogenously. Armen Alchian [1950] argued, in effect, that the process of reaching an equilibrium is a lot like Darwinian evolution – that is, 'natural selection' or the 'survival of the fittest'. In economics, the fittest are the ones who have successfully solved all the problems of forming expectations and maximization in the face of uncertainties. According to this view, if the world is always limited in its resources and everything is potentially variable, we do not have to assume that each participant necessarily behaves according to the textbook with regard to profit or utility maximization, optimum learning processes, or perfect expectations. Such appropriate behavior is endogenous in the sense that it is implied by the achievement of any equilibrium of survivors. If any firm, for example, is incurring costs that exceed its revenues, it will not survive. And, since for the economy as a whole there must naturally be an equality between aggregate revenues and aggregate costs, should any one firm be making profits, some other must be making losses. If there are profits to be had, someone will find them. So if we are considering any economy consisting only of surviving firms (and households) we must be looking at an economy in long-run equilibrium, that is, one where all firms have learned enough to be making zero profits. And, as well, zero profits must be the best they can do.

The natural fact that any economy always has a finite amount of resources, means that if no one is losing money, then no one is gaining money. Thus, according to Alchian, the need to survive forces the acquisition of adequate knowledge or learning methods. If we extend this to questions of stability, it says that Nature forces convergence regardless of how we explain the behavior of individuals. But as clever as this tactic is, it still does not explain how long it would take. If there is a convergence here it is only because the convergence process is assumed to be exogenously given. This is the same as simply assuming that equation [9.3] is true, *a priori*, and thus rendering [9.4]–[9.6] unnecessary.

5.   Endogenous Convergence with Autonomous Learning

eIn each of these various approaches to specifying the price adjustment process in mathematical models (or analytical theory), an equilibrium is always presumed to be possible. Sometimes it is even presumed to exist in advance. But the process is always either *ad hoc* or exogenously imposed by circumstances. The point is that these usual ways of solving stability analysis problems may actually violate the requirements of methodological individualism. When building a complete model of the economy for which any equilibrium is stable but the stability is endogenous, the stability or convergence must not depend on exogenous considerations that are unacceptable for methodological individualism. In particular, whenever we successfully specify the necessary equations but the specification is *ad hoc* or exogenous, the completed model forms

an explanation which is either incomplete or introduces exogenous variables that are not natural givens.

It is widely recognized that a minimum requirement for an equilibrium model is that any price adjustment process which fulfills the role of equations [9.4]–[9.6] must be derivable from the maximizing behavior of individuals [e.g. Gordon, 1981, p. 512; Fisher, 1981, p. 279]. This requirement is the source of all the problems discussed in the literature concerning the disequilibrium foundations of equilibrium economics. Any shortcomings of current attempts to specify equilibrium models are almost always due to failures to recognize this requirement. To understand the requirement we need to examine its implied procedural rules for the model builder.

The paradigm of maximizing behavior has always been the utility maximizing individual. It is not clear whether such a paradigm can ever adequately represent all aspects of the problem of constructing an optimal price adjustment mechanism. The speed of adjustment (dP/dt) of equation [9.4] is not a direct source of utility; that is, it is not desired for its own sake. The price-adjustment speed is merely a means to the acquisition of final goods from which the utility is derived. Few people drink wine (or beer) for its own sake but do so for its alcohol content, among other attributes. The sources of the utility are the various attributes (or 'characteristics' [Lancaster, 1966]). Viewing the price-adjustment speed in this manner does not put it beyond the domain of choice theory. All that is required is a representable mechanism that shows how the price-adjustment speed affects the quantities of final goods. This mechanism is not apparent in models built using such assumptions as the Hahn Process. Nevertheless, the specification of such a mechanism seems to be the ultimate purpose of the models built by theorists interested in stability analysis – and it is not totally unreasonable that such a mechanism might be constructed.

We must now ask, will any such mechanism do? Or are there some limits on what can be assumed in the process of constructing such a mechanism? Apart from satisfying the formal requirements of an optimizing model according to mathematical standards and techniques, there are really only the requirements of methodological individualism. If the mechanism is to be consistent with neoclassical theory, any alleged exogenous variable which is non-natural and non-individualist will need further explanation by acceptable means. A typical example of this requirement occurs in the explanation of the price-adjustment mechanism using monopoly theory. For a monopoly to exist – or for that matter, anything less than perfect competition – there must be something restricting competition. Is that restriction exogenous or endogenous?

None of the well-known imperfect-competition stability models provide an explanation for *why* there is less-than-perfect competition. But, as we argued in Chapter 1, whenever any complete explanation is consistent with the psychologistic version of methodological individualism, a long-run equilibrium model of price-takers is assumed. Given that psychologism is almost always taken for granted in neoclassical economics (since the individual is always identified with his or her utility function), one wonders whether explanations of stability based on imperfect-competition will ever satisfy all neoclassical model builders.